Explorations in Economic History: A Test of Structural Break in the US Money Supply Data

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Abstract

In a televised address to the Nation on Sunday evening, August 15, 1971, President Richard Nixon announced the "temporary" suspension of the dollar's convertibility into gold. While the dollar had struggled throughout most of the 1960s within the parity established at Bretton Woods, Nixon's announcement of the closing of the gold window greatly signified the end of the Bretton Woods system. We argue that the federal policies to supply money under the gold exchange standard prevalent before closing the gold window and the fiat currency regime that replaced the gold exchange standard after closing the gold window are substantially different. In this paper, we provide evidence of structural breaks in the M1 and M2 measures of money supply time series data due to the policy switch from the gold exchange standard to the fiat currency system.

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Introduction

On Sunday evening, August 15, 1971, in a televised address to the Nation President Richard Nixon announced: "… I have directed Secretary Connally to suspend temporarily the convertibility of the dollar into gold or other reserve assets, except in amounts and conditions determined to be in the interest of monetary stability and in the best interests of the United States" (Nixon 1971). Truman (2017, p. 1) contends, "… Nixon's New Economic Program, which was designed to help him win reelection in 1972. It included a 90-day freeze on wages and prices, with a voluntary restraint program to follow, and tax measures to stimulate the US economy. It also included two measures not intended to be permanent: the suspension of the convertibility of official US dollar holdings into gold and a 10 percent surcharge on dutiable imports from all countries. Nixon declared, "[This program] isn't directed against any other country. It is an action to make certain that American products will not be at a disadvantage because of unfair exchange rates. When the unfair treatment is ended, the import tax will end as well" (Nixon 1971).

This episode, also known as "Nixon shock," is of substantial historical interest.[1] Our objective in this research is to examine the effects of President Nixon's intervention on the US monetary policy to end the convertibility of US Dollars to gold. We apply a simple test of structural break to analyze monthly M1 and M2 measures of money supply time series data from January 1959 through December 1979. The results indicate that a structural break did occur in these data series following the policy switch from the gold exchange standard to the present regime of fiat currency in 1971. The article thus uncovers previously uninvestigated characteristics of the US M1 and M2 money supply time series data, that, we think, would be useful to policymakers who study, analyze and/or participate in the formulation of monetary policy in the USA and elsewhere.[2]2

The paper is organized as follows: Section 2 presents a brief literature review focusing on the evolution of monetary policy in the USA, emphasizing the time period when the Bretton Woods System became fully functional years. Section 3 presents an empirical analysis and results, followed by conclusion in Section 4.

1 For an interesting discussion of how President Nixon manipulated Arthur Burns and the Fedd eral Reserve Bank into creating a political business cycle that helped secure his reelection victory in 1972, see Abrams (2006), and Abrams and Butkiewicz (2012).

2 Luitel and Mahar (2015) and Amiraslany, Luitel and Mahar (2019) reported structural breaks in the US as well as Canada GDP. In this article, we follow the same research design and report structural breaks in the US M1 and M2 money supply time series data.

Literature Review

The US monetary policy has been studied extensively in the literature. See, for example, Friedman and Schwartz (1982, 1963), Friedman (1977, 1968), Farmer (2013), Taylor (ed.) (1999), Eichengreen (2011, 2008), Triffin (1964), Bloomfield (1959), among others. For our purpose, we will focus on the evolution of the monetary policy in the USA after World War II, a period that has been widely studied, is a subject of ongoing inquiry and is not novel by any means [see Dooley et al. (2014), Bordo and Eichengreen (ed.) (1993), Triffin (1960), Metzler, Triffin and Haberler (1947)]. From the Canadian perspective, the study of US monetary policy is important because whenever the Canadian dollar approaches its historic lows, the debate about the monetary union with the US dollar resurfaces (Robson and Laidler, 2002).

Historically, the international monetary arrangement agreed to by delegates from forty-four countries meeting at Bretton Woods, New Hampshire in 1944 subsequently became known as the Bretton Woods System. In retrospect, the Bretton Woods System can be interpreted as the best compromise between the competing interests of the United States and Britain, given concrete form in the plans drawn up by Harry Dexter White (United States) and John Maynard Keynes (Britain) (Solomon 1982, Capie 2002). Eichengreen (2004, p.7) writes, "The US (plan) attached priority to stable money, understandably given the monetary turmoil that the country had endured in the 1930s, while the British (plan) attached priority to monetary room for maneuver, again understandably given how the Bank of England had been inhibited from adapting policy to the needs of the economy in the 1920s. The compromise was one in which gold was made the ultimate anchor of the Bretton Woods System but subject to qualifications that enhanced the autonomy of central banks."

Under the Bretton Woods Agreement, countries were allowed to maintain a pegged exchange rate within narrow margins to the dollar. Notably, countries were allowed to buy or sell dollars in the foreign exchange market to keep their currencies from appreciating or depreciating more than 1% from parity. The United States assumed the ultimate responsibility for keeping the gold price fixed by permitting conversions and, at a more basic level, by adjusting the production of dollars to maintain confidence in future convertibility to gold. Although the Bretton Woods Articles of Agreement entered into force on December 27, 1945, in many respects, the system did not become fully functional until the end of 1958 (Schwartz 1987, Pauls 1990, Meltzer 1991, Bordo 1993, Truman 2017).

The literature on the Bretton Woods System is extensive. For comprehensive surveys on the Bretton Woods System, see Bordo (1993) and James (1996). For a discussion of Federal Reserve policy under the Bretton Woods System, see Meltzer (1991, 2003, 2009a, 2009b), Eichengreen (2000, 2013). While Coombs (1976) and Solomon (1982) provide valuable discussions from the point of view of former Federal Reserve officials, Pauls (1990) offers a more Federal centric view of the period. Irwin (2012) examines the political, economic, and legal issues surrounding the import surcharge.

From the inception, it was clear to some that the design of the Bretton Woods System was structurally flawed [Feldstein (1993), Triffin (1960)]. Prior to 1959, even when currencies of major industrial countries were not fully convertible, and even when international trade (flow of goods and services) and international finance (flow of capital) were somewhat limited, the world did not readily accept the dollar as the equivalent of gold. France, for example, was one of the major industrial countries to oppose a dollar-based international monetary system[3]. By 1960, when the Bretton Woods System became fully functional, concerns about the dollar's convertibility raised serious questions about the viability of Bretton Wood System and elicited criticisms of dollar's privileged place in the system (Bordo and Humpage 2014, p. 1).

The 1960s was the first peacetime period for more than a quarter of a century when policymakers recognized that the external constraint did matter for the United States. After World War II, the US trade balance was continuously in surplus, partly because the United States dominated the world economy and partly because countries in Europe, Asia, and Africa were not fully integrated into the international system. As such, the 1950s presented no balance-of-payments challenges to the United States. Besides, the Eisenhower administration's economic policy had emphasized balanced budgets, price stability, and maintenance of the Bretton Woods peg to gold at $35 an ounce [Eichengreen (2000), (2004), Bordo and Eichengreen (2008)].

A series of events in the 1960s further escalated the growing lack of confidence in the Bretton Woods System in terms of the ability and willingness of the United States to meet all the claims on its gold stock -- to maintain the

3 France's opposition to a dollar-based international monetary system became obvious after the Suez crisis. In 1956, the United States had insisted that France, the UK, and Israel withdraw from Suez, and Washington threatened to use its political leverage for force their compliance if necessary. This led to political problems and economic difficulties, most notably in France in 1957-8 (Block 1977).

convertibility of the US dollar into gold for official foreign holders (Truman (2017, p. 9). During the election campaign in 1960, the international monetary intentions of the Democratic presidential candidate, John F. Kennedy, were not clear. Particularly, his election campaign slogan "getting the economy going again" did not bode well among the dollar bears (Eichengreen 2004, p. 13). However, immediately after taking office in 1961, in order to gain confidence of the international community and to address concerns about the US balance of payments as well as the US dollar's role in the international monetary system, President Kennedy sent a special message to the US Congress in which he characterized the United States as "the principal banker of the free world" and concluded that "[t]he United States must in the decades ahead, much more than at any time in the past, take its balance of payments into account when formulating its economic policies and conducting its economic affairs" (Solomon 1982, p. 39). "Despite these fine words, US economic and financial policymakers chafed under these constraints and sought to avoid their becoming binding. US officials for much of the next decade engaged in "lively and confused debates, sometimes acrimonious, [primarily with European counterparts] . . . on international monetary matters," seeking agreement to "institutional innovations designed to protect the dollar and to bolster international cooperation" while at the same time loosening somewhat the external constraints on US economic policies to stimulate and otherwise manage the US economy" (Truman 2017, p. 10).

On October 20, 1960, a run in the London gold market sent the price to $40 an ounce, exacerbating the confidence in the Bretton Woods System. In response, concerted international efforts were made to stem a run on gold and to uphold the Bretton Woods System. On November 1, 1961, the London Gold Pool -- a group of eight central banks -- was formed. Included in the Gold Pool were the central banks from the following countries: Great Britain, West Germany, Switzerland, the Netherlands, Belgium, Italy, France, and the United States (Ghizoni, 2013). However, the formation of the Gold Pool was not a satisfactory solution to stem a run on gold for all its member countries. Although it facilitated these central banks to share the cost of maintaining the London price of gold at $35 an ounce rather than depleting US gold reserves, it simply shifted some of the pressure of keeping the $35 gold price in London away from the United States. During 1964-1967, the British pound sterling suffered a sustained speculative attack, culminating in the British government's devaluation of the pound on November 18, 1967, that resulted in another run on gold.

France insisted on a more contractionary US monetary policy for its continued participation in the Gold Pool. When the United States did not follow through, France withdrew its participation, and the Gold Pool collapsed in March 1968 (Eichengreen 2004). Nevertheless, the seven remaining central bank members of the London Gold Pool continued working together. They formulated a two-tiered system in which they agreed to use their gold only to settle international debts and not sell monetary gold on the private market. The two-tier system was in place until the US gold window closed finally in 1971 (Ghizoni 2013).

While the literature on the Bretton Woods system is extensive, most studies focus on why the system ultimately failed, and so far, little attention has been given to the analysis of M1 and M2 monetary aggregates for the period the Bretton Woods system was fully functional. Moreover, many leading econometrics textbooks have used the data series of the money stock to illustrate examples of various time series analysis in the economics curriculum, and, to our knowledge, none has used monthly time series data to examine the effects of President Richard Nixon's intervention on the US monetary policy that ended convertibility of US Dollars to gold in 1971. Thus, this study sheds some light on previously unexplored characteristics of M1 and M2 measures of money supply time series data for the period the Bretton Woods system became fully functional as the international monetary system.

Data Analysis and Results

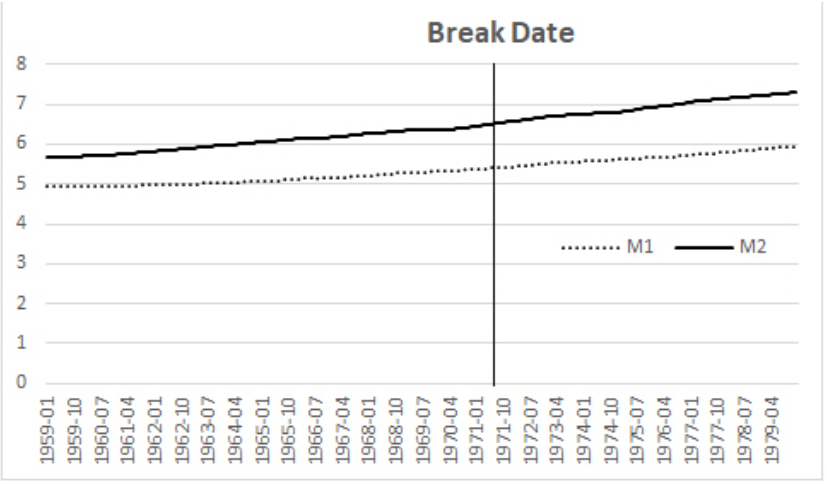
From January 1959 to December 1979, the money supply data covered two independent sample periods. Up to August 1971, the Federal Reserve -- the central bank of the USA (or, the Fed, in short) -- reported money supply data according to the gold exchange standard. In August 1971, the gold exchange standard was replaced by the fiat system. We suspected that if the data reporting methods under the gold exchange standard and under the fiat system are substantially different, the parameters governing the money supply process under these two systems would likely be different. To explore this possibility, we collected monthly M1 and M2 measures of money supply data from January 1959 to December 1979.[4] We limit our analysis to include only M1 and M2

4 We limit the time period of our data analysis from January 1959 to December 1979 because in the early 1980s, the US economy experienced a "double-dip recession." According to the National Bureau of Economic Research (NBER), which maintains a chronology of US business cycles, the US economy went into recession in 1980, briefly bounced back, and then plunged into recession again in 1981. Consequently, the Federal Reserve manipulated the money supply data extensively in the later 1980s, and the money supply process became much more complex.

monetary aggregates because the literature suggests that monetarists were long divided over whether a narrow aggregate, such as the monetary base or M1, or a broader aggregate, such as M2 or M3, was a preferable target for monetary policy.[5] Interestingly, St. Louis Fed officials advocated M1, while Milton Friedman favored M2 (Hafer and Wheelock 2001). Data was collected from the Federal Reserve's official website.[6]

As an exploratory analysis, it would be useful to draw a graph of M1 and M2 money supply time series data to judge if the identification of structural break through visual inspection is possible. Figure 1 shows line charts of M1 and M2 money supply between January 1959 and December 1979. Contrary to our expectation, however, we found the graph to be deceiving for it did not show a break in the actual data. Therefore, we proceed with a Chow test, first proposed by Chow (1960), to examine whether structural breaks did occur in these series.

Figure 1: Log of M1 and M2 Supply of Money
(January 1959 to December 1979)



Source: The Federal Reserve, https://www.federalreserve.gov/.

Web access date: March 14, 2021

5 Although monthly M3 money supply data is available for the period January 1959 - December 1979, the publication of M3 was ceased on March 23, 2006. We do not include M3 in our analysis because the Federal Reserve acknowledges that M3 did not appear to convey any additional information about economic activity that was not already embodied in M2 and had not played a role in the monetary policy process for many years (Federal Reserve 2006).

6 Data are reported in billions of dollars by the Federal Reserve. We analyze the data after taking their natural log. The data are available from the corresponding author, if requested.

Consider the following semi-log linear time-trend regression model: $ln(Y_t)=\beta_0+\beta_1 X_t+u_{1t}$

where the dependent variable, $ln(Y_t)$, represents the natural log of M1 and M2 supply of money, the independent variable, X_t, is a time indicator that increases in value by one for each month between January 1959 and December 1979, and u_{1t} is the random error.

We know the specific date when the Federal Reserve moved the reporting of the money supply and other monetary aggregates from the gold exchange standard to the fiat currency system. Our objective in this research, therefore, is to determine if the switch from the gold exchange standard to the fiat system had changed the model parameters. Econometrically, this is equivalent to posing the question: Were the regression coefficients -- β_0 and β_1 -- stable over the entire sample period? To find out the answer, we split the data into two sample periods: from January 1959 to July 1971, and from August 1971 to December 1979, and estimated the two regression equations separately as below:

Period January 1959 – July 1971: $ln(Y_t)=\alpha_0+\alpha_1 X_t+u_{2t}$

Period August 1971 – December 1979: $ln(Y_t)=\delta_0+\delta_1 X_t+u_{3t}$

where u_{2t} and u_{3t} are the sample specific error terms.

If the data generating process of M1 and M2 supply of money time series data had not changed under the gold exchange standard and the fiat system, we would expect that $\beta_0=\alpha_0=\delta_0$ (i.e. the intercepts are statistically the same) and $\beta_1=\alpha_1=\delta_1$ (i.e. the slope coefficients are statistically the same). Table 1 reports the results from the three regression equations described above for both M1 and M2 measures of money supply, and their respective residuals sums of squares. We note here that there are 252 observations: 151 in the period from January 1959 to July 1971 and 101 in the period from August 1971 to December 1979.

We further assume that the error terms $u2t$ and $u3t$ are normally distributed, have the same variance (i.e., var (u_{2t}) = var $(u_{3t}) = \sigma^2$), and are independently distributed. Under these assumptions, the Chow test proceeds as follows: The assumption that u_{2t} and u_{3t} are independently distributed suggests that the two samples are independent, in which case, we can obtain the unrestricted residual sum of squares (USSR) by adding SSR_1 (the residual sum of squares from the second regression equation) and SSR_2 (the residual sum of squares from the third regression equation). This USSR will have (n_1+n_2-2k) degrees

***Table 1*: OLS Regression Results**

Regression under the assumption of parameter stability			**Regressions under the assumption of parameter variability**					
Time Period: January 1959-December 1979			**Time Period: January 1959-July 1971**			**Time Period: August 1971-December 1979**		
Variables	M1	M2	Variables	M1	M2	Variables	M1	M2
β_0	4.8591 **(**929.43**)**	5.6522 (1186.10)	α_0	4.9079 (1201.50)	5.6989 (2650.68)	δ_0	4.7005 (497.88)	5.4532 (443.30)
$\beta 1$	0.0042 (109.00)	0.0066 (188.58)	α_1	0.0032 (61.78)	0.0057 (206.59)	δ_1	0.0051 (104.20)	.0077 (120.99)
N = n_1+n_2	252	252	n_1	151	151	n_2	101	101
R^2	0.9794	0.9930	R_2	0.9624	0.9965	R_2	0.9910	0.9933
RSSR	0.5013	0.4165	SSR_1	.1215	0.0336	SSR_2	0.0207	0.0351
df	251	251	Df	150	150	df	100	100

Note: Figures in the parenthesis are absolute t statistics.
Source: Authors calculations

of freedom, where n_1 is the number of observations in the first sample, n_2 is the number of observations in the second sample, and k is the number of parameters estimated in each regression equation. Similarly, we can obtain the restricted residual sum of squares (RSSR) – that is, the residual sum of square from the first regression equation -- under the assumption of parameter stability. This RSSR will have (n-k) degrees of freedom, where $n=n_1+n_2$. If there was stability of parameters, USSR and RSSR should be statistically the same. However, if there was no stability of parameters, both USSR and RSSR should be statistically significantly different from each other. This can be tested by showing that

$$F=\frac{(RSSR-SSR_1-SSR_2)/k}{(SSR_1+SSR_2)/(n-2k)} \sim F_{[k,(n-2k)]}$$

Because there are k parameters in the restricted regression model (first regression equation) and $2k$ parameters in the unrestricted regression model (second and third regression equations), the F values calculated above will follow F distribution with k and (n-2k) degrees of freedom. The decision rule is to reject the null hypothesis if, say, at 1 percent, 5 percent, or 10 percent level of significance, the calculated F statistics is statistically significant. Rejecting the null hypothesis implies that the DGP of the US supply of money had gone

a structural change over time. However, if the null hypothesis is not rejected because the calculated *F* statistics is found to be statistically not significant, it would imply that the parameters had remained stable over time. Table 2 below shows the calculation of *F* statistics:

Table 2: Computation of F Statistics

M1	M2
$\frac{(RSSR-SSR1-SSR2)/k}{(SSR1+SSR2)/(n-2k)}$	
$\frac{(0.5013-0.1215-0.0207)/2}{(0.1215+0.0207)/(252-2\times2)} = 359.1.$	$\frac{(0.4165-0.0336-0.0351)/2}{(0.0336+0.0351)/(252-2\times2)} = 627.76$
$F(2, 248) = 313.06$	$F(2, 248) = 626.42$
$Prob > F = 0.0000$	$Prob > F = 0.0000$

Source: Table 1; authors calculations

As noted previously, the number of observations for both M1 and M2 supply of money are the same, 252, in our sample. As such, the *F* statistics for both M1 and M2 supply of money follows the *F* distribution with 2 and 248 degrees of freedom in the numerator and denominator. As reported in Lind, Marchal and Wathen (2010; Table B.4, page 755), the critical value at the 1 percent significance level is ≈ 4.61. Because the calculated *F* values for both series far exceed the reported critical value, we would reject the null hypothesis H_0: $\beta_0=\alpha_0=\delta_0$ and $\beta_1=\alpha_1=\delta_1$ (i.e., reject the hypothesis of parameter stability). These results suggest that the regression models for the two sample periods were not the same. Thus, we can conclude that money supply process in the USA over the time period from January 1959 to December 1979, had undergone a structural change, beyond a simple switch from the gold exchange standard to the fiat currency regime, in August 1971.

Conclusion

President Richard Nixon's intervention on the US monetary policy on August 15, 1971, essentially ended the convertibility of US Dollars to gold and turned the US dollar into a fiat currency. Because the money supply process under the gold exchange standard prevalent before the intervention and the fiat currency system prevalent after the intervention were substantially different, we were curious to know if the switch from the gold exchange standard to the fiat currency system changed the model parameters of M1 and M2 measures of money supply. In this research, we applied a simple test of structural break, proposed

by Chow (1960). The results indicate that structural breaks did occur in both M1 and M2 measures of money supply time series data due to the switch from the gold exchange standard to the fiat currency system. The implications of the structural break findings in this article in the context of the monetary policy and quantity theory of money are further discussed elsewhere.

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