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Modeling the Demand for Money in light of Economic Uncertainty in Saudi Arabia

By:

Moayad Al Rasasi, PhD

Amlak AlMutairi

Economic Research and Reports Department

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Abstract

We assess the effects of economic policy uncertainty on money demand in Saudi Arabia by utilizing quarterly data spanning from 2010Q1 to 2023Q1. The estimated coefficients showed that income, exchange rate, inflation, and interest rates statistically influence money demand. However, the impact of economic uncertainty on money demand was statistically insignificant. This could be due to the sound macroeconomic policies ensuring not only the stability of monetary conditions and the financial sector resilience but also the sustainability of economic growth. Stability tests also confirmed the stability of the money demand function in Saudi Arabia.

Keywords: Money demand, interest rate differential, economic policy uncertainty, Saudi Arabia, ARDL

JEL Codes: C13, C22, E41, E52, F41

[1] Corresponding authors emails: malrasasi@sama.gov.sa and AmlAlmutairi@SAMA.GOV.SA

1. Introduction

Economic uncertainty may arise from either volatility in macroeconomic variables, geopolitical conflict, natural disasters, rapid changes in economic policies, or the implementation of structural reforms. As a result, decisions made by households, firms, or governments are subject to frequent changes whenever there are signs of economic uncertainty. Consequently, there is abundant literature assessing the effects of economic uncertainty on various macroeconomic and financial variables like economic growth, inflation, exchange rate, trade, investment, and stock markets (e.g., Bialkowski et al., 2008, Bernal et al., 2016, Bahmani-Oskooee and Ghodsi 2017, Kang et al., 2017, Bahmani-Oskooee et al. 2018, Bahmani-Oskooee and Saha 2019a, 2019b, Bahmani-Oskooee and Nayeri 2019, 2020, Bahmani-Oskooee and Mohammadian 2021, Bahmani-Oskooee et al. 2021, Bahmani-Oskooee and Hasanzade 2022). Correspondingly, examining the effects of economic uncertainty on money demand has also received substantial attention from economists and policymakers (e.g., Bahmani-Oskooee et al. 2012, Bahmani-Oskooee et al. 2013, Bahmani-Oskooee et al. 2013, Ozdemir and Saygili, 2013, Gan et al., 2015). This attention comes from the fact that any source of economic uncertainty usually affects macrocosmic aspects, which in turn affects the demand for money. For example, during the recent global COVID-19 pandemic, economic agents preferred to hold more cash and less risky assets due to the high economic uncertainty. In the same vein, with an environment of high inflation economic agents tended to hedge against it and preferred holding more real assets and less cash as they were uncertain about the path of macroeconomic policies to mitigate inflationary pressure. Therefore, we aim to extend the literature by exploring the response of the money demand to economic policy uncertainty as to the best of our knowledge, this issue has not been tackled for the Saudi economy previously in the literature. It is important for policymakers to assess how the money demand responds to economic uncertainty and how policymakers deal with it and ensure the stability of money demand by controlling money supply through either open market operations or direct intervention to ensure ample liquidity in the market. Maintaining a stable money demand function is also essential for policymakers as it implies a robust relationship between monetary demand and its determinants. It also implies the effectiveness of the

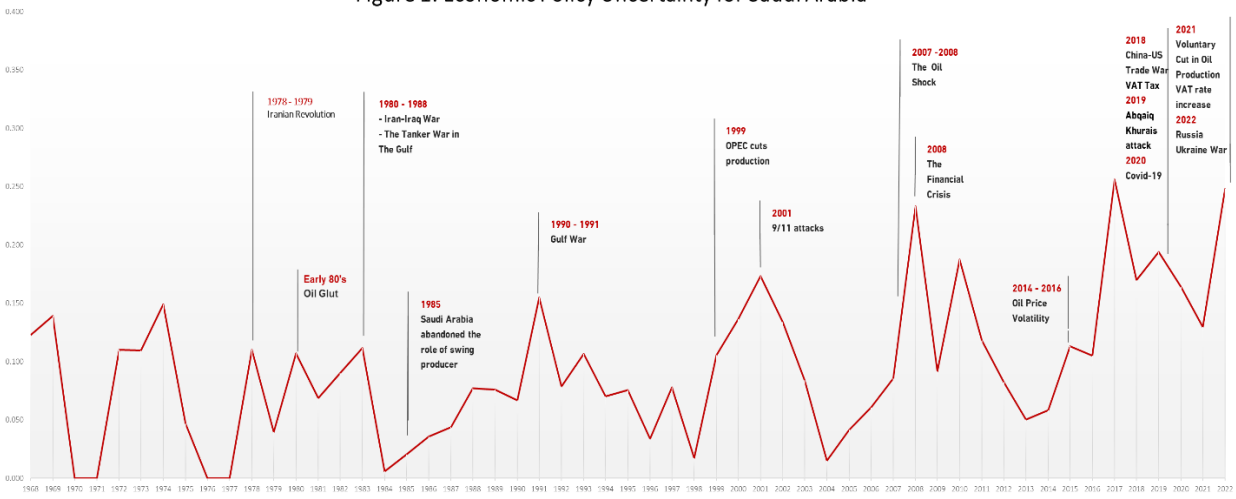
monetary policy transmission mechanism, as changes in monetary aggregates can accurately predict macroeconomic variables.

The remainder of the paper is organized as follows. Section 2 describes the economic policy uncertainty measure, while section 3 summarizes the literature on money demand for Saudi Arabia. The foundation of the money demand function is contained in section 4, and the dataset description is covered in section 5. The empirical methodology and results are discussed in section 6, while section 7 summarizes and concludes the paper.

2. Economic Policy Uncertainty Measure

Baker et al. (2016) from the Economic Uncertainty Group constructed a new measure of Policy Uncertainty for many countries. In this measure, words like "uncertain" or "uncertainty" that are associated with "tax," "spending," "regulation," "central bank," "budget," and "deficit" are collected from a country's popular newspapers to construct the index. To give a visual representation of how this new measure performs from 1986 to 2022 for Saudi Arabia, we plot the measure in Figure 1, highlighting the major events that increased uncertainty during the years. It is clear that some global and regional events have increased the uncertainty for Saudi Arabia. For example, the Gulf War in the early 1990s was one of the crucial and devastating events increasing uncertainty. In recent years, the COVID-19 outbreak pandemic and the sharp decline in oil prices in 2020 were important global events raising uncertainty not only in Saudi Arabia but also across the globe.

Figure 1: Economic Policy Uncertainty for Saudi Arabia



Source: Federal Reserve Economic Data (FRED).

3. Literature review

Due to its importance to monetary policymakers, a large share of the literature has explored the influential factors capturing the behavior of money demand in various economies, including advanced, less advanced, and emerging economies. Sriram (2000), Banafea (2012), and most recently Hasanov et al. (2022) provided a comprehensive literature review of the money demand literature covering different economies. Regarding the scope of this paper, we will summarize the literature relevant to the Saudi economy.

Alkaswani and Al Tawajairi (1999) utilized quarterly data covering the period from 1977 to 1997. They employed the cointegration tests proposed by Johansen and Juselius (1990) to investigate the long-run relationship between money demand and its determinants within Saudi Arabia. Their empirical analysis indicated a significant long-term relationship between money demand and its determinants. Specifically, they highlighted the existence of a positive relationship between exchange rates and real income with money demand; on the other hand, they found a negative relationship between money demand and interest rates.

In addition, Bahmani (2008) modeled money demand for 14 Middle Eastern countries, including Saudi Arabia, with annual data from 1970 to 2004. The estimated results based on the

Autoregressive Distributive Lag (ARDL) model confirmed the essential role of income, interest rate, exchange rate, and prices in determining money demand over long and short runs. With regard to Saudi Arabia, the estimated results showed that inflation and income were the key determinants affecting money demand in the long run, and their impacts are as expected by theory; in other words, they found that higher income leads to higher money demand while inflationary pressure tended to reduce money demand.

Similarly, Abdulkheir (2013) used annual data from 1987 to 2009 to explore the potential long-term relationship between money demand and its determinants in Saudi Arabia. The empirical analysis, based on the cointegration tests of Johansen and Juselius (1991), confirmed the existence of a long-run relationship between money demand, exchange rates, inflation rates, and interest rates. In particular, he documents that the impact of income on money demand is positive, while the impact of other variables on money demand is negative.

By applying bounding cointegration tests, Alyousef (2014) assessed the connection between money demand (M2) and its determinants in Saudi Arabia. With quarterly data from 1996 to 2012, the empirical evidence supports a long-term and stable relationship between money demand and real income, interest rate, financial innovation and stock prices. Specifically, the results indicated that income and financial innovation significantly and positively impact money demand in Saudi Arabia in the long and short term. Conversely, the results confirmed a negative relationship between money demand, interest rates and stock prices.

Banafea (2014) utilized annual data from 1980 to 2012 to estimate the long-term relationship between money demand and its key determinants, including real income and interest rates. The author relied on various stability tests, such as those proposed by Andrews (1993) and Andrews and Ploberger (1994), to assess whether the money demand function is stable. In addition, he applied Gregory and Hansen's (1996) cointegration tests accounting for structural break. The empirical findings revealed that there exists a long-run relationship between money demand and its determinants, as expected by theory; however, the stability tests confirmed the instability of the money demand function. Nonetheless, Hasanov et al. (2017) assessed the stability of the money

demand function for Saudi Arabia over the period 1987-2016 based on annual data and cointegration and stability tests. The estimated Keynesian money demand function showed the presence of a long run and a stable relationship between money demand and its determinants, as expected by theory, implying the positive impact of income on money demand and the negative impacts of interest rates, prices, and exchange rates on money demand. Furthermore, the authors tested for income and price homogeneity hypotheses and confirmed their validity for the Saudi money demand function.

Similarly, Al Rasasi and Banafea (2018) estimated the money demand based on a cash-in-advance model with quarterly data from 2000 to 2016. The estimation results based on ARDL showed the existence of a stable money demand function over the short and long runs. In particular, there is a positive relationship between money demand and output and inflation; however, exchange and interest rates have a negative relationship with money demand. The authors also checked for the stability of the money demand function and confirmed its stability.

Al Rasasi (2020) conducted various structural break tests to assess the stability of the money demand function in Saudi Arabia, using quarterly data covering the period from 2007 to 2018 and based on Johansen and Juselius's (1991) cointegration approach. The author also applies several stability tests, including those used by Banafea (2014). The results illustrate the stability of the money demand function in Saudi Arabia. The parameter estimates showed the presence of a stable relationship between money demand and its determinants in the long run. In particular, there is a positive relationship between money demand and output, while a negative relationship is found between money demand and interest rate and exchange rate. It is worth noting that the reported results contradict the findings of Banafea (2014).

Al Rasasi and Qualls (2020) also estimated money demand based on Keynesian theory based on annual data for 1980-2017. The authors converted the monetary aggregate data before 1988 from the Hijra-based data into a Gregorian basis and estimated the long-run relationship based on Johansen and Juselius's (1991) cointegration tests. Their results showed that money demand is influenced by output and interest rate over the long run, as expected by theory. Al Rasasi et al. (2020) augmented the money demand function with stock prices based on quarterly data from 2010 to 2018.

They applied the cointegration tests of Johansen and Juselius (1991) to assess the long-run relationship between money demand and its determinants. Their findings revealed that income and stock prices positively impact money demand, while interest rate negatively impacts money demand in the long run.

Alkhareif and Al Rasasi (2021) constructed the broad Divisia monetary aggregate to estimate Saudi Arabia's money demand utilizing annual data from 1999 to 2018. The estimated ARDL model confirmed that money demand is critically determined by interest rate and output over the long run and confirmed the stability of the money demand function. Specifically, the results are consistent with theoretical expectations, meaning that higher income increases money demand while a higher interest rate reduces money demand.

Hasanov et al. (2022) explored the dynamics of money demand within a fixed exchange rate system by using Saudi Arabia as a case study. The authors utilized an annual dataset starting from 1987 to 2018 and applied cointegration analysis as well as various stability tests to assess the dynamic of money demand over the long run. In their analysis, they emphasized the significance of oil prices as a key element in shaping money demand for the case of Saudi Arabia, in addition to exchange rate and interest rate differential. The study's findings supported earlier studies and indicated a stable relationship between money demand and its fundamentals. In particular, the empirical analysis showed that interest rate differential affects the money demand negatively, while income, oil prices, and real exchange rate positively impact money demand. Several studies also assessed money demand for the GCC countries, including Saudi Arabia, using a panel data econometric approach. Such studies, including Harb (2004), Lee et al. (2008), Basher & Fachin (2014), and Hamdi et al. (2015), concluded that money demand was stable for the GCC countries. However, the impacts of money demand determinants appeared to vary from one country to another.

There is another strand of the literature investigating the impact of economic policy uncertainty on money demand in different economies. For example, Bahmani-Oskooee and Bahmani (2014), utilized a bounding cointegration testing approach and error-correction modeling to assess the impact of monetary uncertainty on money demand in Korea, using annual data from 1971 to 2010. Their

empirical results provided evidence supporting Friedman's volatility hypothesis, both in the short and long term. Moreover, the use of a monetary uncertainty measure established a stable money demand in Korea. Furthermore, Bahmani-Oskooee and Nayeri (2018b, 2018c) examined the impact of policy uncertainty on money demand in Australia utilizing quarterly data over the period 1998 to 2016 and Canada based on quarterly data over the period 1985-2017. In both studies, they utilized a nonlinear ARDL model to investigate if the effects of policy uncertainty were asymmetric. Their findings demonstrated that policy uncertainty indeed has significant asymmetric effects on money demand. However, based on our knowledge, no previous studies have explored the impact of uncertainty measures on money demand in Saudi Arabia. Therefore, we aim to fill this gap in the existing literature.

4. Modeling Money Demand Function

There are various money demand theories (e.g. the Keynesian Theory, quantity Theory, Inventory Theory, Friedman's Theory) aiming to identify the key factors explaining the behavior of money demand. However, these theories may hold or may not for some economies, depending on their economic structure. Therefore, many empirical studies tend to embed their money demand function with additional economic and financial variables (e.g. foreign interest rate, exchange rate, oil prices, trade balance, government spending, or private consumption) that are capable of explaining the behavior of money demand. Likewise, there have been many studies assessing the demand for Saudi Arabia, and some of these studies have tended to include additional variables in their money demand specifications. However, a recent study by Hasanov et al. (2022) conducted an intensive literature review for money demand in countries with fixed exchange rate and floating exchange rate regimes and found that countries with pegged exchange rates usually consider vital variables (e.g. financial development, foreign interest rate, oil prices, budget deficit, domestic consumption, interest rate differential, stock prices, and total trade) in their specified money demand function. Therefore, Hasanov et al. (2022) specified the

money demand in Saudi Arabia by considering the crucial variables for the Saudi economy. Their specified money demand function can be written as follows.

$$m_t^d = a_0 + a_1 GDP_t + a_2 REER_t + a_3 OP_t + a_4 IRD + a_5 P_t + a_6 Trend + e_t \qquad (1)$$

Where m_t^d denotes money demand while $GDP_t, REER_t, OP_t, IRD, P_t, e_t$ represent real income measured by real nonoil GDP, real effective exchange rate, oil prices, interest rate differential, consumer price index and error term, respectively. The authors also include the time trend denoted by $Trend$ in their specified money demand function to capture the impact of other sources influencing the money demand, like financial innovation.

In order to assess the impact of economic policy uncertainty, we replaced oil prices in specification (1) with economic policy uncertainty denoted (EPU).

$$m_t^d = a_0 + a_1 GDP_t + a_2 REER_t + a_3 EPU_t + a_4 IRD + a_5 P_t + a_6 Trend + e_t \qquad (2)$$

The removal of oil prices from specification (2) is mainly to avoid multicollinearity, as oil prices are considered a main source of economic uncertainty for the Saudi economy.

5. Data

This study employs quarterly time-series data from 2010:Q1 to 2023:Q1 to estimate the money demand in Saudi Arabia. The dataset consists of the consumer price index (CPI), real non-oil GDP, money supply (M3), real effective exchange rate (REER), the Economic Policy Uncertainty Index for Saudi Arabia, crude oil prices, the 3-month Saudi Arabian Interbank Offered Rate (SAIBOR), and 3-month Euro Interbank Offered Rate (EURIBOR). We calculate the interest rate differential (spread) between the SAIBOR and EURIBOR. The data are obtained from various sources, including the International Monetary Fund database, the Saudi Central Bank (SAMA), the General Authority for Statistics (GASTAT), and the St. Louis Fed. All the variables are transformed into logarithms to achieve stationarity in variance except the interest rates and the economic policy uncertainty index.

TABLE 1: Variables and Their Descriptions

VARIABLE	NOTATION	SOURCE
Real Non-Oil GDP	GDP	GSTAT
M3	M	SAMA
Real Effective Exchange Rate	REER	IMF
Consumer Price Index	P	IMF
Oil Prices	OP	St. Louis Fed
Uncertainty Index	EPU	St. Louis Fed
Interest Rate Differential	IRD	Authors' calculation

6. Empirical Analysis

6.1. Initial Assessment

The starting point of our analysis is to assess the stochastic properties of the time series to avoid spurious regressions that lead to misleading results. To do so, we relied on the established unit root tests such as the Augmented Dickey and Fuller (ADF) test developed by Said and Fuller (1981) and the test developed by Phillips and Perron (1988) to check whether the employed data are stationarity or not. The results of both tests confirm the non-stationarity of the variables in their levels. However, they became stationary when the first difference in the data was taken. The detailed results are available from the authors upon request.

6.2. Autoregressive Distributed Lag Model

Since the variables are integrated of order one; there might be a possibility to be integrated as suggested by Engle and Granger (1987); therefore, testing for cointegration is crucial. In doing

so, we proceed with our assessment based on the autoregressive distributed lag framework developed by Pesaran et al. (2001) to check whether a long-run relationship exists among the variables of interest. The benefits of choosing this approach, according to Nkoro and Uko (2016), can be summarized in three points. Firstly, estimating the ARDL model does not require the stationarity condition of the variables; indeed, the ARDL model deals with the issue of mixed order of integration. Secondly, it is suitable for small sample sizes. Thirdly, it deals with possible serial correlation and endogeneity issues by selecting the appropriate lags. Lastly, the error correction term derived from the ARDL model makes it more likely to comprehend the long-run relationship and the short-run dynamics. With all these advantages, it is important to ensure that the order of integration for the employed variables is I(1) and not I(2). Clearly, from previous stationarity tests, all variables are integrated of order one.

Next, to assess whether there is a cointegration relationship between the money demand and its potential determinants based on specifications (1) and (2), we started first by estimating the following basic Error Correction ARDL model, producing both the short and long-run coefficients simultaneously.

$$\Delta M_t = \beta_0 + \beta_1 M_{t-1} + \beta_2 GDP_{t-1} + \beta_3 REER_{t-1} + \beta_4 OP_{t-1} + \beta_5 IRD_{t-1} + \beta_6 P_{t-1} + \sum_{i=1}^{k} \mu_i \Delta GDP_{t-i} + \sum_{i=1}^{k} \varphi_i \Delta REER_{t-i} + \sum_{i=1}^{k} \rho_i \Delta OP_{t-i} + \sum_{i=1}^{k} \delta_i \Delta IRD_{t-i} + \sum_{i=1}^{k} \sigma_i \Delta P_{t-i} + \emptyset ECT_{t-1} + \varepsilon_t \quad (3)$$

Where M is the dependent variable and $GDP, IRD, OP, REER$ are the independent variables, Δ reflects the first difference operator, k is the optimal lag length selected by certain criteria, while ε_t is the error term. The β coefficients capture the long-run relationship while $\mu, \varphi, \delta, \rho$ coefficients explain the short dynamics of the model. The ECT_{t-1} denotes the error correction term and ∅ measures the speed of adjustment to equilibrium.

To examine the existence of a long-run relationship, we conducted the bounding test developed by Pesaran et al. (2001) based on F-test. According to this test, we defined the null hypothesis of no cointegration among the variables as follows: $H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$ against the alternative hypothesis $H_1:: \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq 0$. Based on the

estimated F-statistics, we can determine whether there is a cointegration or not. In other words, if the F-statistics is higher than its upper bound, it implies the presence of a cointegration relationship. Nonetheless, such cointegration would disappear in case the F-statistics appeared to be below its lower bound. When the F-statistics lie between its upper and lower bounds, then it would be difficult to determine whether there is a cointegration relationship.

Table 2 summarizes the results of the bounding test and confirms the presence of a long-run relationship between money demand and its determinant as F-statistics is above the upper bound.

Table 2: Bounding Tests for Cointegration

	fication 1	fication 2
F-statistics	5.46	6.19
Critical values	5 %	
Sample size	I(0)	I(1)
45	3.470	4.470
50	3.383	4.432
Asymptotic	3.050	3.970

Note: I(0) and I(1) are respectively the stationary and non-stationary bounds.

Since we found evidence confirming the presence of a long-run relationship between money demand and its determinants, we can proceed with the interpretation of long-run estimated parameters, as shown in Table 3. Clearly, from both specifications, we can see the positive and significant impact of income on money demand; in other words, higher income leads to higher money demand. In addition, we found higher consumer prices lead to higher money demand and this can be attributed to the fact that people are not concerned about domestic prices as Saudi Arabia witnessed low levels of inflation over the past decades. The impact of interest rate differential appears to be significant in both specifications; however, the effect of interest rate differential is small, ranging from 0.02 to 0.03 percent. This can be due to the fact the interest rate in Saudi Arabia is higher than the foreign interest rate (Euro), making people prefer to hold money in local currency that can be deposited in the form of savings accounts in commercial

banks. By looking at the impacts of the exchange rate, we find it to be negative and significant and this means that when the depreciation of the local currency against foreign currency people prefer to hold cash or hold financial or real estate assets. Al Rasasi and Banafea (2018) attributed the negative impact of exchange rates in the long run to the citizens' preference for holding foreign currency rather than domestic currency, implying the presence of substitute effects.

With regards to economic uncertainty – measured by either oil prices or economic policy uncertainty, the estimated coefficients of both measures of uncertainty are positive yet statistically insignificant; this can be credited to the sound macroeconomic policies. In other words, the prudent actions of the Saudi Central Bank maintain the stability of monetary conditions and safeguard the financial system against economic uncertainty. This finding is consistent with the conclusion of Al Rasasi et al. (2020).

Table 3: Long Run Parameters' Estimates

Parameters estimates	Specification 1	Parameters estimates	Specification 2
GDP	0.85**	GDP	0.78**
	(3.77)		(3.57)
REER	-0.40	REER	-0.72**
	(-0.74)		(-2.05)
OP	0.03	EPU	0.14
	(0.69)		(1.55)
IRD	0.03***	IRD	0.02**
	(1.89)		(2.02)
P	1.19**	P	1.64**
	(2.09)		(3.27)
Trend	0.01**	Trend	0.01**
	(3.15)		(2.81)

Note: numbers in parentheses are t-statistics and *, **, *** denote the significant level of 1%, 5%, 10% respectively.

In the short run, the estimated coefficients reveal the essential role of income, exchange rate, and interest rate differential in determining the money demand, as shown in Table 4. The error

correction coefficients are negative and significant, implying the speed of adjustment to the steady state conditions.

Table 4: Short Run Parameters' Estimates

Parameters estimates	fication 1	neters estimates	fication 2
ECT_{t-1}	-0.33** (-6.69)	ECT_{t-1}	-0.32** (-7.12)
ΔGDP	0.18** (3.92)	ΔGDP	0.14** (3.39)
$\Delta REER$	0.29** (2.15)	$\Delta REER$	0.30** (2.29)
$\Delta REER_{t-1}$	0.11 (0.72)	$\Delta REER_{t-1}$	0.11 (0.76)
$\Delta REER_{t-2}$	0.37** (2.45)	$\Delta REER_{t-2}$	0.42** (2.82)
$\Delta REER_{t-3}$	0.19 (1.42)	$\Delta REER_{t-3}$	0.19 (1.38)
ΔIRD	0.02** (3.73)	ΔIRD	0.02** (3.86)

Note: numbers in parentheses are t-statistics and *, **, *** denote the significant level of 1%, 5%, and 10% respectively.

To this end, we assessed the stability of our estimated models by relying on the common stability tests – known as the cumulative sum (CUSUM) and cumulative sum of squares (CUSUM of Squares) – and developed by developed by Brown et al. (1975). The stability tests for both specifications, as plotted in Figures 2 and 3, confirmed the stability of money demand functions as the test statistics fall within the critical bounds at 5 percent significance.

Figure 2: Stability Tests for Specification 1

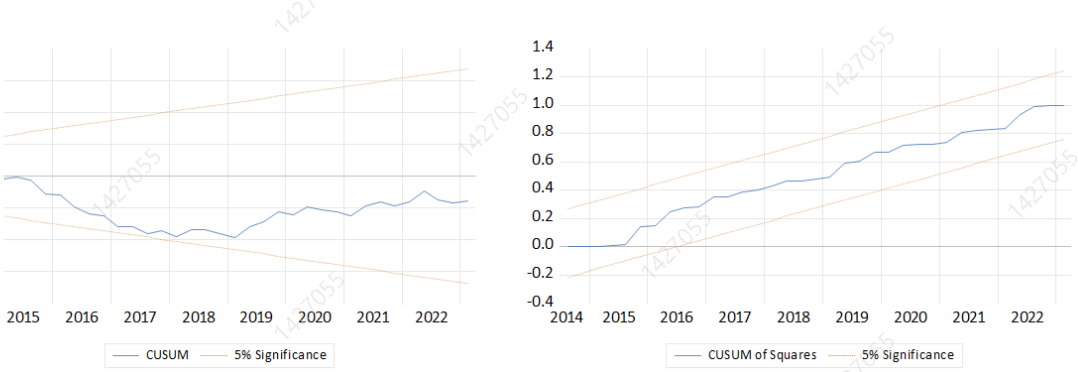
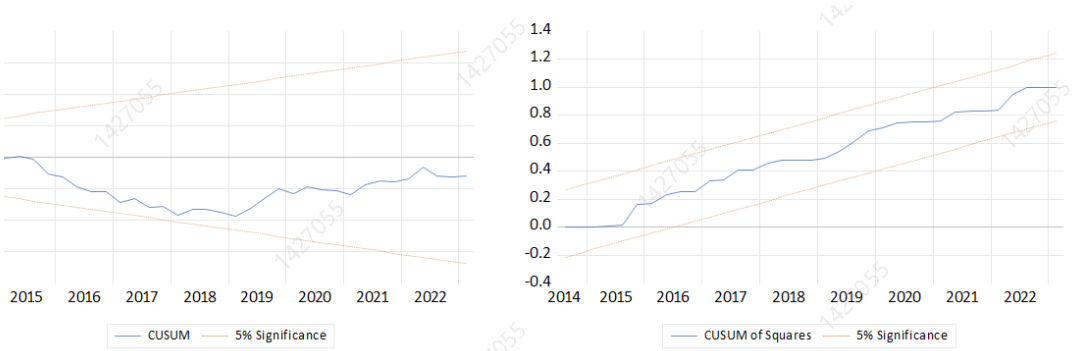


Figure 3: Stability Tests for Specification 2



7. Conclusion

In this paper, we delved into the money demand function for the Saudi economy, following the recent research by Hasanov et al. (2022), who formulated, based on an intensive literature review, the money demand function taking into account the exchange regimes for the case of Saudi Arabia. Our analysis introduced economic policy uncertainty into the money demand function to assess the impact of economic policy uncertainty on money demand in Saudi Arabia for the period 2010-2023, based on a quarterly dataset. Our econometric analysis confirmed the existence of a long-run relationship between money demand and its vital determinants based on the bounds test by Persian et al. (2014). Specifically, our estimated ARDL model indicated the significant impacts of income, interest rate, exchange rate, and prices on money demand in the long run. However, the impact of economic uncertainty, measured by oil prices or economic policy uncertainty index, seemed to be positive but insignificant on money demand in the long run. This might be attributed to the sound macroeconomic policies – fiscal and monetary policies – aiming to safeguard the financial sector. Indeed, the Saudi Central Bank's stable and proactive monetary policy plays a crucial role in promoting market confidence and ensuring stable monetary conditions and a resilient financial sector. As we conclude, we acknowledge the need for further research to deepen our comprehension of the money demand dynamics, offering valuable insights for policymakers and economists. Examining the nonlinear econometric techniques would be an interesting exercise.

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