On the Effect of Government Spending on Money Demand in the United States: An ARDL Cointegration Approach

Ebadi, Esmaeil

Department of Economics, Grand Valley State University

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Esmaeil Ebadi

Grand Valley State University

Seidman College of Business

Department of Economics

Email: ebadiesm@gvsu.edu

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Abstract

This paper sheds light on the effect of government spending on money demand. The conventional literature of money demand has been developed with money demand defined as a function of income, interest rate, exchange rate, and inflation. I propose the new method of income decomposition to the public sector and the private sector following Barro's (1990) spending model. I include government spending in the conventional money demand function to investigate the impact of government spending on the demand for money. The results confirm the long-run significant effect of government spending on money demand. In addition, I find that money demand tends to be unstable and moves on the edge of structural break during recessions. Moreover, the tendency of instability lasted longer in the early recession of 2000s than in the Great Recession 2007-2008 and the results do not support Friedman's (1969) idea that the demand for money is "highly stable". Instead, the findings suggest that money demand is "slightly stable" during recessions.

Key Words: Monetary Policy, Money Demand, Stability, ARDL Cointegration Approach

JEL: E41

I. Introduction

To conduct a proper monetary policy, demand for money plays a crucial role. For a long time, economists studied money demand function and its main determinants, but they have not investigated sufficiently to see the effect of government spending on money demand. Since the Great Depression, following Keynesian demand management policies, the government has been spending a lot of money. This has caused chronic budget deficit and a huge national debt not only in the United States, but also in all developed countries. The only thing Central Banks, as an independent organization, could do is to control inflationary effects of government spending using monetary policy tools. Thus, it is worthwhile to study how government spending influences money demand as this is one of the most important factors in the decision-making process of monetary authorities.

Theoretically, there is a consensus among economists that money demand is a function of income as a scale variable that represents the economic activity (Laidler, 1993). While government spending has a positive and significant effect on real GDP, we need to consider its effect of government spending on money demand. The new method of decomposition of real GDP to the public and private sectors using Barro's (1990) spending model sheds light on the fact that conventional literature misses the importance of the effect of the public sector on money demand by including government spending in the money demand function[1].

Conventional literature focuses on two main points to estimate the demand for money: variable selection and the chosen framework. For variable selection, alongside with income (scale variable) as a representative for economic activity, I include inflation, interest rate, and exchange rate in the model as representatives for opportunity cost of holding money. This is a comprehensive model that includes all opportunity costs determinants of holding money based on theoretical and empirical approaches.[2]

To get meaningful results, it is important to have a reliable model specification and an estimation method that is free of identification problems[3]. While Sriram (2001) believes that the error-

[1] For more information see Ebadi (2018).

[2] For example; see Golinelli and Pastorello (2002), Carlson et al. (2000), Ball (2001), Hafer and Jansen (1991), Bahmani (1996), Bahmani and Shabsigh (1996), Bahmani-Oskooee and Gelan (2009).

[3] See a comprehensive survey of literature on the demand for money that is prepared by Sriram (2001).

correction models (ECM) meet the criteria to get meaningful results, the ECM that use approaches such as Engel and Granger (1987), Johansen (1988), and Johansen and Juselius (1990) are not reliable enough due to the assumptions made (Pesaran and Pesaran, 1990). Therefore, this paper applies the Autoregressive Distributed Lag (ARDL) approach that meets the provided criteria which works despite having endogenous regressors. The ARDL procedure achieves an empirical advantage over other asymptotically efficient estimators such as DOLS, FMLS, and MLE because it is an optimal estimator (Panopoulou and Pittis, 2004). However, the results are not reliable without applying stability tests to make sure the coefficient estimates are stable[4].

I discuss the stability of demand for money in the United States using the CUSUM and CUSUMSQ tests to make sure the coefficients in the model are stable. Although these tests are required to conduct long-run relationships, they provide useful information regarding the time and the duration of the structural break.

Section II discusses the model and the estimation strategy. Section III provides empirical results. Finally, section IV summarizes the conclusions of the study.

II. The Model and Estimations Strategy

Following the conventional demand for money including income as a representative for scale variable and inflation, interest rate, and exchange rate as an illustrative for the opportunity costs the model specification is as follows:

$$\ln M_t = c + \alpha \ln Y_t + \beta \ln TBILL_t + \gamma \ln NEER_t + \eta \ln CPI_t + \varepsilon_t \qquad (1)$$

Where $\ln M$ is the logarithm of real M2[5] (broad money), $\ln Y$ is the logarithm of real GDP, $\ln TBILL$ is the logarithm of 3-month Treasury bill rate, $\ln NEER$ is the logarithm of nominal effective exchange rate, $\ln CPI$ is the logarithm of consumer piece index (CPI), c is the constant term, and ε is the error term.

Following Ebadi (2018), I decompose GDP to public sector and private sector and rearrange the demand for money as follows:

[4] For more information see Bahmani-Oskooee and Bohl (2000), Bahmani-Oskooee and Shin (2002), Bahmani-Oskooee and Rehman (2005).

[5] M2 is the preferable measure to study the long-run economic impacts. For more information see Daniele *et al*. (2016).

$$\ln M_t = c + \alpha \ln RGE_t + \beta \ln RK_t + \gamma \ln TBILL_t + £ \ln NEER_t + \eta \ln CPI_t + \varepsilon_t \qquad (2)$$

$\ln RGE$ is the logarithm of real government spending, and $\ln RK$ is the logarithm of real capital stock[6]. All data has been collected form the Federal Reserve Economic Data (FRED) database.

I apply the ARDL approach to cointegration to estimate the long-run relationship between variables in the model. To make sure that there is no I(2) variable in the model I use the Augmented Dickey-Fuller (1981) (ADF) test[7]. The ARDL model has been proceed as follows:

$$\Delta \ln M_t = \alpha + \sum_{i=1}^{n} \beta_i \Delta \ln M_{t-i} + \sum_{i=1}^{n} \gamma_i \Delta \ln RGE_{t-i} \sum_{i=0}^{n} \eta_i \Delta \ln RK_{t-i} + \sum_{i=0}^{n} £_i \Delta \ln TBILL_{t-i} \sum_{i=0}^{n} \mu_i \Delta \ln NEER_{t-i} + \sum_{i=0}^{n} €_i \Delta \ln CPI_{t-i} + \lambda_1 \ln M_{t-1} + \lambda_2 \ln RGE_{t-1} + \lambda_3 \ln RK_{t-1} + \lambda_4 \ln TBILL_{t-1} + \lambda_5 \ln NEER_{t-1} + \lambda_6 \ln CPI_{t-1} + \varepsilon_t \qquad (3)$$

The first part of equation with parameters β_i , γ_i , η_i , $£_i$, μ_i , and $€_i$ depicts short-run dynamics of the model. The second part demonstrates the long-run relationship with parameters $\lambda_1, \lambda_2, \lambda_3, \lambda_4, \lambda_5,$ and λ_6. The null hypothesis of existing cointegration is:

H_0: $\lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = \lambda_6 = 0$

H_1: $\lambda_1 \neq 0, \lambda_2 \neq 0, \lambda_3 \neq 0, \lambda_4 \neq 0, \lambda_5 \neq 0, \lambda_6 \neq 0$

Following Pesaran and Shin (1999), the optimal lags for the variables in the model are determined and then I estimate the parameters.

III. Empirical Results

I estimate equation (3) using quarterly data for the period of 1973Q1-2013Q4. To select the optimal order, I did not follow the literature to impose maximum lags of eight[8]. Instead, I used maximum lags of 12 to take care of the serial correlation that occurred using the lower number of maximum lags. The lags are supposed to take care of serial correlation and endogeneity and I find that misspecification can occur if we use a lower number of lags. The sample size plays an important role when we impose more lags to the model.

[6] For more information, see Ebadi (2018).

[7] The ARDL approach is not applicable when we have an I(2) variable in the model (Pesaran and Shin, 2001).

[8] See Bahmani-Oskooee and Gelan(2009).

Although, the ARDL model could not get rid of serial correlation using Akaike's Information Criterion (AIC) (Akaike, 1974), and Schwarz' Bayesian Information Criterion (BIC) (Schwarz, 1978) to select the optimum lags, Hannan- Quinn Information Criterion (HIQ) (Hannan and Quinn, 1979) solves the problem as the second-best model selection criterion[9]. Since the calculated LM statistic is less that its critical value (9.48), the LM (Lagrange Multiplier test of residual serial correlation) test confirms the model does not suffer from omitted variable problem and endogeneity with the selected optimal lags. In addition, the Ramsey Reset test strongly rejects the misspecification in the proposed model (Table.1, panel B, the calculated RESET statistic is less than its critical value of 3.48). The result is strong enough to support the statement that the proposed model is correctly specified.

To establish the long-run relationship between the variables in the model, I conducted the bound test (Pesaran and Shin, 2001). Since the calculated F statistic (24.6) is far beyond the upper bound at 5% significant level (3.8), the null hypothesis of no cointegration is rejected strongly. This means there is a long-run relationship among the variables in the model.

After conducting the diagnostic tests, I implement the CUSUM and CUSUMSQ tests[10] to make sure that the coefficients are stable. The results show that the coefficients in the proposed model are stable according to both tests. It is worth mentioning that the CUSUMSQ test shows that during recessions money demand tends to be unstable and moves on the edge of structural break. Also, the tendency of instability lasted longer during the recession of the early 2000s when compared with the Great Recession of 2007-2008. Moreover, the results do not support the idea that "money demand (M2) appeared to be stable until the early nineties, when the structural break occurred[11]." This paper confirms there was no structural break in money demand but it does not support Friedman (1969) idea that money demand is "highly stable". Instead, the results show that money demand is "slightly stable" during the recessions.

As can be seen from panel B, all coefficients are strongly significant and carry the expected signs. The results show that the elasticity of money demand with respect to real government spending as a proxy for public sector and with respect to private sector representative found to be 0.62 and 0.67

[9] See Shikui and Lei (2012)
[10] See Brown *et al*. (1975)
[11] See Calaza and Sousa (2003)

Table.1 Full-information estimate of Equation 3

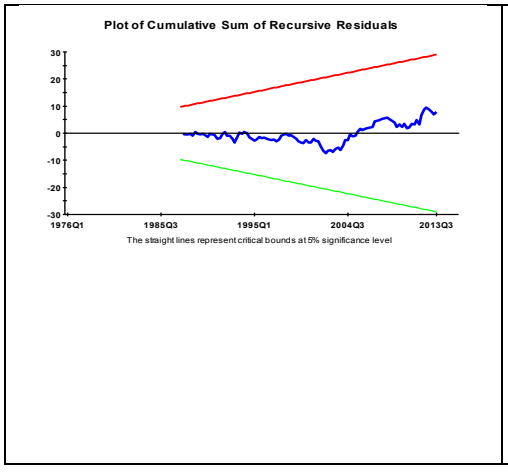
Panel A: Short-run coefficient estimates

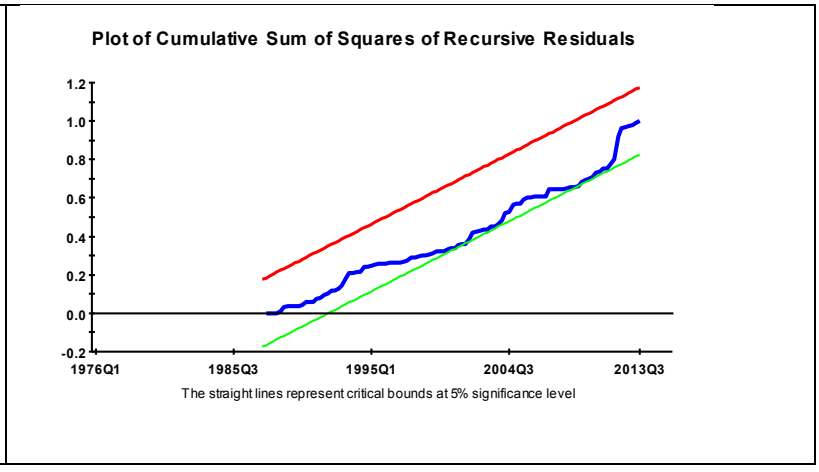
Lag order	0	1	2	3	4	5	6	7	8	9	10	11
$\Delta \ln M$		0.22	-0.01	0.21	-0.05	0.1	0.03	0.20	0.13			
		(3.88)	(0.22)	(3.28)	(0.82)	(1.71)	(0.59)	(3.29)	(1.97)			
$\Delta \ln RGE$	0.06											
	(2.05)											
$\Delta \ln RK$	0.04	-0.14	0.01	-0.04	-0.10	-0.002	-0.06	-0.07	-0.05			
	(1.58)	(4.38)	(0.34)	(1.18)	(2.89)	(0.06)	(1.80)	(2.25)	(1.74)			
$\Delta \ln NEER$	0.20	0.02	0.03	0.01	0.02	0.006	0.03	0.02	0.03			
	(1.25)	(1.35)	(2.20)	(0.76)	(1.40)	(0.38)	(2.22)	(1.53)	(1.79)			
$\Delta \ln TBILL$	-0.01	0.002	0.008	0.01	0.01	0.006	0.004	0.006	0.02	0.007	0.003	-0.01
	(6.30)	(1.13)	(3.44)	(5.19)	(3.78)	(2.41)	(1.95)	(2.37)	(7.1)	(2.27)	(1.31)	(4.36)
$\Delta \ln CPI$	-1.14											
	(12.4)											

Panel B: Long-run coefficient estimates and diagnostics

Constant	$\ln RGE$	$\ln RK$	$\ln NEER$	$\ln TBILL$	$\ln CPI$	Adj.R^2	F[b]	EC_{t-1}	LM	RESET
-0.0009	0.62	0.67	-0.21	-0.10	-0.27	0.99	24.68	-0.10	8.68	0.49
(0.82)	(4.10)	(3.27)	(4.63)	(5.35)	(2.90)			(3.80)		

Panel C: Stability tests





Notes: a. Numbers inside parentheses are absolute value of t-ratio

b. The upper bound critical value of the F test at the usual 5% level of significance is 3.88 (Pesaran and Pesaran, 2009, Microfit.5)

c. LM is the Lagrange multiplier test for serial correlation. It has a χ^2 distribution with one degree of freedom. The critical value at 5% level of significance is 9.48.

d. RESET is Ramsey's specification test. It has a χ^2 distribution with only one degree of freedom. The critical value at the 5% level of significance is 3.84.

respectively. Also, the interest rate elasticity of money demand and consumer price index elasticity are -0.1 and -0.27. The coefficient of exchange rate in money demand (it can be positive[12] or negative[13]) is found to be negative which supports the wealth effect of domestic currency in the United States. Finally, the adjusted R^2 portrays the high forecasting power of the proposed money demand model.

IV. Conclusion

This paper sheds light on the effect of government spending on money demand as a crucial determinant in conducting proper monetary policy. Since the effectiveness of monetary tools relies on having a stable money demand, this paper attempts to provide an accurate estimate of the effect of government spending on money demand in the United States. The results illustrate the positive and significant effect of government spending on money demand. In addition, the diagnostic tests of stability of coefficients in the proposed money demand model provide astonishing information about the stability of money demand in the United States. The empirical results show there was no structural break in money demand in the early 1990s and thereafter. Moreover, the idea of switching to interest rate as a target due to unstable money demand is unconvincing. Although the proposed money demand is stable over the period of the study, it is not "highly stable" as Friedman (1969) believes. Instead, it is "slightly stable" during recessions and moves on the edge of the structural break but remains stable.

[12] Arango and Nadiri (1981)
[13] Bahmani-Oskooee and Pourheydarian (1990)

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