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The Impact of Money Supply on the Economy: A Panel Study on Selected Countries

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Abstract: This study investigates the impact of money supply on economic growth rate, inflation rate, exchange rate and real interest rate. We used a panel of 217 countries from 1960 to 2020 and four different models to address these questions. The empirical results support the quantity theory of money. In addition, the study found evidence for a negative relationship between real interest rate and inflation and between money supply and real interest rate. Finally, our results show that lagged money growth rate is positively correlated with GDP growth rate but money growth rate is negatively correlated with GDP growth rate.

Keywords: Money supply, Economic growth, Inflation, Real interest rate, Real exchange rate

1. Introduction

Most monetarists believe that there is a positive correlation between money supply and inflation rate in the long run. And there is no significant relationship between money supply and economic growth rate. In addition, the value of a country's currency will decrease as well as the exchange rate should its central bank keeps printing money. Nonetheless, the Keynesian economists postulate that there is a positive relationship between money supply and economic growth in the short run should markets experience sticky prices and wages. Economists have studied this topic for a long time and are still searching for an ultimate answer. This study aims to provide more evidences regarding these arguments at a global scale.

The study uses a panel of 217 countries in the world ranging from 1960 to 2020 to empirically test the impact of money supply on economic growth rates, exchange rates and real interest rates. This study addresses four specific questions:

(1) Does an increase in money supply boost economic growth?

(2) Does an increase in money supply lead to increase in inflation rate?

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(3) Is exchange rate of a currency correlated with money supply?

(4) How does money supply affect real interest rates in an economy?

This paper differs from previous ones in several aspects. First, while most of papers in the literature used cross-sectional or pooled time-series data, this study uses a panel data set that allows us to take care of heterogeneity issue across countries and lessen omitted variable bias. Second, our data are more up to date and cover the longest time range.

2. Literature Review

There is a rich literature on the effects of money supply on an economy. Researchers have used different sets of data from different times and different econometric methodologies. The empirical results are mixed. Some studies show evidence that money supply is positively correlated with inflation rate and economic growth. Some show no relationship or negative ones. [7] used a sample of 53 countries from 1973 to 1981 and found evidence that growth and inflation are negatively correlated. He also suggested that changes in the growth rate of money have no effect on the capital stock in the long run. [3] used data from a sample of about 160 countries from 1969 to 1999 and showed that in the long run, there is a strong positive relationship between inflation and money growth. Yet, such relationship is due to countries with hyperinflation. When it comes to countries with low inflation (less than 10%), the relationship is weak or even doesn't exist. They also found that velocity accelerates with increasing inflation, thereby leading to inflation rates exceeding the growth rates of the money stock. Other studies found evidences to support supports the quantity theory of money, which states that money supply and price level in an economy are in direct proportion to one another [4-6,10,12-14,18].

Regarding the relationship between money supply and economic growth, [2] studied a group of selected countries in the ASEAN area including Thailand, Indonesia, Singapore, Malaysia, Philippines, Vietnam, Lao PDR and Cambodia from 1995 to 2013. The results show a positive relationship between money supply and economic growth while demand deposits have a negative relationship with GDP growth. [1] found similar results using data from Nigeria. Other studies also found evidence for a positive relationship between money supply and economic growth [8,9,11,15-17].

3. Data

This section describes data used in this study. The source of the data is the World Bank Database as described in Table 1. Data was collected on a sample of 217 countries from 1960 to 2020.

Table 1. Variables and Sources

Variable	Sources
GDP Growth Rate	World Bank Database
Money Supply	World Bank Database
Inflation Rate	World Bank Database
Unemployment Rate	World Bank Database
Real Interest Rate	World Bank Database
Foreign Direct Investment	World Bank Database
Government Expenditure	World Bank Database
Gross Fixed Capital Formation	World Bank Database
Real Exchange Rate	World Bank Database
Corruption	World Bank Database

When studying the impact of money supply on economic growth, there are other variables that could affect and change GDP as well. So, we included as many relevant and significant explanatory variables as possible. The number of variables studied in this research is 11, and they are GDP growth rate, money supply, real interest rate, unemployment rate, gross fixed capital formation, foreign direct investment, level of education, level of corruption, government expending and exchange rate. We used lagged GDP growth rate to control for any potential endogenous issues.

4. Econometric Methods

This section discusses empirical methods. To answer the research questions, it is important to look at different aspects of the economy that are related to the question. Thus, this study has four different models that seek to address the impact of specific explanatory variables on different dependent variables.

In the first model, we examine the relationship between money supply growth rate and GDP growth rate. The first model is as follows:

$$GDP\ Growth\ rate_{it} = b_0 + b_1\ Money\ Supply\ Growth\ Rate_{it} + b_2\ Money\ Supply\ Growth\ Rate_{it-1} + b_3\ Money\ Supply\ Growth\ Rate_{it-2} + \beta_4\ GDP\ Growth\ Rate_{it-1} + \beta_5\ Real\ Interest\ Rate_{it} + \beta_6\ Unemployment\ Rate_{it} + \beta_7\ Gross\ Fixed\ Capital\ Formation_{it} + \beta_8\ Foreign\ Direct\ Investment_{it} + \beta_9\ Level\ of\ Corruption_{it} + \varepsilon_{it} \qquad (1)$$

This model seeks to identify the impact of money supply growth rate on GDP growth rate. Money supply growth rate is the main of interest independent variable. Real interest rate should affect GDP growth rate because if it decreases households and firms will invest more and it will help the economy grow and vice versa. If unemployment is low, there is more people working and total output increases, and vice versa. Gross fixed capital formation includes land improvements; plant, machinery, and equipment purchases; and the construction of roads, railways, and the construction

of infrastructures like schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. In addition, foreign direct investment affects GDP because if foreign firms invest in a country and produce goods and services in such country, they are helping the economy grow. The level of corruption has an impact on how the economy does as well because a corrupted government would seek their benefit and hurt the economy. If they steal money or apply fiscal or monetary policies that benefit them instead of the country, total output and growth will be affected in a negative way.

In the second model, we investigate the relationship between money supply growth rate and inflation rate. The second model is the following:

Inflation Rate $_{it}$ = b_0 + β_1 Inflation Rate $_{it}$ + b_2 Money Supply Growth Rate $_{it}$ + b_3 Money Supply Growth Rate $_{it-1}$ + β_4 Real Interest Rate $_{it}$ + β_5 Gross Fixed Capital formation $_{it}$ + β_6 Foreign Direct Investment $_{it}$ + β_7 Government Expending $_{it}$ + ε_{it}   (2)

This model looks at inflation and some of the variables that have an impact on it such as money supply growth rate, real interest rate, gross fixed capital formation, foreign direct investment and government expending. If a country increases money supply, there will be more money available in the economy, which will lead to an increase in prices (inflation). In addition, as seen before in the previous model, interest rate, gross fixed capital formation and foreign direct investment are related to economic growth, which also leads to inflation.

In the third model, we study the correlation between money supply growth rate and exchange rate. The third model is the following:

Real Exchange Rate $_{it}$ = b_0 + b_1 Money Supply Growth Rate $_{it}$ + b_2 Real Interest Rate $_{it}$ + b_3 Gross Fixed Capital Formation $_{it}$ + β_4 Foreign Direct Investment$_{it}$ + ε_{it}   (3)

This model looks at how exchange rate is correlated by money supply growth rate, real interest rate, gross fixed capital formation and foreign direct investment. If money supply increases, the currency of that country will depreciate, and this will make exports rise. Gross fixed capital represents a country's assets and foreign direct investment if other countries believe it is worth it to invest, and both variables can affect exchange rate.

Finally, in the last model we look at the relationship between money supply growth rate and real interest rate. The model is as follows:

Real Interest Rate $_{it}$ = b_0 + b_1 Money Supply Growth Rate $_{it}$ + b_2 Government Expending $_{it}$ + b_3 Foreign Direct Investment $_{it}$ + ε_{it}   (4)

This last model uses money supply growth rate, government expending and foreign direct investment to predict real interest rate. In theory, if money supply increases interest rate will decrease and output will increase. In addition, government expending and foreign direct investment are related to real interest rate because investment depends on interest rate and the amount of government expending determines if interest rate increases or decreases.

5. Empirical Results

5.1 OLS Regressions

Table 1 describes sources of data. Table 2 is the correlation matrix and Table 3 provides summary statistics of all variables used in this study.

We begin with the baseline OLS regressions results. The first columns of Tables 4, 5, 6, and 7 provide the empirical results for the OLS regressions for all four models discussed in the previous section. According to Table 4, the signs of the coefficients are what it was expected for most of the explanatory variables. Yet, money supply growth rate appears to have the opposite sign than expected. One possible reason for the negative sign of money supply growth rate is that when an economy is not doing so well and GDP decreases, the central bank usually increases money supply to help the economy. Thus, money supply growth rate and GDP growth rate have a negative relationship but lagged money supply is positive because it takes time for the monetary policies to have an impact on output. The coefficient of money supply growth rate is -0.059 and it is statistically significant at the 1% level. The coefficient of lagged money supply growth rate is 0.048 and it is statistically significant at the 1% level.

Regarding the second model, the coefficients of real interest rate, FDI and gross fixed capital formation are statistically significant and relevant. The sign of interest rate is negative as it was expected because if interest rates are low, investment increases and the economy will grow. Yet, the sign of gross fixed capital formation being negative does not correspond to the theory because if it increases, GDP will increase and so will inflation. In addition, it is important to say that even though money supply growth rate is not statistically significant in this model its coefficient is positive as expected.

The third model measures the impact of money supply, interest rate, FDI, and gross fixed capital formation on real exchange rate. Out of these variables, the results show that only real interest rate and FDI are statistically significant. Foreign direct investment seems to be the most significant and relevant explanatory variable, but its coefficient does not correspond with the theory. The results show a negative relationship between FDI and exchange rate, but in theory if FDI increases, the demand for the currency increases and the exchange rate appreciates or rises.

Table 2. Overall Summary Statistics

	Observations	Mean	S.D.	Minimum	Maximum
GDP Growth Rate	9,504	3.82	6.19	-64.05	149.97
Money Supply	7,462	45.12	36.36	0	400.41
Inflation Rate	7,897	24.33	339.50	-30.24	23,773.13
Unemployment Rate	5,610	8.09	6.16	0.11	37.97
Real Interest Rate	4,144	5.69	15.63	-97.69	628.32
Foreign Direct Investment	7,983	5.57	47.33	-1268.17	1,704.59
Government Expenditure	7,930	16.11	8.01	0	147.73
Gross Fixed Capital Formation	7,397	22.31	8.18	-2.42	95.32
Real Exchange Rate	3,591	116.28	115.00	18.73	3,520.35

Table 3. Correlation Matrix

	GDP Growth Rate	Money Supply Growth Rate	Inflation Rate	Unemployment Rate	Interest Rate	FDI	Gov. Expenditures	Exchange Rate	Fixed Capital Formation
GDP Growth Rate	1								
Money Supply Growth Rate	-0.14	1							
Inflation Rate	0.02	-0.20	1						
Unemployment Rate	-0.09	-0.08	-0.11	1					
Interest Rate	0.02	-0.27	-0.03	0.07	1				
FDI	0.18	-0.14	0.06	0.18	0.10	1			
Gov. Expenditures	-0.15	0.23	-0.10	0.54	-0.20	-0.01	1		
Exchange Rates	-0.05	0.08	-0.26	-0.28	-0.01	-0.06	-0.25	1	
Fixed Capital Formation	017	-0.03	-0.14	0.38	-0.11	0.39	0.15	-0.21	1

Table 4. Regression Results of Model 1

Independent Variables	OLS	Fixed-Effects Model
Intercept	2.269	0.4565
	(0.883)	(1.818)
Lag GDP	0.312***	0.208***
	(0.098)	(0.042)
Money Supply Growth Rate	-0.059***	-0.054***
	(0.022)	(0.013)
Money Supply Growth Rate $_{(t-1)}$	0.048***	0.024*
	(0.015)	(0.013)
Money Supply Growth Rate $_{(t-2)}$	0.014	0.007
	(0.012)	(0.011)
Unemployment Rate	-0.073***	-0.324***
	(0.025)	(0.116)
Real Interest Rate	-0.0039	0.013
	(0.015)	(0.021)
Foreign Direct Investment	0.048**	0.101***
	(0.019)	(0.022)
Gross Fixed Capital Formation	0.035**	0.021
	(0.017)	(0.028)
Corruption	0.273	-1.551***
	(0.28)	(0.549)
N	621	621
R²	0.28	0.26

***p<0.01, **p<0.05, *p<0.1 Numbers in parenthesis are robust standard errors.

(Dependent Variable = GDP Growth Rate)

Table 5. Regression Results of Model 2

Independent Variables	OLS	Fixed-Effects Model
Intercept	65.12	62.95
	(29.74)	(19.90)
Inflation Rate $_{(t-1)}$	0.344	0.312***
	(0.256)	(0.014)
Money Supply Growth Rate	0.717	1.057***
	(0.652)	(0.256)
Money Supply Growth Rate $_{(t-1)}$	0.294	0.233
	(0.385)	(0.231)
Real Interest Rate	-2.18**	-3.394***
	(1.084)	(0.315)
Foreign Direct Investment	-0.291**	-0.357
	(0.146)	(0.525)
Gross Fixed Capital Formation	-0.659**	-0.792*
	(0.303)	(0.489)
Government Expenditure	-0.898	-1.077
	(0.56)	(1.042)
N	2836	2836
R²	0.199	0.192

***p<0.01, **p<0.05, *p<0.1 Numbers in parenthesis are robust standard errors.

(Dependent Variable = Inflation Rate)

Finally, the fourth model aims to examine the relationship between interest rate and money supply growth rate. The results show that the coefficients of money supply growth rate is statistically significant at the 1 percent level. The sign of the coefficient of money supply is negative as it was expected, because an increase in money supply will lower interest rate and vice versa.

Table 6. Regression Results of Model 3

Independent Variables	OLS	Fixed-Effects Model
Intercept	106.72	97.75
	(8.29)	(7.29)
Money Supply Growth Rate	0.416*	0.386***
	(0.234)	(0.144)
Real Interest Rate	-0.415**	-0.335***
	(0.191)	(0.089)
Foreign Direct Investment	-1.354***	-2.197***
	(0.318)	(0.351)
Gross Fixed Capital Formation	0.574	1.132***
	(0.402)	(0.317)
N	1641	1641
R^2	0.12	0.12

***p<0.01, **p<0.05, *p<0.1 Numbers in parenthesis are robust standard errors.
(Dependent Variable = Real Exchange Rate)

Table 7. Regression Results of Model 4

Independent Variables	OLS	Fixed-Effects Model
Intercept	3.73	-1.93
	(1.19)	(1.40)
Money Supply Growth Rate	- 0.347***	- 0.336***
	(0.042)	(0.022)
Government Expenditure	0.082	0.469***
	(0.09)	(0.088)
Foreign Direct Investment	0.49	-0.025
	(0.031)	(0.050)
N	3246	3246
R^2	0.06	0.05

***p<0.01, **p<0.05, *p<0.1 Numbers in parenthesis are robust standard errors.
(Dependent Variable = Real Interest Rate)

5.2 The Fixed-Effects Model

As this study uses a panel set of data of different countries over a long period of time, one can argue that the OLS estimators may not capture the impacts of unobserved characteristics of observations. The unobserved features may correlate with the explanatory variables in our models. According to [19], one way to deal with it is to difference the data in adjacent time periods

then apply pooled OLS. The alternative is to use a Fixed-Effects regression, which is more efficient when the error terms are not serially correlated. Another option is to use a Random-Effects estimator, which is suitable if the unobserved feature is not correlated with explanatory variables.

Given the long period in the dataset, we believe the Fixed-Effects estimator is more efficient than the pooled OLS's. In addition, the Fixed-Effects estimator is unbiased as it is likely that the unobserved characteristics correlate with the explanatory variables in the models. Furthermore, we checked whether the Random-Effects specification is more appropriate than the Fixed-Effects one or not. To carry out this task, we used the Hausman (1978) specification test. The result is $\chi^2(7) = 152.39$ and Prob. $> \chi^2 = 0.000$. It rejects the Random-Effects specification. Thus, we argue that the Fixed-Effects regressions provide results that are more appropriate.

The second columns of Tables 4,5,6, and 7 show the results for the Fixed-Effects models. According to Tables 4,5,6, and 7, the Fixed-Effects and OLS regressions have similar results regrading signs and significant levels of main independent variables. Overall, these results support what we obtained from the OLS regressions.

6. Conclusions

This study investigates the relationship between money supply growth rate and economic growth rate, inflation rate, real exchange rate and real interest rate. We used a panel of 217 countries in the world ranging from 1960 to 2020, the OLS, and the Fixed-Effects regressions to empirically test four different models. The results show a negative relationship between money supply growth rate and economic growth rate in the first year but a positive relationship in the second year. We also found evidence for a negative relationship between real interest rate and inflation and between real interest rate and money supply as expected from the literature. In addition, our results support the argument of the quantity theory of money. In the long run, an increase in money supply might lead to an increase in inflation rate.

The results suggest that an increase in money supply may support the economy in the short run but may create inflation in the long run. Policymakers and central banks may not want to overuse an expansionary monetary policy to avoid inflation scenarios.

References

[1] Adetunji. M and Isa.M (2011), "Money Supply, Inflation and Economic Growth in Nigeria" *Asian-African*

Journal of Economics and Econometrics, Vol 11, No 1, pp 221-237.

[2] Chaitip. P et al. (2015), "Money Supply Influencing on Economic Growth-Wide Phenomena of AEC Open Region" *International Conference of Applied Economics*, Vol 24, pp. 108-115.

[3] De Grauwe. P and Polan. M (2005), "Is Inflation Always and Everywhere a Monetary Phenomenon?" *Scand. J. of Economics*, Vol 107(2), pp. 239-259.

[4] Drabicki. J and Takayama.A (1984), "The Stability of a Neoclassical Monetary Growth Model" *The Economic Studies Quarterly*, Vol 35, No 3.

[5] Dwyer, G. P. Jr. and Hafer, R. W. (1999), "Are Money Growth and Inflation Still Related?", Federal Reserve Bank of Atlanta Economic Review 84, 32-43.

[6] Emerson.J (2006), "The Quantity Theory of Money: Evidence from the United States" *Economics Bulletin*, Vol. 5, No. 2 pp. 1-6.

[7] Fischer. S (1983), "Inflation and Growth" *National Bureau of Economic Research*, No 1235.

[8] Friedman, B, and Kuttner, K. (1992), "Money, Income, Prices, and Interest Rates.", *The American Economic Review,* 82: 472-492.

[9] Herwartz, H., and Reimers H.-E. (2006), "Long-Run Links among Money, Prices and Output: Worldwide Evidence", *German Economic Review*, Vol. 7: 65-86.

[10] Jansen, E. (2004), "Modelling Inflation in the Euro Area", ECB Working Paper no. 322, Frankfurt.

[11] Majid, M. Z. A. (2007), "Causal Link between Money, Output and Prices in Malaysia: An Empirical Re-Examination", *Applied Econometrics and International Development*, 7(1).

[12] Miyao, R. (1996) "Does a Cointegrating M2 Demand Relation Really Exist in the United States?", *Journal of Money, Credit, and Banking* 28 (3), 365-380.

[13] Moosa, I. A. (1997) "Testing the long-run neutrality of money in a developing economy: The case of India.", *Journal of Developmental Economics* 53, 139-155.

[14] Moazzami, B. and Gupta, K. L. (1996) "The quantity theory of money and its long-run implications.", *Journal of Macroeconomics* 17, 667-682.

[15] Owoye O, Onafowora AO. (2007) "M2 Targeting , Money Demand and Real GDP Growth in Nigeria: Do Rules Apply?" *Journal of Business and Public Affair*, 1(2): 25-34.

[16] Ramachandra, V. S. (1986) "Direction of Causality between Monetary and Real Variables in India-An Extended Result.", *Indian Economic Journal*, 34: 98-102.

[17] Sims C.A. (1992). "Money Income, Causality", *American Economic Review*, 62: 540 -542.

[18] Whitesell, W. (1997) "Interest Rates and M2 in an Error Correction Macro Model." *Finance and Economics Discussion Series* 59, Washington: Board of Governors of the Federal Reserve System.

[19] Wooldridge, J. M., (2019). Introductory Econometrics: A Modern Approach, 7th Edition, Mason, Ohio: South-Western Cengage Learning.