

The Role of Broadest Money: Tracking Economic Signal

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December 19, 2025

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Appendix B. Supplementary Discussion

We discussed the major findings in Section 5. In summary, Tables 7 and 8 show that the Money-interest rate rule yields results that are precisely consistent with the benchmark study across almost all ranges of monetary aggregates, outperforming the Taylor-type equations. The only exceptions are M3 and M4(-), which (as noted in Section 4) exhibit weak causal relationships with real economic variables. Table 17 and 18 show that across all ranges of monetary aggregates, at least one rule precisely replicates the benchmark results. While no single rule demonstrates consistent explanatory power across all ranges, at least one rule substantiates the usefulness of each specific monetary aggregate.

Other than the results above, we have minor findings. In Table 7, Taylor-type monetary policy rules indicate that an increase in the federal funds rate is driven by an increase in output and a decrease in prices. In contrast, for a non-Taylor-type monetary policy rule (Money-interest rate rule), there is a negative relationship between the money supply and the policy rate. This suggests that a positive monetary policy shock is associated with both an increase in the policy rate and expansion of the money supply. The money demand equations reveal a positive relationship between real money service and output, and a negative relationship between real money and user costs. Equation (18) illustrates how the monetary system transmits an increase in the policy rate to consumers of monetary services through higher user costs. Additionally, a positive relationship between real money services and the user cost can be interpreted as a supply curve for monetary services. In Table 8, which examines the narrow money case, the results differ from those in Table 7. Most of the monetary policy rules display a negative relationship between the policy rate and explanatory variables. However, the money demand and money service equations remain consistent with those in the broad money case.

Tables 9 and 10 present the results when the policy rate is switched to the traditional effective federal funds rate. Under the Taylor-type monetary policy, both broad and narrow money show an increase in the policy rate in response to an increase in output and prices. In the case of the Money-interest rate rule case, we observe different behaviors between broad and narrow money in the monetary policy equation. For broad money, there is a negative relationship between the policy rate and money supply, whereas in the narrow money case, we observe the opposite relationship. In the money demand equations, narrow money shows a stronger positive relationship between real money service and output, alongside a negative relationship between real money service and user costs. For the monetary system equation, the signs of the variables are less consistent, although the narrow Money-interest rate rule reveals a positive relationship between user costs and the explanatory variables. Overall, the use of the effective federal funds rate provides clearer insights into the monetary policy equations, while the shadow federal funds rate offers a more transparent explanation of money demand behavior and the functioning of the monetary system.

Tables 11 and 12 present the results using the Divisia and shadow federal funds rate for the second sub-sample period. No significant differences are observed between broad and narrow money. Under the Taylor-type monetary policy rule, the increase in the policy rate is associated with a decrease in both output and prices. In contrast, the non-Taylor-type monetary policy rule reveals a negative relationship between the money supply and the policy rate. In the money demand equations, user costs play a dominant role. Specifically, user costs have a positive effect on money demand under both the Taylor rule with money and the Money-interest rate rule. However, user costs have a negative effect

under the Taylor rule without money. For the monetary service equation, user costs are positively correlated with both the policy rate and real money services.

Tables 13 and 14 illustrate the equations using Divisia and the effective federal funds rate for the second sub-sample period. Under the Taylor-type monetary policy rules, the increase in the policy rate is driven by an increase in output. In the money demand equation, the impact of the user costs outweighs the effect of the output. Notably, we do not observe the expected negative relationship between the real money and the user costs, nor the positive relationship between the real money and the output. For the monetary system equation, the Taylor-type model demonstrate a positive relationship between user costs, policy rate, and real money service.

Appendix C. Supplementary Estimation

This appendix reports additional estimation in which the federal funds rate and monetary aggregates are included jointly in a single equation. This paper estimates the causal relationship between various monetary aggregates and real variables, between the federal funds rate and real variables based on Bernanke and Blinder (1992), Belongia and Ireland (2015), and Dery and Serletis (2021) in Section 4. We additionally estimate a unified specification that includes both monetary aggregates and the federal funds rate in the same equation. This allows us to directly examine whether the federal funds rate absorbs or diminishes the explanatory power of monetary aggregates.

Specifically, we re-estimate equation (6) by augmenting it with the federal funds rate as an additional control variable:

$$Y_t = \alpha + \sum_{i=1}^6 \lambda_i Y_{t-i} + \sum_{i=1}^6 \beta_i X_{t-i} + \sum_{i=1}^6 \gamma_i P_{t-i} + \sum_{i=6}^6 \eta_i R_{t-i} + e_t,$$

where Y_t represents one of several measures of real economic variables as section 4, while X_t denotes a measure of monetary policy only, such as various monetary aggregates. P_t is the consumer price index (CPI) and now we include the federal funds rate R_t . The terms α , λ_i , β_i , γ_i , and η_i ($i = 1, 2, \dots, 6$) are regression coefficients. We apply six lags of each variable ($i = 1, 2, \dots, 6$) and take the logarithm for all variables. The null hypothesis that the monetary aggregates do not Granger-cause the real variables.

Table C.1 through C.4 report the results. Consistent with the existing U.S. evidence, the inclusion of the federal funds rate does not eliminate the predictive content of monetary aggregates. In particular, the coefficients on Divisia monetary aggregates remain statistically significant and economically meaningful after controlling for the policy rate. These findings indicate that the information content of monetary aggregates is not subsumed by the federal funds rate, even in shorter samples that include the recovery phase from an economic downturn. Therefore, the results reinforce the view that Divisia monetary aggregates contain independent information about real economic activity beyond that captured by the policy rate.

Table C.1: Causality Test Results: Traditional Divisia, Narrow Money (Federal Funds Rate as an Additional Control)

Forecasted variable	Divisia M1	Divisia M2M	Divisia MZM	Divisia M2	Divisia M2 ALL
<i>Sample Period 1992:01 - 2019:12</i>					
Industrial production	0.0000	0.0000	0.0000	0.0000	0.0000
Capacity utilization	0.0000	0.0000	0.0000	0.0001	0.0000
Employment	0.0000	0.0000	0.0000	0.0000	0.0000
Unemployment rate	0.0000	0.0000	0.0000	0.0000	0.0000
Housing starts	0.0002	0.0000	0.0000	0.0000	0.0001
Personal income	0.0254	0.0130	0.0030	0.0120	0.0027
Retail sales	0.0000	0.0000	0.0000	0.0000	0.0000
Consumption	0.0126	0.0007	0.0013	0.0005	0.0009
Durable-goods orders	0.0000	0.0000	0.0000	0.0000	0.0001
<i>Sample Period 2006:07 - 2019:12</i>					
Industrial production	0.0055	0.0003	0.0000	0.0004	0.0.0001
Capacity utilization	0.0056	0.0007	0.0001	0.0010	0.0001
Employment	0.0046	0.0000	0.0000	0.0011	0.0000
Unemployment rate	0.0207	0.0004	0.0001	0.0124	0.0007
Housing starts	0.0068	0.0069	0.0066	0.0127	0.0088
Personal income	0.2309	0.0072	0.0247	0.0133	0.0446
Retail sales	0.0000	0.0000	0.0000	0.0000	0.0000
Consumption	0.1829	0.0139	0.0062	0.0084	0.0154
Durable-goods orders	0.0057	0.0017	0.0043	0.0062	0.0088

Note. Values in the table are marginal significance levels for the hypothesis.

Table C.2: Causality Test Results: Divisia, Broad Money (Federal Funds Rate as an Additional Control)

Forecasted variable	Divisia M3	Divisia M4—	Divisia M4
<i>Sample Period 1992:01 - 2019:12</i>			
Industrial production	0.0002	0.0014	0.0007
Capacity utilization	0.0000	0.0000	0.0000
Employment	0.0001	0.0001	0.0278
Unemployment rate	0.0005	0.0011	0.1416
Housing starts	0.0004	0.0011	0.0078
Personal income	0.0147	0.0078	0.0063
Retail sales	0.0000	0.0000	0.0000
Consumption	0.0001	0.0002	0.0001
Durable-goods orders	0.0002	0.0034	0.0110
<i>Sample Period 2006:07 - 2019:12</i>			
Industrial production	0.0011	0.0030	0.0035
Capacity utilization	0.0009	0.0025	0.0033
Employment	0.0009	0.0012	0.1550
Unemployment rate	0.0123	0.0110	0.6115
Housing starts	0.0593	0.0904	0.0646
Personal income	0.1620	0.1384	0.1424
Retail sales	0.0000	0.0000	0.0000
Consumption	0.0037	0.0067	0.0102
Durable-goods orders	0.0036	0.0171	0.0077

Note. Values in the table are marginal significance levels for the hypothesis.

Table C.3: Causality Test Results: credit-augmented Divisia, Narrow Money (Federal Funds Rate as an Additional Control)

Forecasted variable	C.Divisia M1	C.Divisia M2M	C.Divisia MZM	C.Divisia M2	C.Divisia M2 ALL
<i>Sample Period 2006:07 - 2019:12</i>					
Industrial production	0.0181	0.0756	0.0933	0.0671	0.0973
Capacity utilization	0.0166	0.1556	0.1620	0.1283	0.1417
Employment	0.3404	0.2002	0.0709	0.4864	0.1346
Unemployment rate	0.3402	0.3059	0.1994	0.7240	0.3784
Housing starts	0.0849	0.2468	0.1557	0.2790	0.1897
Personal income	0.4939	0.0314	0.0470	0.0507	0.0692
Retail sales	0.0000	0.0000	0.0000	0.0000	0.0000
Consumption	0.0954	0.0226	0.0075	0.0056	0.0080
Durable-goods orders	0.0635	0.1193	0.1919	0.1880	0.2370

Note. Values in the table are marginal significance levels for the hypothesis.

Table C.4: Causality Test Results: credit-augmented Divisia, Broad Money (Federal Funds Rate as an Additional Control)

Forecasted variable	C.Divisia M3	C.Divisia M4–	C.Divisia M4
<i>Sample Period 2006:07 - 2019:12</i>			
Industrial production	0.0064	0.0173	0.0022
Capacity utilization	0.0071	0.0173	0.0019
Employment	0.0233	0.0316	0.1225
Unemployment rate	0.0852	0.0881	0.4424
Housing starts	0.0766	0.1532	0.0960
Personal income	0.3977	0.3982	0.2574
Retail sales	0.0000	0.0000	0.0000
Consumption	0.0045	0.0078	0.0028
Durable-goods orders	0.0132	0.0362	0.0161

Note. Values in the table are marginal significance levels for the hypothesis.