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TECHNICAL APPENDIX TO
MONEY DOES GRANGER-CAUSE OUTPUT
IN THE BIVARIATE OUTPUT-MONEY RELATION

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This appendix contains robustness checks on all the results in Christiano and Ljungqvist (1987). In that paper we used data for the period February 1948 to December 1985 and the analysis was based on bootstrap simulations, i.e. the disturbances in the experiments were obtained by randomly sampling from the fitted residuals. The robustness checks were done along two dimensions. First, the simulations were executed by drawing disturbances from the Normal distribution with mean zero and variance-covariance matrix equal to its estimated value. Second, all experiments were also done using data for the shorter period January 1959 to December 1985.

The results in Christiano and Ljungqvist (1987) are replicated in this appendix to facilitate a comparison. So there are in total four setups, each one characterized by the length of its dataset and the type of disturbances used in the simulations;

setup [1948-85, fitted],

setup [1948-85, normal],

setup [1959-85, fitted],

setup [1959-85, normal].

The robustness checks are presented in eleven tables below. Each table provides a reference to Christiano and Ljungqvist (1987), which makes it possible to keep the explanatory text at a minimum. The dataset used in the analysis is reproduced at the end of the appendix.

Table B1
 Relating the Empirical F Statistics to their Simulated
 Distributions¹
 (Section 4 in Christiano and Ljungqvist (1987))

| | Data | Setup | | | |
|--------------------------|-------------------------------|--------------------|--------------------|--------------------|--------------------|
| | Generating | | | | |
| | Mechanism | [48-85, fitted] | [48-85, normal] | [59-85, fitted] | [59-85, normal] |
| Simulated level F's > | | | | | |
| the empirical value | DGM _O ^D | 2.56% | 2.28% | 1.86% | 1.98% |
| | DGM _A ^L | 81.54% | 81.86% | 80.24% | 81.62% |
| | DGM _O ^L | 1.08% | 0.82% | 0.70% | 0.52% |
| | DGM _A ^D | 35.22% | 35.18% | 30.26% | 29.02% |
| Simulated difference F's | | | | | |
| < the empirical value | DGM _O ^D | 77.96% | 77.26% | 74.80% | 74.64% |
| | DGM _A ^L | 16.46% | 14.84% | 17.32% | 15.94% |
| | DGM _O ^L | 72.76% | 71.96% | 65.22% | 64.88% |
| | DGM _A ^D | 18.04% | 16.42% | 16.76% | 16.40% |

¹The empirical pair (level F, difference F) is (3.19,1.38) for the estimation period September 1948-December 1985 and (3.29,1.32) for the estimation period August 1959-December 1985.

Table B2

First and Second Moments of Simulated F Statistics
(Table 1 in Christiano and Ljungqvist (1987))

| Data Generating Mechanism | | Setup | | | |
|---------------------------------|--------------------------------|------------------------|------------------------|------------------------|------------------------|
| | | [48-85, fitted] | [48-85, normal] | [59-85, fitted] | [59-85, normal] |
| DGM _O ^D | level F mean | 1.51 | 1.50 | 1.52 | 1.53 |
| | difference F mean | 1.00 | 1.01 | 1.00 | 1.01 |
| | correlation/variance matrix | 0.51 0.31 0.72 0.36 | 0.52 0.31 0.72 0.36 | 0.49 0.29 0.70 0.34 | 0.50 0.30 0.71 0.35 |
| DGM _A ^L | level F mean | 4.64 | 4.61 | 4.72 | 4.71 |
| | difference F mean | 2.53 | 2.50 | 2.40 | 2.39 |
| | correlation/variance matrix | 2.60 1.57 0.81 1.43 | 2.30 1.34 0.79 1.25 | 2.73 1.57 0.82 1.36 | 2.49 1.39 0.81 1.19 |
| DGM _O ^L | level F mean | 1.18 | 1.17 | 1.14 | 1.15 |
| | difference F mean | 1.10 | 1.10 | 1.17 | 1.19 |
| | correlation/variance matrix | 0.41 0.25 0.60 0.41 | 0.40 0.25 0.62 0.39 | 0.39 0.25 0.58 0.47 | 0.39 0.26 0.60 0.47 |
| DGM _A ^D | level F mean | 2.89 | 2.88 | 2.80 | 2.80 |
| | difference F mean | 2.50 | 2.47 | 2.42 | 2.42 |
| | correlation/variance matrix | 1.33 1.24 0.90 1.43 | 1.25 1.14 0.88 1.33 | 1.27 1.17 0.89 1.38 | 1.22 1.11 0.88 1.32 |

Table B3

Frequency of Event (simulated level $F >$ the empirical value,
simulated difference $F <$ the empirical value)¹
(Table 2 in Christiano and Ljungqvist (1987))

| Data Generating Mechanism | Setup | | | |
|---------------------------------|--------------------|--------------------|--------------------|--------------------|
| | [48-85, fitted] | [48-85, normal] | [59-85, fitted] | [59-85, normal] |
| DGM_O^D | 0.46% | 0.38% | 0.22% | 0.20% |
| DGM_A^L | 5.60% | 4.88% | 5.10% | 4.84% |
| DGM_O^L | 0.16% | 0.12% | 0.06% | 0.00% |
| DGM_A^D | 0.08% | 0.32% | 0.10% | 0.22% |

¹The empirical pair (level F, difference F) is (3.19,1.38) for the estimation period September 1948-December 1985 and (3.29,1.32) for the estimation period August 1959-December 1985.

Table B4

Confidence ellipsoid on which the empirical F Statistics lie¹
 Section 5a in Christiano and Ljungqvist (1987))

| Data Generating Mechanism | Setup | | | |
|---------------------------------|--------------------|--------------------|--------------------|--------------------|
| | [48-85, fitted] | [48-85, normal] | [59-85, fitted] | [59-85, normal] |
| DGM _O ^D | 96.14% | 96.42% | 97.18% | 97.28% |
| DGM _A ^L | 39.68% | 42.48% | 37.94% | 41.24% |
| DGM _O ^L | 98.56% | 98.94% | 99.42% | 99.46% |
| DGM _A ^D | 95.24% | 95.16% | 97.20% | 96.70% |

¹The empirical pair (level F, difference F) is (3.19,1.38) for the estimation period September 1948-December 1985 and (3.29,1.32) for the estimation period August 1959-December 1985.

Table B5

Power Comparisons of Level and Difference F
(Table 3 in Christiano and Ljungqvist (1987))

| Prob (Type I error) | Setup | | | | | | | |
|---------------------|--------------------|-------|--------------------|-------|--------------------|-------|--------------------|-------|
| | [48-85, fitted] | | [48-85, normal] | | [59-85, fitted] | | [59-85, normal] | |
| | 5% | 10% | 5% | 10% | 5% | 10% | 5% | 10% |
| Difference Model | | | | | | | | |
| Difference F | | | | | | | | |
| critical value | 2.11 | 1.78 | 2.12 | 1.84 | 2.10 | 1.76 | 2.15 | 1.79 |
| power in % | 58.18 | 69.60 | 56.80 | 67.50 | 55.54 | 68.68 | 54.58 | 67.42 |
| Level F | | | | | | | | |
| critical value | 2.81 | 2.43 | 2.83 | 2.46 | 2.80 | 2.45 | 2.81 | 2.47 |
| power in % | 48.18 | 62.48 | 47.50 | 61.40 | 45.50 | 58.36 | 44.60 | 58.22 |
| Level Model | | | | | | | | |
| Difference F | | | | | | | | |
| critical value | 2.31 | 1.95 | 2.29 | 1.97 | 2.45 | 2.08 | 2.48 | 2.10 |
| power in % | 51.98 | 64.14 | 51.78 | 63.82 | 42.06 | 54.80 | 41.98 | 56.10 |
| Level F | | | | | | | | |
| critical value | 2.42 | 2.04 | 2.33 | 2.02 | 2.32 | 1.98 | 2.32 | 1.99 |
| power in % | 93.66 | 96.98 | 95.36 | 97.74 | 95.08 | 97.50 | 95.28 | 97.52 |

Table B6

Percent Variance in the Log of Output Due to an Orthogonalized
Disturbance in the Log of Money in the Unrestricted Level Model
(Table 4 in Christiano and Ljungqvist (1987))

| Horizon (months) | Setup | Mean | Standard Deviation | Confidence Intervals | |
|---------------------|-----------------|-------|-----------------------|----------------------|---------------|
| | | | | 70 percent | 90 percent |
| 12 | [48-85, fitted] | 18.09 | 7.37 | (10.40-25.91) | (6.97-31.41) |
| | [48-85, normal] | 18.02 | 7.06 | (10.63-25.51) | (7.34-30.42) |
| | [59-85, fitted] | 21.23 | 8.78 | (12.00-30.66) | (7.86-36.45) |
| | [59-85, normal] | 21.18 | 8.56 | (12.32-29.98) | (8.16-36.38) |
| 24 | [48-85, fitted] | 25.00 | 9.76 | (14.66-35.39) | (10.01-42.07) |
| | [48-85, normal] | 24.86 | 9.24 | (15.17-34.82) | (10.41-40.99) |
| | [59-85, fitted] | 27.58 | 10.58 | (16.26-39.00) | (11.07-45.51) |
| | [59-85, normal] | 27.55 | 10.40 | (16.55-38.42) | (11.59-45.61) |
| 36 | [48-85, fitted] | 27.80 | 10.57 | (16.63-39.14) | (11.37-46.08) |
| | [48-85, normal] | 27.64 | 9.99 | (17.06-38.29) | (11.99-44.91) |
| | [59-85, fitted] | 30.30 | 11.15 | (18.42-42.34) | (12.84-49.17) |
| | [59-85, normal] | 30.29 | 10.97 | (18.71-41.69) | (13.44-49.24) |
| 48 | [48-85, fitted] | 29.71 | 11.07 | (17.99-41.55) | (12.25-48.62) |
| | [48-85, normal] | 29.54 | 10.45 | (18.47-40.80) | (13.14-47.44) |
| | [59-85, fitted] | 32.23 | 11.49 | (20.03-44.67) | (14.18-51.55) |
| | [59-85, normal] | 32.22 | 11.31 | (20.14-44.11) | (14.65-51.61) |

Table B7

Percent Variance in the Log First Difference of Output Due to
 an Orthogonalized Disturbance in the Log of Money in the
 Unrestricted First Difference Model
 (Section 7 in Christiano and Ljungqvist (1987))

| Horizon (months) | Setup | Mean | Standard Deviation | Confidence Intervals | |
|---------------------|----------------|------|-----------------------|----------------------|--------------|
| | | | | 70 percent | 90 percent |
| 12 | [48-85,fitted] | 4.88 | 2.70 | (2.17-7.64) | (1.30- 9.92) |
| | [48-85,normal] | 4.83 | 2.62 | (2.20-7.49) | (1.41- 9.70) |
| | [59-85,fitted] | 5.92 | 3.29 | (2.65-9.35) | (1.52-12.03) |
| | [59-85,normal] | 5.90 | 3.28 | (2.63-9.18) | (1.58-12.13) |
| 24 | [48-85,fitted] | 5.15 | 2.86 | (2.27-8.06) | (1.35-10.46) |
| | [48-85,normal] | 5.09 | 2.77 | (2.30-7.91) | (1.44-10.16) |
| | [59-85,fitted] | 6.08 | 3.38 | (2.72-9.58) | (1.55-12.38) |
| | [59-85,normal] | 6.07 | 3.37 | (2.69-9.44) | (1.62-12.50) |
| 36 | [48-85,fitted] | 5.16 | 2.87 | (2.28-8.08) | (1.35-10.49) |
| | [48-85,normal] | 5.10 | 2.78 | (2.30-7.93) | (1.45-10.17) |
| | [59-85,fitted] | 6.08 | 3.38 | (2.72-9.58) | (1.55-12.38) |
| | [59-85,normal] | 6.08 | 3.38 | (2.69-9.45) | (1.62-12.51) |
| 48 | [48-85,fitted] | 5.16 | 2.87 | (2.28-8.08) | (1.35-10.49) |
| | [48-85,normal] | 5.10 | 2.78 | (2.30-7.93) | (1.45-10.18) |
| | [59-85,fitted] | 6.08 | 3.38 | (2.72-9.58) | (1.55-12.38) |
| | [59-85,normal] | 6.08 | 3.38 | (2.69-9.45) | (1.62-12.51) |

Table B8

Percent Variance in the Log of Output Due to an Orthogonalized
Disturbance in the Log of Money in the Unrestricted First
Difference Model
(Table 5 in Christiano and Ljungqvist (1987))

| Horizon (months) | Setup | Mean | Standard Deviation | Confidence Intervals | |
|---------------------|-----------------|-------|-----------------------|----------------------|--------------|
| | | | | 70 percent | 90 percent |
| 12 | [48-85, fitted] | 6.99 | 4.70 | (2.29-11.75) | (0.90-15.90) |
| | [48-85, normal] | 6.93 | 4.63 | (2.26-11.75) | (0.90-15.42) |
| | [59-85, fitted] | 8.55 | 6.25 | (2.32-15.18) | (0.70-20.57) |
| | [59-85, normal] | 8.47 | 6.19 | (2.31-14.61) | (0.71-20.35) |
| 24 | [48-85, fitted] | 13.14 | 8.66 | (4.23-22.28) | (1.49-29.77) |
| | [48-85, normal] | 13.03 | 8.44 | (4.28-21.86) | (1.49-28.99) |
| | [59-85, fitted] | 14.78 | 10.15 | (4.20-25.61) | (1.28-34.30) |
| | [59-85, normal] | 14.67 | 10.08 | (4.21-25.04) | (1.35-33.90) |
| 36 | [48-85, fitted] | 16.05 | 10.49 | (5.18-27.38) | (1.76-36.08) |
| | [48-85, normal] | 15.92 | 10.22 | (5.27-26.80) | (1.73-35.06) |
| | [59-85, fitted] | 17.08 | 11.54 | (4.93-29.45) | (1.51-38.98) |
| | [59-85, normal] | 16.97 | 11.48 | (4.98-28.89) | (1.55-38.54) |
| 48 | [48-85, fitted] | 17.58 | 11.46 | (5.65-29.90) | (1.91-39.32) |
| | [48-85, normal] | 17.46 | 11.16 | (5.80-29.43) | (1.84-38.14) |
| | [59-85, fitted] | 18.21 | 12.23 | (5.30-31.42) | (1.63-41.34) |
| | [59-85, normal] | 18.10 | 12.17 | (5.37-30.82) | (1.66-41.13) |

Table B9

t-Statistic on the Coefficient on Time in the Regression of the
Growth of the Variable on Six Lags of its Growth Rate, a Constant
and Time

(Footnote 10 in Christiano and Ljungqvist (1987))

| Variable | Setup | | | |
|-----------------------|--------------------|--------------------|--------------------|--------------------|
| | [48-85, fitted] | [48-85, normal] | [59-85, fitted] | [59-85, normal] |
| LIP | | | | |
| empirical t | -0.496 | -0.496 | -0.776 | -0.776 |
| mean of simulated t's | -0.413 | -0.444 | -0.762 | -0.764 |
| simulated t's > | | | | |
| the empirical value | 55.28% | 53.66% | 52.08% | 50.10% |
| LM1 | | | | |
| empirical t | 4.89 | 4.89 | 4.61 | 4.61 |
| mean of simulated t's | 4.97 | 4.96 | 4.49 | 4.48 |
| simulated t's > | | | | |
| the empirical value | 54.74% | 53.84% | 45.14% | 44.64% |

Table B10

Frequency of Event (Simulated Likelihood Ratio Statistics > the
Empirical Value)¹
(Appendix A in Christiano and Ljungqvist (1987))

| Roots ² | Setup | | | |
|----------------------------------|--------------------|--------------------|--------------------|--------------------|
| | [48-85, fitted] | [48-85, normal] | [59-85, fitted] | [59-85, normal] |
| .991 & 1.003 (.984 & 1.003) | 71.46% | 71.18% | 70.22% | 69.32% |
| .991 & 1.000 (.984 & 1.000) | 0.00% | 0.06% | 1.06% | 0.76% |
| 1.000 & 1.003 (1.000 & 1.003) | 30.64% | 30.92% | 17.56% | 15.98% |

¹ The empirical likelihood ratio statistic is 39.24 for the estimation period September 1948-December 1985 and 36.23 for the estimation period August 1959-December 1985.

² The roots refer to the estimation period September 1948-December 1985 (August 1959-December 1985).

Table B11

Frequency of Rejecting a False Null Hypothesis (two unit roots)
 (Table A1 in Christiano and Ljungqvist (1987))

| Roots ¹ | Significance level | Setup | | | |
|--------------------|-----------------------|--------------------|--------------------|--------------------|--------------------|
| | | [48-85, fitted] | [48-85, normal] | [59-85, fitted] | [59-85, normal] |
| .991 & 1.003 | 5% | 99.94% | 99.98% | 99.88% | 99.96% |
| (.984 & 1.003) | 10% | 99.96% | 100.00% | 99.98% | 100.00% |
| .991 & 1.000 | 5% | 22.58% | 22.62% | 47.16% | 49.62% |
| (.984 & 1.000) | 10% | 34.22% | 34.82% | 63.00% | 64.32% |
| 1.000 & 1.003 | 5% | 98.10% | 98.40% | 89.14% | 89.82% |
| (1.000 & 1.003) | 10% | 99.06% | 99.36% | 94.60% | 94.40% |

¹ The roots refer to the estimation period September 1948-December 1985 (August 1959-December 1985).

The results in Christiano and Ljungqvist (1987) are virtually unchanged when the simulations are executed by drawing normally distributed errors instead of using the fitted residuals. The results obtained from the shorter estimation period are also very similar except for the two last tables describing the experiments with the likelihood ratio statistic. However, our conclusion is still valid, i.e. in a likelihood ratio sense the explosive root accounts for most of the difference between the level model and the difference model. But the importance of the second largest root has increased in the shorter estimation period. This is hardly surprising since that root is farther away from unity in the shorter estimation period compared to the longer estimation period, .9840 versus .9912, and the explosive root is closer to unity, 1.0027 versus 1.0033.

Industrial production, IP ($LIP \equiv \log(IP)$)
MONTHLY FROM 1948,1 TO 1985,12

| | | | | |
|-------|-----------|-----------|-----------|-----------|
| 48- 1 | 30.000000 | 30.100000 | 29.700000 | 29.800000 |
| 48- 5 | 30.300000 | 30.700000 | 30.700000 | 30.600000 |
| 48- 9 | 30.400000 | 30.600000 | 30.200000 | 29.900000 |
| 49- 1 | 29.600000 | 29.300000 | 28.800000 | 28.600000 |
| 49- 5 | 28.200000 | 28.200000 | 28.100000 | 28.400000 |
| 49- 9 | 28.700000 | 27.600000 | 28.300000 | 28.800000 |
| 50- 1 | 29.300000 | 29.500000 | 30.400000 | 31.400000 |
| 50- 5 | 32.200000 | 33.100000 | 34.200000 | 35.300000 |
| 50- 9 | 35.000000 | 35.300000 | 35.200000 | 35.800000 |
| 51- 1 | 35.900000 | 36.200000 | 36.300000 | 36.400000 |
| 51- 5 | 36.300000 | 36.100000 | 35.500000 | 35.200000 |
| 51- 9 | 35.400000 | 35.400000 | 35.700000 | 35.900000 |
| 52- 1 | 36.300000 | 36.500000 | 36.600000 | 36.300000 |
| 52- 5 | 35.900000 | 35.600000 | 35.000000 | 37.300000 |
| 52- 9 | 38.600000 | 39.000000 | 39.800000 | 40.000000 |
| 53- 1 | 40.200000 | 40.400000 | 40.700000 | 40.900000 |
| 53- 5 | 41.100000 | 40.900000 | 41.500000 | 41.200000 |
| 53- 9 | 40.400000 | 40.000000 | 39.100000 | 38.100000 |
| 54- 1 | 37.900000 | 38.000000 | 37.700000 | 37.500000 |
| 54- 5 | 37.700000 | 37.900000 | 37.900000 | 37.900000 |
| 54- 9 | 37.900000 | 38.400000 | 39.000000 | 39.500000 |
| 55- 1 | 40.400000 | 40.900000 | 41.900000 | 42.400000 |
| 55- 5 | 43.000000 | 43.100000 | 43.400000 | 43.400000 |
| 55- 9 | 43.700000 | 44.400000 | 44.500000 | 44.700000 |
| 56- 1 | 44.900000 | 44.600000 | 44.600000 | 44.900000 |
| 56- 5 | 44.500000 | 44.100000 | 42.800000 | 44.500000 |
| 56- 9 | 45.500000 | 45.900000 | 45.500000 | 46.200000 |
| 57- 1 | 46.000000 | 46.500000 | 46.400000 | 45.800000 |
| 57- 5 | 45.600000 | 45.700000 | 46.000000 | 46.000000 |
| 57- 9 | 45.600000 | 44.900000 | 43.900000 | 43.000000 |
| 58- 1 | 42.200000 | 41.300000 | 40.800000 | 40.200000 |
| 58- 5 | 40.600000 | 41.600000 | 42.200000 | 43.100000 |
| 58- 9 | 43.500000 | 44.000000 | 45.300000 | 45.300000 |
| 59- 1 | 46.000000 | 46.900000 | 47.600000 | 48.600000 |
| 59- 5 | 49.300000 | 49.400000 | 48.200000 | 46.600000 |
| 59- 9 | 46.500000 | 46.200000 | 46.500000 | 49.300000 |
| 60- 1 | 50.600000 | 50.200000 | 49.700000 | 49.300000 |
| 60- 5 | 49.300000 | 48.700000 | 48.500000 | 48.400000 |
| 60- 9 | 47.900000 | 47.900000 | 47.200000 | 46.300000 |
| 61- 1 | 46.400000 | 46.300000 | 46.600000 | 47.500000 |
| 61- 5 | 48.300000 | 48.900000 | 49.500000 | 50.000000 |
| 61- 9 | 49.900000 | 50.900000 | 51.700000 | 52.100000 |
| 62- 1 | 51.700000 | 52.500000 | 52.800000 | 52.900000 |

| | | | | |
|-------|------------|------------|------------|------------|
| 62- 5 | 52.800000 | 52.700000 | 53.200000 | 53.300000 |
| 62- 9 | 53.600000 | 53.700000 | 53.900000 | 53.900000 |
| 63- 1 | 54.300000 | 54.900000 | 55.300000 | 55.800000 |
| 63- 5 | 56.400000 | 56.600000 | 56.400000 | 56.500000 |
| 63- 9 | 57.100000 | 57.500000 | 57.700000 | 57.600000 |
| 64- 1 | 58.100000 | 58.500000 | 58.500000 | 59.500000 |
| 64- 5 | 59.800000 | 60.000000 | 60.400000 | 60.800000 |
| 64- 9 | 61.000000 | 60.200000 | 62.000000 | 62.700000 |
| 65- 1 | 63.400000 | 63.800000 | 64.700000 | 64.900000 |
| 65- 5 | 65.500000 | 66.000000 | 66.600000 | 66.900000 |
| 65- 9 | 67.000000 | 67.700000 | 68.000000 | 68.800000 |
| 66- 1 | 69.500000 | 70.000000 | 70.900000 | 71.000000 |
| 66- 5 | 71.700000 | 72.000000 | 72.400000 | 72.500000 |
| 66- 9 | 73.200000 | 73.700000 | 73.200000 | 73.300000 |
| 67- 1 | 73.700000 | 72.800000 | 72.400000 | 73.100000 |
| 67- 5 | 72.500000 | 72.500000 | 72.300000 | 73.700000 |
| 67- 9 | 73.600000 | 74.200000 | 75.200000 | 76.000000 |
| 68- 1 | 76.000000 | 76.200000 | 76.500000 | 76.600000 |
| 68- 5 | 77.400000 | 77.700000 | 77.600000 | 77.800000 |
| 68- 9 | 78.100000 | 78.300000 | 79.300000 | 79.500000 |
| 69- 1 | 80.000000 | 80.500000 | 81.200000 | 80.900000 |
| 69- 5 | 80.600000 | 81.300000 | 81.800000 | 82.000000 |
| 69- 9 | 81.900000 | 82.000000 | 81.200000 | 81.000000 |
| 70- 1 | 79.500000 | 79.400000 | 79.300000 | 79.100000 |
| 70- 5 | 79.000000 | 78.800000 | 79.000000 | 78.800000 |
| 70- 9 | 78.300000 | 76.700000 | 76.200000 | 78.000000 |
| 71- 1 | 78.600000 | 78.400000 | 78.400000 | 78.800000 |
| 71- 5 | 79.200000 | 79.500000 | 79.300000 | 78.800000 |
| 71- 9 | 80.100000 | 80.700000 | 81.100000 | 82.000000 |
| 72- 1 | 83.800000 | 84.400000 | 85.100000 | 86.500000 |
| 72- 5 | 86.300000 | 86.500000 | 86.400000 | 87.600000 |
| 72- 9 | 88.500000 | 89.800000 | 90.900000 | 91.800000 |
| 73- 1 | 91.800000 | 93.100000 | 93.100000 | 93.400000 |
| 73- 5 | 93.800000 | 94.500000 | 95.100000 | 95.100000 |
| 73- 9 | 95.800000 | 96.100000 | 96.200000 | 94.700000 |
| 74- 1 | 93.300000 | 93.000000 | 93.400000 | 93.200000 |
| 74- 5 | 94.300000 | 94.600000 | 94.200000 | 93.900000 |
| 74- 9 | 94.200000 | 93.600000 | 90.900000 | 87.100000 |
| 75- 1 | 84.800000 | 83.500000 | 82.000000 | 82.700000 |
| 75- 5 | 82.500000 | 83.600000 | 84.100000 | 85.600000 |
| 75- 9 | 86.400000 | 86.900000 | 87.700000 | 88.400000 |
| 76- 1 | 89.300000 | 90.900000 | 90.700000 | 91.100000 |
| 76- 5 | 92.100000 | 92.200000 | 92.700000 | 93.200000 |
| 76- 9 | 93.500000 | 93.900000 | 95.400000 | 96.200000 |
| 77- 1 | 96.500000 | 97.200000 | 98.000000 | 99.000000 |
| 77- 5 | 99.600000 | 100.400000 | 100.700000 | 101.000000 |
| 77- 9 | 101.400000 | 101.800000 | 102.100000 | 102.100000 |
| 78- 1 | 101.600000 | 101.600000 | 103.000000 | 105.500000 |
| 78- 5 | 105.800000 | 106.900000 | 107.500000 | 107.700000 |
| 78- 9 | 108.300000 | 109.200000 | 109.900000 | 110.800000 |
| 79- 1 | 110.300000 | 110.900000 | 111.200000 | 109.900000 |
| 79- 5 | 110.900000 | 110.900000 | 110.500000 | 110.200000 |

| | | | | | |
|-----|---|------------|------------|------------|------------|
| 79- | 9 | 110.400000 | 111.000000 | 111.000000 | 111.000000 |
| 80- | 1 | 111.300000 | 111.400000 | 111.400000 | 109.100000 |
| 80- | 5 | 106.200000 | 105.000000 | 104.800000 | 106.300000 |
| 80- | 9 | 107.700000 | 108.500000 | 110.700000 | 111.000000 |
| 81- | 1 | 111.000000 | 111.200000 | 111.600000 | 110.600000 |
| 81- | 5 | 111.200000 | 112.000000 | 113.400000 | 112.800000 |
| 81- | 9 | 111.500000 | 110.400000 | 109.000000 | 107.400000 |
| 82- | 1 | 105.400000 | 107.000000 | 105.800000 | 104.500000 |
| 82- | 5 | 103.600000 | 103.000000 | 102.500000 | 102.000000 |
| 82- | 9 | 101.300000 | 100.500000 | 100.600000 | 100.500000 |
| 83- | 1 | 102.500000 | 103.300000 | 104.200000 | 105.600000 |
| 83- | 5 | 106.900000 | 107.800000 | 109.800000 | 111.600000 |
| 83- | 9 | 113.700000 | 114.400000 | 114.800000 | 115.500000 |
| 84- | 1 | 118.400000 | 119.300000 | 120.100000 | 120.700000 |
| 84- | 5 | 121.300000 | 122.300000 | 123.200000 | 123.500000 |
| 84- | 9 | 123.300000 | 122.700000 | 123.400000 | 123.300000 |
| 85- | 1 | 123.600000 | 123.700000 | 124.000000 | 124.100000 |
| 85- | 5 | 124.100000 | 124.300000 | 124.100000 | 125.200000 |
| 85- | 9 | 125.100000 | 124.400000 | 125.100000 | 126.000000 |

MONE (LM1 \equiv log(MONE))
 MONTHLY DATA FROM 48 1 TO 85 12
 MONEY SUPPLY: M1

| | | | | |
|-------|------------|------------|------------|------------|
| 48- 1 | 111.486076 | 111.289451 | 110.699578 | 110.404641 |
| 48- 5 | 110.208017 | 110.109705 | 110.306329 | 110.404641 |
| 48- 9 | 110.306329 | 110.208017 | 109.913080 | 109.618143 |
| 49- 1 | 109.323207 | 109.323207 | 109.323207 | 109.421519 |
| 49- 5 | 109.618143 | 109.421519 | 109.323207 | 109.126582 |
| 49- 9 | 109.028270 | 109.028270 | 109.126582 | 109.323207 |
| 50- 1 | 109.618143 | 110.208017 | 110.601266 | 111.289451 |
| 50- 5 | 111.781013 | 112.174262 | 112.665823 | 113.059072 |
| 50- 9 | 113.255696 | 113.747257 | 113.943882 | 114.238819 |
| 51- 1 | 114.730380 | 115.123629 | 115.615190 | 115.811814 |
| 51- 5 | 116.205063 | 116.598312 | 117.089873 | 117.581435 |
| 51- 9 | 118.367932 | 118.957806 | 119.940928 | 120.629114 |
| 52- 1 | 121.022363 | 121.513924 | 121.710549 | 122.005485 |
| 52- 5 | 122.398734 | 122.890295 | 123.185232 | 123.578481 |
| 52- 9 | 124.266667 | 124.561603 | 124.954852 | 125.249789 |
| 53- 1 | 125.151477 | 125.249789 | 125.839662 | 126.134599 |
| 53- 5 | 126.331224 | 126.331224 | 126.429536 | 126.527848 |
| 53- 9 | 126.429536 | 126.527848 | 126.527848 | 126.626160 |
| 54- 1 | 126.822785 | 126.921097 | 127.019409 | 126.429536 |
| 54- 5 | 127.510970 | 127.707595 | 128.100844 | 128.494093 |
| 54- 9 | 128.690717 | 129.280591 | 129.870464 | 130.067089 |
| 55- 1 | 130.755274 | 131.640084 | 131.345148 | 131.640084 |
| 55- 5 | 132.328270 | 132.131646 | 132.524895 | 132.524895 |
| 55- 9 | 132.721519 | 132.918143 | 132.623207 | 132.918143 |
| 56- 1 | 133.213080 | 133.213080 | 133.409705 | 133.704641 |
| 56- 5 | 133.508017 | 133.704641 | 133.704641 | 133.409705 |
| 56- 9 | 133.901266 | 133.999578 | 134.294515 | 134.589451 |
| 57- 1 | 134.589451 | 134.491139 | 134.589451 | 134.589451 |
| 57- 5 | 134.687764 | 134.589451 | 134.687764 | 134.786076 |
| 57- 9 | 134.491139 | 134.196203 | 133.999578 | 133.606329 |
| 58- 1 | 133.213080 | 133.901266 | 134.196203 | 134.687764 |
| 58- 5 | 135.179325 | 136.064135 | 136.064135 | 136.752321 |
| 58- 9 | 137.145570 | 137.735443 | 138.521941 | 138.718565 |
| 59- 1 | 139.800000 | 140.300000 | 140.700000 | 140.600000 |
| 59- 5 | 141.600000 | 142.100000 | 142.700000 | 142.800000 |
| 59- 9 | 142.000000 | 141.400000 | 141.400000 | 141.000000 |
| 60- 1 | 141.000000 | 140.900000 | 140.800000 | 140.600000 |
| 60- 5 | 140.700000 | 140.700000 | 141.300000 | 142.400000 |
| 60- 9 | 142.300000 | 142.000000 | 141.900000 | 141.800000 |
| 61- 1 | 142.200000 | 142.800000 | 143.100000 | 143.300000 |
| 61- 5 | 143.900000 | 144.100000 | 144.200000 | 144.800000 |
| 61- 9 | 145.100000 | 145.500000 | 146.100000 | 146.500000 |
| 62- 1 | 146.600000 | 147.000000 | 147.300000 | 147.800000 |
| 62- 5 | 148.200000 | 147.900000 | 147.900000 | 147.900000 |
| 62- 9 | 147.700000 | 148.100000 | 148.700000 | 149.200000 |
| 63- 1 | 149.700000 | 150.300000 | 150.600000 | 151.200000 |

| | | | | |
|-------|------------|------------|------------|------------|
| 63- 5 | 151.800000 | 151.900000 | 152.800000 | 153.200000 |
| 63- 9 | 153.400000 | 154.100000 | 155.100000 | 154.700000 |
| 64- 1 | 155.300000 | 155.800000 | 156.000000 | 156.300000 |
| 64- 5 | 156.900000 | 157.200000 | 158.400000 | 159.400000 |
| 64- 9 | 160.300000 | 160.900000 | 161.500000 | 161.800000 |
| 65- 1 | 162.300000 | 162.500000 | 163.100000 | 163.700000 |
| 65- 5 | 163.300000 | 163.900000 | 164.700000 | 165.300000 |
| 65- 9 | 166.500000 | 167.700000 | 168.400000 | 169.500000 |
| 66- 1 | 170.800000 | 171.300000 | 172.200000 | 173.500000 |
| 66- 5 | 173.000000 | 173.300000 | 172.100000 | 172.500000 |
| 66- 9 | 173.700000 | 172.900000 | 173.100000 | 173.700000 |
| 67- 1 | 173.600000 | 174.800000 | 176.600000 | 176.000000 |
| 67- 5 | 177.500000 | 178.900000 | 180.000000 | 181.600000 |
| 67- 9 | 182.500000 | 183.600000 | 184.200000 | 185.100000 |
| 68- 1 | 186.000000 | 186.600000 | 187.400000 | 188.600000 |
| 68- 5 | 190.000000 | 191.400000 | 192.500000 | 193.800000 |
| 68- 9 | 194.800000 | 196.100000 | 198.000000 | 199.400000 |
| 69- 1 | 200.700000 | 201.400000 | 202.100000 | 202.700000 |
| 69- 5 | 202.800000 | 203.400000 | 203.800000 | 203.700000 |
| 69- 9 | 204.200000 | 205.000000 | 205.600000 | 205.800000 |
| 70- 1 | 208.000000 | 206.400000 | 207.900000 | 209.300000 |
| 70- 5 | 209.600000 | 209.900000 | 210.300000 | 212.300000 |
| 70- 9 | 213.900000 | 214.600000 | 215.400000 | 216.500000 |
| 71- 1 | 217.800000 | 219.300000 | 221.200000 | 222.800000 |
| 71- 5 | 224.700000 | 226.200000 | 227.300000 | 228.200000 |
| 71- 9 | 228.900000 | 229.400000 | 229.900000 | 230.700000 |
| 72- 1 | 232.800000 | 234.600000 | 236.800000 | 238.200000 |
| 72- 5 | 238.600000 | 239.400000 | 241.300000 | 243.600000 |
| 72- 9 | 245.700000 | 247.600000 | 248.900000 | 251.900000 |
| 73- 1 | 254.400000 | 254.800000 | 254.600000 | 255.400000 |
| 73- 5 | 257.800000 | 259.900000 | 260.500000 | 260.800000 |
| 73- 9 | 260.900000 | 261.900000 | 263.900000 | 265.800000 |
| 74- 1 | 267.100000 | 268.300000 | 269.800000 | 269.900000 |
| 74- 5 | 270.700000 | 271.900000 | 272.400000 | 273.200000 |
| 74- 9 | 274.100000 | 275.200000 | 276.800000 | 277.500000 |
| 75- 1 | 277.300000 | 278.100000 | 280.100000 | 279.700000 |
| 75- 5 | 282.500000 | 286.300000 | 286.800000 | 288.300000 |
| 75- 9 | 289.100000 | 288.700000 | 291.400000 | 291.100000 |
| 76- 1 | 292.400000 | 294.600000 | 295.900000 | 297.900000 |
| 76- 5 | 299.800000 | 299.700000 | 300.800000 | 302.800000 |
| 76- 9 | 303.400000 | 306.900000 | 307.500000 | 310.300000 |
| 77- 1 | 313.200000 | 315.500000 | 317.400000 | 320.000000 |
| 77- 5 | 320.500000 | 322.200000 | 324.600000 | 326.200000 |
| 77- 9 | 328.400000 | 331.400000 | 333.100000 | 335.300000 |
| 78- 1 | 338.800000 | 339.300000 | 340.800000 | 344.300000 |
| 78- 5 | 347.600000 | 350.000000 | 352.000000 | 353.600000 |
| 78- 9 | 357.600000 | 358.600000 | 360.400000 | 363.000000 |
| 79- 1 | 363.100000 | 364.500000 | 367.300000 | 372.100000 |
| 79- 5 | 372.400000 | 377.400000 | 381.200000 | 383.800000 |
| 79- 9 | 386.200000 | 387.000000 | 387.500000 | 389.000000 |
| 80- 1 | 391.400000 | 395.000000 | 394.500000 | 388.100000 |
| 80- 5 | 388.400000 | 393.800000 | 398.300000 | 406.400000 |

| | | | | | |
|-----|---|------------|------------|------------|------------|
| 80- | 9 | 412.100000 | 416.700000 | 419.000000 | 414.800000 |
| 81- | 1 | 417.100000 | 419.500000 | 423.900000 | 431.100000 |
| 81- | 5 | 428.700000 | 428.400000 | 430.600000 | 433.500000 |
| 81- | 9 | 433.900000 | 434.800000 | 438.100000 | 441.800000 |
| 82- | 1 | 449.400000 | 447.000000 | 447.300000 | 450.900000 |
| 82- | 5 | 451.000000 | 451.600000 | 452.400000 | 457.700000 |
| 82- | 9 | 463.600000 | 471.200000 | 477.700000 | 480.800000 |
| 83- | 1 | 484.400000 | 490.100000 | 495.800000 | 499.200000 |
| 83- | 5 | 505.800000 | 509.900000 | 514.800000 | 518.400000 |
| 83- | 9 | 520.500000 | 524.000000 | 526.200000 | 528.000000 |
| 84- | 1 | 530.000000 | 534.200000 | 537.300000 | 539.200000 |
| 84- | 5 | 542.500000 | 547.300000 | 546.900000 | 548.900000 |
| 84- | 9 | 551.500000 | 548.300000 | 553.800000 | 558.500000 |
| 85- | 1 | 562.700000 | 569.400000 | 572.100000 | 574.900000 |
| 85- | 5 | 581.600000 | 591.200000 | 595.800000 | 605.900000 |
| 85- | 9 | 611.900000 | 611.100000 | 617.900000 | 624.700000 |

Reference

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