

The Changed Nature of Monetary Policy

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Abstract: In 1968 Andersen and Jordan published a strong regression result relating money growth to the economy, specifically nominal GDP. Graph 1 shows an even stronger relation of money and real GDP. But, in 2015, Lucas and Nicolini noted that, "Long standing empirical relations connecting monetary aggregates like M1, M2, and the monetary base to movements in prices and interest rates began to deteriorate in the 1980s and have not been restored since". In 2017, Xi Wang of Washington University found that, "It appears that the period 1955-80 is the only period during which the QTM (Quantity Theory of Money) fits data well — It starts to breakdown when we go beyond this period". Our regressions of their time periods: 1985-2015 and 1985-2017 plus 1985-2020 agree with the breakdown as the GDP-M relation turned from strongly positive to negative. We think we have an explanation as to why the GDP-M relation changed. Graph 2 shows that Fed behavior during recessions changed radically in the last three (2000-2001, 2008-2009, 2020) compared to those of 1948-1949 to 1981-1982 and also 1937-1938. Prior to 1981-1982 recessions were Fed induced, presumably to combat inflation. In the last three recessions the Fed made rescue attempts to lessen the effects of the dot.com crash, the CDO-Lehman "Great Recession". financial crash, and the Covid-19 Pandemic. The 1990-1991 recession behavior was a transition. The Fed has always been concerned with controlling interest rates. Three weeks after the Lehman bankruptcy on September 15, 2008 at the heart of the Great Recession, the Fed began paying interest on bank reserves (IOR) as a new way to control short term rates, radically changing the nature of monetary policy. Then came ZIRP (zero interest rate policy), difficulties at the ZB (zero interest rate bound), and QE (Quantitative Easing). Japan has been at the ZB and so has the U.S. in 1938-1940, 2010-2016, and 2020. What are the consequences?

Key words: monetary policy; banking in economic stabilization; interest rate policy **JEL code:** E

1. Introduction

Paul Volcker's defeat of the Great Inflation in 1980-1982 was a highlight of monetary policy (Meltzer, 2014, pp. 1019-1117) for a full description. A short version is that the only way to get rid of an entrenched inflation appears to be a two-stage process. The main stage is to cause a recession with its increased unemployment rate (reaching 10.8% in late 1982) which lowers demand and inflation. The question is how to cause a recession. The answer comes from Graph 1 which comes from the St. Louis Federal Reserve Bank's FRED data base. The Fed

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causes money growth to drop which causes GDP to drop. If Volcker had known of another way to get rid of Inflation without the cost of high unemployment, something that his predecessors Martin, Burns, and Miller along with economists such as Tobin, Ackley, and Heller had hoped for, presumably he would have used it. A brief history of the Fed and inflation 1936-1982. Even though the U.S. was still in the Great Depression in 1936 there was mild inflation of 4% along with huge excess reserves in the banking system which if lent out could have, in theory, led to more inflation. So, the Fed contracted the money stock by doubling bank reserve requirements and other operations. The sharp contraction in the money stock led to the severe recession of 1937-1938 and inflation disappeared. Another effect of this event was that short-term rates (3 mo. T-Bill rate) went to the zero bound ZB. Note: there was no Federal Funds rate (iFF) at the time because there was no need for interbank borrowing because of the huge excess reserve surplus. This ZB problem is deferred to a later section. All of the post WWII recessions were preceded or accompanied by drops in the money growth rate as seen in Graph 1 (FRED money data begin in 1959, 1929-1958 available from Rasche, Monetary Aggregates, St Louis Fed website). The 1948-1949 recession got rid of the vestiges of the WWII inflation, 1953-1954 the vestiges of the Korean War inflation, and 1957-1958 the inflation of 1956-1957. The minor recession of 1960-1961 reduced year over year (YOY) inflation from 1.44% to 1.01%. The mini-recession of 1966-1967 reduced inflation from 3.3% to 2.7%. The very mild recession of 1969-1970 reduced inflation from 5.5 to 5.1%. The severe recession of 1974-1975 was complicated by the OAPEC oil boycott and oil price rise of 1973-1974 with inflation peaking at 10.9%. But by mid-1976 inflation was down to 5.5%. Finally, the double recession of 1980 and 1981-1982 lowered inflation from the Iran oil crisis peak of 10.2% to 3.6% in 1983. In summary, the Fed was more or less continuously fighting inflation every 3 to 5 years from WWII to the Volcker solution in 1981-1982. The procedure to oppose inflation was to slow money growth to cause a recession which then would slow inflation. The problem with the anti-inflation efforts of 1966 and 1969 was that the Fed quit too early. And the Nixon price and wage control program of August 15, 1971 did not work either.

2. A Change in Fed Recession Responses

Fed induced recessions (recessions of 1937-1938 and 1948 to 1981 were amused by the reducing money growth and then GDP. Recession correlations and regression coefficients are strongly positive. Table 2 shows totally different behavior for the last three recessions of 2000-2001, 2008-2009, and 2020. Instead of going down with GDP, money went up in the opposite direction. In these recessions correlations and regression coefficients are strongly negative. The question is: what caused the Fed to change its behavior? The post 1984 recessions were caused by exogenous or quasi-exogenous events rather than a fear of inflation which governed pre 1984 behavior. The current 2020 recession is easy to analyze. It was caused by the Covid 19 Virus, a truly exogenous event. The 1990-1991 was caused by the 3rd oil crisis and the Iraq-Kuwait 1st Gulf War, another exogenous event. The causes of the 2001 and 2009 recessions are a bit more complicated. The 2001 recession is a bit strange. It is the weakest of all the recessions covered in this paper and has an unusual pattern. Here are the real GDP figures from NIPABEA tables for the last half of 2000 and all of 2001: 13178, 13260, 13223, 13300, 13245, 13281. The % changes are: 0.62, -0.28, 0.58, -42, 0.27. Two small declines separated by a larger gain. Note: all other recessions have two successive declines, except 19601 which has the pattern 2.25, 0.54, 0.49, 1.28, 0.67. The quasi-exogenous cause was the dot.com stock market crash of March 2000 to October 2002 with the S&P500 down 45% and Nasdaq down 78% comparable to the January 1973-December, 1974 crash of 52% adjusted for

inflation. The economy turned down in 4Q2000 and the money growth rescue operation started a quarter later. To understand what happened in the Great Recession of 2009 we need some statistics and history. In 4Q2007 the economy grew 0.61%. In 1Q2008 the economy fell 0.57% featuring the collapse of Bear Stearns. But in 2Q08 the economy grew 0.52%. The real recession started on September 6 when the Treasury had to take over Fannie and Freddie (Federal National Mortgage and Federal Home Loan Mortgage) followed by the bankruptcy of Lehman Brothers on September 15. Money market funds held Lehman commercial paper so runs began on money market funds and the FDIC bailed out the funds with the Temporary Liquidity Guarantee Program on the 19th. Also, on the 15th Merrill-Lynch was taken over by Bank of America. On the 16th came the \$85 billion bailout of AIG, On the 22nd, Goldman Sachs and Morgan Stanley converted from being investment banks to commercial banks to gain protection from the Fed and FDIC. On the 25th Washington Mutual (WAMU) became the 5th largest bank failure ever and was bought by J. P. Morgan. On October 3, Wachovia Bank, the fourth largest in the country at the time had to be rescued by Wells Fargo. There was more but it is clear this was a panic rivalling the bank collapses in the Great Depression. On October 3, a rescue operation known as TARP (Troubled Asset Relief Program) became law as part of the Emergency Economic Stabilization Act, a \$400+ billion bailout. On October 6 the Fed began paying interest to banks on their reserves which is discussed in detail in a later section. The net result is that the Fed contributed to the rescue effort with M2 growth rates of 13.59 and 13.42% (annual rate) for 4Q2008 and 1Q2009. When the Fed extended its operations to purchasing long term Treasuries, Agency securities, and eventually mortgage backed securities (WSHOMCB on FRED) the operations became known as Quantitative Easing (OE). Summary The relation between GDP and money (M1 or M2) became negative in the last three recessions as the Fed engaged in rescue operations of exogenous events. Prior to 1983 GDP and money were positively related. Tables 1 and 2 in the Appendix contains GDP-Money regressions of pre and post 1983 recessions. All the pre-1983 regressions are positive and significant and the last three negative and significant. In the 1990-1991 Kuwait incident the Fed basically did nothing and the result is insignificant. The regressions of Tables 1 and 2 cover only the recession portion of the business cycle. We also want to know how GDP and M relate during the non-recession portion and over the whole cycle. We can define the whole cycle as a recovery sub-period then a recession, then the next cycle as the next recovery period plus the next recession and so on. Using Robert Rasche's money data (dotted line on Table 3a) from FRED: Monetary Aggregates, we have extended the analysis back to the 1953-1954 recession cycle. Table 3 has 3 sections. The top section contains regressions of growth prior to the designated recession, or the nonrecession sub-period of the cycle. The second section has regressions of the recessions, a repeat of Table 1 with the addition of the recession of 1953-1954 and the mini-recession of 1966-1967. The mini-recession seems to have disappeared from modern analysis but clearly appears as a business cycle in Graph 3a. It is discussed in Meltzer (pp. 493, 525). It is fairly ll known that the BEA has had problems with seasonal adjustments which is why it was more noticeable in older data. The third section is regressions of the whole cycle, the non-recession period and the recession period together. All of the pre-1983 recessions are strongly related to money with a significant positive sign except the mini-recession which is positive but only at the 8.4% level. The last 3 recessions featuring rescue operations are significantly negative. The omitted 1990-1991 Kuwait recession had an adjR2 of -0.13, with p-value 0.3949, insignificant. Now let us look at the GDP-M regressions during non-recession or growth or recovery periods in the top section of Table 3. The striking feature is that 5 of the 7 pre-1983 events are insignificant. The other two are positive. Of the three rescue cycles one non-recessionary period is positive and the other two were negative. The negativity of the runup to the 2020 recession is a bit weak perhaps because the 2010 to 2Q16 period was essentially at the ZIRB (zero interest

rate boundary). At the ZIRB money (cash, demand deposits, passbook saving, MMDAs, money market funds) is virtually indistinguishable from 3 month and shorter Treasury Bills. Having surplus money has no penalty at the ZIRB compared to say 1981 when the T-Bill rate was about 14%. Then people tried to hold the bare minimum of cash and zero interest demand deposits because of the opportunities elsewhere. Behavior in ZIRB conditions is discussed below. Net observation: the influence of money on the economy is stronger during recessions than during non-recession. GDP-M during the whole cycle. Pre-1983 all cycles are positive as expected from conventional monetary theory. For the last three cycles the relationship is negative following the recessionary behavior. What is happening is that recessionary behavior is dominating non-recessionary behavior. This is due to the nature of OLS (ordinary least squares) regressions. In OLS deviations are squared. Thus, a deviation of 2 has four times the influence of a deviation of 1. And in the business cycle where do the biggest deviations tend to occur? In recessions.

	Table 1 Accession Estimates										
	R2	ADJR2	P-val	Coeffic	t	Variable	n				
1957-1958	0.8788	0.8615	0.00019	2.577	7.13	M1-1	9				
1960-1961	0.7346	0.7014	0.00153	1.188	4.71	M1-1	10				
1969-1970	0.8478	0.8278	0.00016	0.7944	6.68	M1-1	10				
1974-1975	0.7565	0.7343	0.00011	2.17	5.85	M1-1	13				
1980-1982	0.7684	0.753	3.91 e-6	1.074	7.06	M1-1	17				

Table 1 Decogion Estimates

	R2	ADJR2	P-val	Coeffic	t	Variable	n		
1990-1991	0.0883	-0.013	0.3749	0.4015	0.93	M2	11		
2000-2001	0.8431	0.817	0.00128	-6372	-5.68	M2	8		
2008-2009	0.9303	0.9216	6.68E-06	-0.9076	-10.33	M2	10		
2020	0.976	0.968	0.00199	-0.7285	-11.05	M2	5		

 Table 2
 Recession Regression 1990-2020

Table 3a	dot.com	(2000-2001),	Great ((2008-2009)	, and	Covid ((2020)	Recession C	vcles
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Dot Com Cycle	R2	ADJR2	P-val	Coeffic	t
Whole4q92-3q02	0.0289	0.0034	0.294	-0.0302	-1.06
PreRecess7q92-3q00	0.3744	0.3535	0.0002	0.2082	4.24
Recess4q00-3q02	0.8431	0.817	0.00128	-0.6372	-5.63
	0.2169	0.1963	0.00246	0.2605	0.32
Great Recession					
Whole2q10-2q20	0.464	0.4456	2.46E-05	-0.8628	-5.01
PreRecess2q10-2q19	0.3003	0.267	0.00678	-0.4844	-3.00
Recess3q19-2q20	0.9505	0.9423	3.85E-05	-8147	-10.74
	0.0982	0.0671	0.08613	0.4036	1.78
Covid					
Whole2q10-2q20	0.6448	0.636	1.57E-10	-0.516	-8.52
PreRecess2q10-2q19	0.1332	0.1091	0.02427	-0.129	-12.86
Recess3q19-2q20	0.9881	0.9821	0.00599	-0.764	-12.86
	0.4778	0.4647	7.03E-07	0.3819	6.05

Notes: counter intuitive signs in bold.

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53-54 cycle	R2	ADJR2	P-val	Coeffic	t
ALL 50-54	0.306	0.2674	0.01141	1.418M	2.82
PRE 50-2q53	0.004	-0.0765	0.944	.0432M	0.07
REC3q53-54	0.8344	0.7792	0.0317	2.837M	3.89
57-58 cycle					
ALL 55-58	0.8903	0.8824	4.228-8	2.334M	10.66
PRE 55-3q57	0.8219	0.8019	0.00012	1.980M	6.44
REC 4q57-4q58	0.9017	0.869	0.01348	2.470M	5.25
60-61 cycle					
ALL 4q58-1q61	0.5149	0.4664	0.0086	1.035M2	3.26
PRE 4q58-1q60	0.0666	-0.1667	0.6214	.3265M2	0.53
REC 1q60-1q61	0.7886	0.7181	0.04421	.8903M2	3.35
66-67 MiniRecess					
ALL2q61-4q67	0.2367	0.2062	0.01007	.7389M	2.78
PRE 2q61-2q66	0.4322	0.4023	0.0012	1.0190M	3.8
REC 2q66-4q67	0.5669	0.4586	0.08404	.6724M	2.29
69-70 cycle					
ALL1968-4q70	0.7388	0.715	0.00014	.985 m	5.58
PRE4q69-4q70	0.0835	-0.0693	0.4877	.385m	0.74
REC4q69-4q70	0.7461	0.6615	0.05911	.822m	2.94
1974-1975 Cycle					
ALL1971-1975	0.7064	0.6909	1.85 e-6	1.903m	6.76
ALL1971-1975	0.2273	0.0985	0.2323	.823m	1.33
REC 1q74-4q75	0.7571	0.735	0.00011	2.168m	5.85
1980-1982 cycle					
ALL1976-3q83	0.1531	0.1239	0.02949	.6713M	2.29
PRE1976-2q79	0.0153	0.1239	0.02949	.6713M	0.43
REC3q79-3q83	0.7682	0.7527	3.94 e-6	1.0740M	7.05

Table 3b dot.com (2000-2001), Great (2008-2009), and Covid (2020) Recession Cycles

3. Other Definitions of Money

Noting how money had lost its relations to other economic variables. Lucas and Nicolini developed a measure called "New M1". Basically, they added MMDAs (Money Market Deposit Accounts at banks) to M1 which really is a step toward M2 which would include other forms of savings accounts. In a sense New M1 is M2 light. Their idea is one reason we used M2 instead of M1 for post 1983 regressions. Another reason was that Wang used M2. But he extended the idea further. Wang notes that M2 is the major liability of depository institutions. They offset loans on the asset side. So, he says that money is not only represented by deposits (on the liability side of the balance sheet) but also by loans (on the asset side). He then extends the idea to real estate. From personal usage we have two other ideas: credit cards or more specifically card limits, and home equity loans (as someone once said using your home like a piggy bank). If any of these proposed versions or additions to the conventional money stock are going to bring back pre-1983 behavior we can detect it with regressions. But it is perhaps easier to make graphs of these variables analogous to Tables 1 and 2. It should be easy to tell positive or negative

relations especially during the last 3 recessions (Tables 4a and 4b). M1 and M2 were losing their high positive correlation with economic variables (Lucas & Nicolini, 2015; Wang, 2017). They suggested new definitions of money and added market deposit accounts (MMDAs) to M1 creating "New M1". New M1 is essentially M2 light and we have already shown that M2 has had a strong negative correlation in the last 3 recessions. Wang took a broader approach. He noted that deposits already in M2 formed the bulk of the right side (liabilities and capital) of the balance sheet of commercial banks. Since balance sheets balance, he went to the asset side and suggested that loans, and particularly real estate loans could be a measure of the money stock. Picking up on that idea we thought that another measure would be M2 plus credit extended for home equity loans and on credit cards. Another measure bringing in the overall influence of the Fed and its various programs would be the size of the Fed's balance sheet made somewhat famous by "taper tantrums" in financial markets as the Fed attempted to reduce its size. None of these modifications restored the pre-1984 positive correlation with GDP. The reason is clear going back to Table 2 showing GDP vs M2 over the last 3 recessions. M2 is embedded in all of these modifications. The rescue operations of M2 up as the economy dropped (negative correlation) are so strong that they dominate all of these modifications. The magnitude of the rescue efforts in Table 4a of the Fed's balance sheet is particularly striking (FRED balance sheet data goes back only to 2002). Table 4a shows negative regression coefficients for the last three recessions in subcomponents and overall (1992-2002 numbers come from individual issues of the Federal Reserve Bulletin). Our interpretation of Wang's idea using the Total Assets of Commercial Banks (TACB) yields an interesting result but has a control problem. Graph 5b and Table 4b show that there is a positive relation throughout the 2000-2001 recession cycle. This recession was very mild, if it was a planet it would be Pluto which has been reclassified as a dwarf planet. The Great Recession cycle as a whole is positive at the 2% level but the adjusted R2 is only 0.1289. The graph shows an apparent relation between GDP and TACB during the recession stage but one thing is very wrong. Rather than leading the economy down TADI lags the downturn in the economy, a case of apparent reverse causation. Accordingly, the recession regression is negative. The 2020 analysis is simple with the recession regression's negativity overpowering the weak positive relation in the run up subperiod. The control problem is: how does the Fed control the aggregated size of depository institutions? The Fed can control its own balance sheet (except when the financial markets scream bloody murder in a taper tantrum). It is another thing to control the balance sheets of endogenous institutions. Note: a modification would be to try the liabilities of depository institutions plus the currency component of M1. We both consider our credit cards to be money up to the limit allowed by the credit card company (Visa, American Express, MasterCard, etc.). M2 is currency held by the public plus checking accounts plus various savings accounts (including MMDAs) plus retail money market mutual funds. But we also use credit cards and there are a number of comments on the web about using home equity loans as a piggy bank. There are two relevant series of home equity loans on FRED: Revolving Home Equity Loans, All Commercial Banks, and Total Home Equity Lines of Credit. Credit card debt is on FRED as REVOLSL, Total Revolving Credit Owned and Securitized. We think the best measure of "moneyness" of credit cards (but not debit cards) and home equity would be the credit limits extended but such data while available for home equity loans are not available for credit card limits. Accordingly, we use the actual loan amounts extended assuming proportionality. Adding REVOLSL and Home Equity loans to M2 creates what we call M6 (M3 and M4 have been used by others). Again, Regressions are run as GDP vs M6 for the last three recession cycles. 8 of the 9 are negative with only the run up to the 2000-1 recession positive.

Summary Due to exogenous events and the responses of the Fed to rescue the economy from the effects of those events, money, however defined, has lost its close relationship with GDP. But this does not mean that

monetary policy is irrelevant. Rather, there has been a shift from controlling money to controlling interest rates. Now we turn to the management of interest rates.

		R2	Adj	P-val	Coeffic	t		
	Recovery	.0003	0333	.97520	0020	(03)		
2000-2001	Recession	.4024	.3170	.06653	.2929	(2.17)		
	Combined	.0097	0164	.54630	0540	(61)		
	Recovery	.0489	.0109	.26760	1055	(-1.13)		
2008-2009	Recession	.8552	.8311	.00101	0378	(-5.95)		
	Combined	.7334	.7250	1.05e-10	047	(-9.38)		
	Recovery	.0150	0131	.46970	0068	(73)		
2020	Recession	.7129	.617	.07203	088	(-2.73)		
	Combined	.4887	. 4750	3.78e-7	0723	(-6.10)		

Table 4aGDP vs Institutions Total Assets Regressions (YOY)dot.com (2000-2001), Great (2008-2009), and Covid (2020) Recession Cycles

Table 4bGDP vs Federal Reserve Total Assets Regressions (YOY)dot.com (2000-2001), Great (2008-2009), and Covid (2020) Recession Cycles

		R2	Adj	P-val	Coeffic	t
	Recovery	.3058	.2894	.00085	.1856	(3.70)
2000-2001	Recession	.7185	.6715	.00786	.6737	(3.91)
	Combined	.0517	.0267	.15830	.1244	(1.44)
	Recovery	.0288	0101	.39740	.1115	(0.86)
2008-2009	Recession	.1656	.0266	.31700	.1893	(-1.09)
	Combined	.1553	.1289	.02111	.2133	(2.43)
	Recovery	.0110	.0110	.52550	.1339	(1.22)
2020	Recession	.8219	.8219	.09343	.1893	(-1.09)
	Combined	.4176	.4176	3.79e-6	.2146	(2.46)

Table 4cGDP vs M6 Regressions (YOY)2000-2001 dot.com, 2008-2009 Great, and 2020 Covid Cycles

		R2	Adj	P-val	Coeffic	t
	Recovery	.3845	.2597	.00171	.2118	(3.45)
2000-2001	Recession	.8688	.8501	.00025	8503	(-6.81)
	Combined	.0487	.0236	.17140	1192	(-1.39)
	Recovery	.1166	.0782	.09475	3689	(-1.74)
2008-2009	Recession	.8878	.8691	.00046	7188	(-6.89)
	Combined	.1668	.1391	.02029	4951	(-2.45)
	Recovery	.1197	.0946	.03592	1534	(-2.18)
2020	Recession	.6741	.5655	.08839	5232	(-2.49)
	Combined	.6627	.6541	9.62e-11	4830	(-8.75)

4. A Brief Overview of Interest Rate Management

What do 1939-1941, 2009-2016, and 2020 (so far) have in common? Short term interest rates at the zero bound (ZB), huge excess reserves in the banking system, and modest inflation or even deflation. Japan has run

into this situation also. The past may contain some lessons for the future.

After the 1937-1938 Recession (which was more severe than the "Great Recession" of 2008-2009) short term interest rates, namely the 3-month Treasury Bill rate (i3mo), fell to near zero, the ZB. Due to the high excess reserves at the commercial banks there was no need for interbank borrowing and the Federal Funds rate (iFF) had fallen into disuse and would not be revived until 1954. In April 1942, as a result of formally entering WWII, the Treasury "asked" the Fed to fix the 3-month bill (i3mo) at 0.375% and the 10-year bond (i10yr) at 2.5%. To maintain these fixed yields the Fed would buy bills with legal tender (raising their price and lowering yield) if the market rate tried to go above 0.375% or sell in the opposite case. The consequence of buying bills and bonds was that currency in circulation and the money stock (which includes bank deposits) increased rapidly leading to inflation and then wartime price controls. In July, 1947, the i3mo was freed and in March 1951 an "Accord" between the Fed and Treasury semi freed the 10-year rate (the Treasury would jawbone the Fed to keep the 10-year rate low especially during Treasury rollovers and new financing).

The Fed has to be secretive about its operations so that people cannot benefit from inside information. But, in 1955, Fed Chairman William McChesney Martin gave a general outline of his operating procedure with his "punch bowl" analogy (When the party gets going, take the punch bowl away) meaning that when the economy is booming and inflation rising, interest rates should be raised to cool off spending (or cut back on money growth); and lower rates and expand money in recessions. This has also been described as "leaning against the wind". The punchbowl theory appeared in December, 2015 and again in December, 2016 as the Fed raised iFF in preemptive moves against a potential inflation.

What went wrong is that as the Great Inflation of 1965-1982 gathered steam, Martin did not have the will to carry out the punchbowl plan. A mild attempt to restrain the economy was made in 1966 (opposed by President Lyndon Johnson with a famous meeting at the Johnson Texas ranch) and abandoned with fears of increasing unemployment. Another half-hearted attempt was made in 1969. Martin was not reappointed by Nixon and was, replaced by Arthur Burns who fumbled another attempt in 1974-1975. By 1979 inflation was in double digits and in August President Carter appointed Paul Volcker as the head of the Fed.

Volcker's solution involved a bit of deception. He realized that beating inflation would require astronomical interest rates like 20% and that the public and politicians would scream bloody murder. So, he switched operations to restricting growth of reserves and the money stock and claimed that the Fed was just stopping inflationary money growth and that it was the market that should be blamed for the high interest rates, not the Fed. See Meltzer p. 1025 footnote. Mistakes were made but after the two recessions of 1980 and 1981-1982 the inflation problem was solved.

But, now there was another problem. The revolution in financial innovation caused by inflation and distortions in funds caused by the interest rate ceilings of Regulation Q led to the invention of money market mutual funds, NOWs (negotiable orders of withdrawal, ATS (automatic transfer service), and money market deposit accounts from the1982 Garn-St. Germain Act, Money was measured as M1, M1+{, M1a, M1b, and MZM. With these developments the Fed did not know how to measure money. See Meltzer p. 1117. It gave up on October 5, 1982 and went back to interest rate control of short-term rates, particularly the Fed Funds rate iFF. This system held until October 6, 2008.

The original idea of paying interest on commercial bank reserves (Friedman, 1960) was then promoted (Goodfriend, 2002). IOR was scheduled to be implemented in 2011 but due to the severity of the Great Recession and financial panic of September, 2008, it was included in the Economic Stabilization Act of October 3, 2008. The

Fed began paying interest on reserves 3 days later.

Another major component of monetary reform is QE. The procedure of open market operations involved buying Treasury Bills from banks and the public and paying with legal tender or electronic equivalent-exchanging cash for T-Bills. This was the traditional "Bills Only" procedure of the Fed. In 1961 the Fed bought and sold long term Treasuries in an effort to influence long term rates. This was known as "Operation Twist". It did not work particularly well. In the Great Recession the Fed put a lot of cash or base money by expanding its purchases of not only bills and bonds but U.S. Agency bonds and mortgage backed securities (MBS, WSHOMCB on FRED). These extraordinary purchases are known as Quantitative Easing. On March 23, 2020 the Fed extended QE to the purchase of investment grade corporate bonds due to the emergency caused by the Corona virus. The Fed made some strange purchases. A CNBC commentator said, "I didn't know that Starbucks needed emergency help" with some sarcasm.

The new policies of IOR and QE had a major influence on several economic variables. Andersen and Jordan had a significant GDP-Ba (monetary base) regression 19522Q68. Table 5a continues plots of Ba and GDP out to 2020. Huge gyrations occurred in 2008 and after as the Fed pumped money into the economy. It is clear that a significant correlation of this kind no longer exists. Graph 5b shows what happened to reserves. The blue line is total reserves and the red line required reserves. The difference is excess reserves, bank cash kept for cashing checks and making loans. Before 2008 banks tried to keep excess reserves to a bare minimum because they earned no interest. But when IOR was adopted in 2008 excess reserves zoomed.

Table 5c shows what happened to short term interest rates; the Fed Funds Rate, the IOR rate and i3mo. Within arbitrage limits the rates are closely linked. For example, if iFF is too high, banks can sell T-bills (held as a secondary reserve) instead. Also, there are "repos" and "reverse repos" which are overnight loans that are unwound the next day. The Federal Reserve Bank of St Louis has an informative article describing the new procedure in detail (Ihrig & Wolla, 2020).

Something not seen since the end of the Great Depression 1938-1941 and before happened from late 2008 to late 2015. Table 5c shows that the short-term rates went to near zero, the zero bound (ZB). They rebounded a bit but are back to the ZB in 2020. Normally, nominal interest rates should not go below zero or at least the storage rate on a safety deposit box. This is important because at the ZB the Fed loses one of its most powerful tools, the ability to lower interest rates to stimulate the economy. Table 5d shows bank reserves and the T Bill rate 1929-1941. Tables 5e and 5f show similar situations in Japan 1999-2016. It is possible that these graphs are signs of something called a liquidity trap. In the next section we look at the empirical relation between GDP and iFF.

Tables 4a, 4b, 4c relate GDP to three alternative measures of the money stock to find out if the old pre 1984 positive relation can be restored. The answer is no. It should not be a surprise. The rescue efforts of 2008-2009 to combat the Great Recession and of 2020 to combat the economic crash of the virus are so strongly negative that they overpower the rest of the 1992-2020 period.

The Fed readopted interest rate management on Oct 5, 1982 (Meltzer, p. 1117 for why). The Fed Funds rate iFF became the main monetary policy tool. Plots of GDP vs iFF show that the iFF lags the economy with one exception. This is consistent with Martin's famous "Punchbowl" idea, or "leaning against the wind". Raise the iFF in booms and lower it in recessions. This also is consistent with being "data dependent". By the way, rescue operations such as 2008-2009 and 2020 is consistent with the Fed's original mission of being the lender of last resort.

	<i>Q</i> =	f (iFF lag) is nor	<i>iFF</i> = <i>f</i> (<i>Qlag</i>) <i>is reverse</i>		
Period	R2	ADJR2	P-val	Coeffic	t
(1) 1956-62-Normal	0.0813	0.0459	0.1415	0.641	1.52
(1) 1956-62-Reverse	0.6812	0.6689	6.51E-08	0.3844	7.45
(2) 1962-71-Normal	0.0136	-0.0154	0.4977	0.145	0.69
(2) 1962-71-Reverse	0.2912	0.2703	0.00068	0.4368	3.74
(3) 1972-84-Normal	0.0057	-0.0414	0.5934	0.0739	0.04
(3) 1972-84-Reverse	0.2418	0.233	0.00017	0.5121	4.06
(4) 1985-02-Normal	0.1402	0.1279	0.00119	0.3375	3.38
(4) 1956-62-Reverse	0.3408	0.3313	7.36E-08	0.6385	6.02
Cycle					
(5) 1985-92-Normal: Kuiwait	0.0921	0.0619	0.09124	0.2883	1.74
(5) 1985-22-Reverse	0.2282	0.2025	0.00569	0.4889	2.98
(6) 1993-022-Normal: dot.com	0.1411	0.1191	0.01551	0.3224	2.43
(6) 1993-02-Reverse	0.4321	0.4175	7.03E-06	7.57E-01	8.45
(7)2010-3Q20-Normal: Covid	0.0445	0.0212	0.1744	0.5676	1.38
(7) 2010-3Q20-Reverse	0.387	0.3721	8.45E-06	2134	5.09
(8) 03-2Q08-Normal: PreGrt Recess	0.0488	0.0013	0.3238	0.1862	1.01
(8) 03-2Q08-Reverse	0.3078	0.2732	0.00736	0.8245	2.98
(9) 03-09-Normal: Grt Recess	0.5623	5.45E-01	4.38E-06	6.00E-01	5.78
(9) 03-09-Reversel: Grt Recess	0.3744	0.3503	0.00054	0.416	3.95

 Table 5
 Normal and Reverse Causation Regressions (YOY)

Note: 1. Only (9) 03-09-Reversel: Great Recession is counter intuitive

But there was another big change on Oct. 6, 2008 when the Fed started IOER as a new financial control system. We have the basic St Louis Fed articles you got explaining the system. We don't have to write about that since we can use these articles as references. More regressions 2008-2020. Now the story gets more interesting because we hit the Zero Interest Rate Bound ZIRB from 2009-2016. And back to the ZIRB in 2020. What are the consequences of ZIRB? As empirical analysts we look at ZIRB data. Periods to look at are: USA 2009-2016, 2020, and the end of the Great Depression 1938-1940. In the first section of the paper, we presented graphs and regression tables of GDP and money. Here we do the same for GDP and the Federal Funds rate iFF. Paul Volcker used money control from October 1979 to October 1982 to defeat the Great Inflation loans was inactive in the 1930s and 1940s because the huge level of excess reserves made overnight interbank borrowing unnecessary. It revived in 1954. Graph 6a covers the GDP and iFF year over year (yoy) to 1968, a period that Andersen and Jordan could have studied had they so wished. A striking feature is the apparent lag. It looks like the Fed Funds rate lags the economy. As opposed to money which apparently leads the economy. Graph 6b carries the plots out to 1984. In the 1950s McChesney Martin of the Fed mentioned the "punchbowl" and "leaning against the wind" methods of managing monetary policy. When the economy boomed it was time to raise interest rates (and/or slow the growth rate of money) to slow the economy, or if the economy was declining lower interest rates to stimulate it. Around 2014-2015 under Janet Yellen another phrase became popular "data dependent". If we wait a bit for data to confirm a trend this introduces a lag. So that can explain why the Fed's interest rate actions lag the economy. There was an interesting variant on December 16, 2015. iFF was raised in anticipation of an inflation. They

jumped the gun because the inflation did not appear. Reverse Causation. Normally we expect the economy to follow a monetary action of the Fed (and also fiscal policy). When the St. Louis Fed Andersen-Jordan result came out in November 1968 showing that money had a stronger effect on the economy than fiscal policy, Keynesian economists said that money was not causing the f(iFF-1) and iFF = g(GDP-1). The regression results for 1956 to 3O2020 are in Table 5. Money wasn't causing the economy but rather the economy was causing money. Tests of causation and reverse causation to help settle the controversy (Granger & Sims, 1972). There are various versions but the graphical appearance is so evident that we use a simplified Sims test. See (8). Normally the economy would be a function of the contemporaneous and lagged monetary variable. Such a function would be GDP = f (iFF, iFF-1). The reverse causation function would be iFF = g (GDP, GDP-1). Or even more simply GDP = g iFF. In Table 5, there are 9 pairs of regressions, the normal function GDP = f(iFF-1) and the reverse iFF =g(GDP-1). Let us look at the first pair in detail. The "normal" regression of GDP on lagged (by 1 quarter) iFF has an R2 of .0813, R2 adjusted of 0.0459, and a p-value of .14150. The linear regression coefficient is .6410 with a t-statistic of 1.52. It is a weak result. The reverse function is very strong with a .6689 R2adjusted, significance of 6.51e-8 (or .0000000651) and a t of 7.45. It indicates that iFF is a function of GDP rather than GDP being a function of iFF, consistent with the lag of data dependency. The coefficient signs are positive, consistent with punchbowl and leaning against the wind theory. 1956-1962 covers two recession cycles (1957-1958 and 1960-1961). We double up to condense the table. Pairs 2 and 3 cover the remaining pre-1985 recessions: the weak 1966-1967 mini-recession and the weak 1969-1970 recession, then the 1980 and 1981-1982 Volcker recessions. Pair 4 covers the Kuwait Oil Crisis 1990-1991 recession plus the 2000-2001 recession. All support the reverse causation hypothesis. Pair 4 is significant because Lucas-Nicolini and Wang have mentioned that post the mid1980s monetary variables seem to have lost their influence. But there is some trouble ahead. Leaving that to the end of this section we now analyze each post 1984 recession cycle. Pair 5 looks at the Kuwait cycle. Pair 6 at the dot.com cycle. No problem, reverse still holds. Pair 7 skips the Great Recession cycle where the trouble is and goes to the Covid Recession cycle. Again, the normal function is insignificant and the reverse function very significant. The problem occurs in the Great Recession itself. First, when did the Great Recession start? The NBER says December 2007, but the decline then was very mild. The real action started with the Treasury rescue of Fannie Mae and Freddie Mac in September 2008. So, we consider that the recession started in 3Q2008. Accordingly, we did Pair 8 from 2003 to 2Q2008 to find out what happened in the pre-recession phase. Again, the normal regression was insignificant and the reverse function significant at the .01 level. But when the missing quarters 3q2008 to 4Q2009 are added in Pair 9, the normal function becomes more significant than the reverse function. It is the only inconsistency in the table. One of the problems causing the aberrant behavior of 3Q2008-4Q2009 is that in December 2008 the Fed Funds rate essentially hit the zero bound barrier. If the zero bound did not exist then the Fed could have let iFF sink into negative territory and maintained the behavior of the other cycles. The second problem is that using year over year data to smooth the data as done by Wang and Lucas-Nicolini means that the iFF change in our yoy data series does not go to zero immediately but takes a whole year for the yoy effect to disappear. Example: if we used monthly differences the iFF change would go to zero in January 2009 since the zero bound was reached in December 2008. But our yoy series does not go to zero until 1Q2010. Using smoothing techniques when encountering a discontinuity causes a problem. This brings up another question. What is the impact on monetary policy when we reach the zero bound?

	Q = f(iFF lag)		Fed leading the economy				
	R2	adjR2	P-val	CoefficFF	t		
dot com cycle 1992-2002	0.1246	0.1032	0.02025	0.2826	2.42		
Pre recession 1992-	0.009	-0.0202	0.5822	-0.0632	-0.55		
dot com recession 2003	0.3203	0.207	0.1437	0.2424	1.68		
Great Recession 2003	0.5571	0.5419	0.00000143	0.8843	6.04		
Pre Recession 2003	0.067	0.0226	0.2329	0.2049	1.23		
Great recession	0.7137	0.6778	0.00415	1.316	4.18		
Covid cycle3Q10-2Q20	0.3287	.3111	0.00011	2.707	4.31	inconclusive	
Pre Recession 3Q10	0.0331	0.0047	0.2882	0.3782	1.08		
Covid Recession -2Q10	0.686	0.5813	0.0832	4.641	2.56		
		iFF = f(Qlag	g) = Fed followin	g the economy	,		
	R2	adjR2	p-val	coeffic-Iff	t		
Pre recession -1992	0.4468	0.4333	0.000000966	0.7961	5.75		
Dot com recession -2002	0.1067	0.0804	0.05188	0.4119	2.02		
	0.9283	0.9164	0.00012	1.355	8.82		
Great Recession 2003							
Pre Recession 2003	0.4408	0.3802	0.0013	0.5291	1.075		
Great recession	0.3192	0.2868	0.00497	0.8414	3.14		
	0.0002	-0.1426	0.969	-0.0129	-0.04		
Covid Cycle 3Q10-2Q20							
Pre Recession 3Q10-	0.1903	0.169	0.00489	0.3356	2.99	inconclusive	
Covid Recession 2Q20	0.0663	0.0389	0.1294	0.1257	1.55		
	0.571	0.428	0.1396	1.075	2		

 Table 6
 Reverse Causation

Notes:

1) Why didn't OE2 stimulate the economy?

2) Why can't we increase inflation?

3) What about inflation regressions?

5. Conclusion

This paper is not the end of our investigation of monetary policy. We have not considered the problem of inflation and how it relates to monetary policy. Curiously we have a problem opposite of that faced by Paul Volcker. Why haven't we been able to get the inflation rate up to the Fed's target of 2% annually? Another question is why didn't QE2 and QE3 get economic growth above 3% consistently? We have mentioned Japan, the U.S. and the zero-bound problem. Tying these factors, the Fisher inflation effect, and the Taylor rule made for an interesting theory of low real economic growth (Bullard, 2020). Much remains to be done.

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