

Federal Reserve Bank of Cleveland

Money Growth and Inflation: How Long is the Long-Run?

by Terry J. Fitzgerald

"Inflation is always and everywhere a monetary phenomenon."

—Milton Friedman, Wincott Memorial Lecture, London, September 16, 1970

"Given continued uncertainty ... , the [Federal Reserve Open Market] Committee would have little confidence that money growth within any particular range selected for the year would be associated with the economic performance it expected or desired."

—Humphrey–Hawkins Report presented February 23, 1999

The growth rate of the money supply currently receives little attention in the conduct of monetary policy. While guarding against rising inflation is one of the Federal Reserve's primary objectives, the Fed has found the short-run relationship between money growth and inflation too unreliable for money growth to merit much attention.

At the same time, many studies have found a strong relationship between long-run averages of money growth and inflation.¹ This relationship seems to provide a straightforward strategy for maintaining low inflation—choose the growth rate of money that corresponds to the desired long-run rate of inflation. In fact, some economists have concluded from this evidence that the problem of controlling inflation has been successfully solved.²

There are two keys to reconciling findings of a close long-run relationship between money growth and inflation and policymakers' relative lack of interest in money growth rates. First, most studies that report a close connection in the long run use data for many countries, and it is sometimes noted that the finding appears to rely heavily on the presence of countries with high rates of money growth and inflation. It is much less clear that a close relationship exists within countries with relatively small changes in money growth such as the United States.

The second key is the time period associated with each observation. Even if a close relationship between money growth and inflation exists over the long run, that relationship largely disappears when one considers relatively short time horizons such as a year or a quarter. Figure 1 illustrates the lack of a relationship in quarterly U.S. data. In conducting monetary policy, the Federal Reserve monitors and seeks to influence inflation and other economic variables over annual and quarterly intervals. A close relationship between money growth and inflation that exists only over very long time horizons is of little use to policymakers trying to control inflation over the next quarter or year.

Because there is the possibility of a close relationship between money growth and inflation in the long run, the lack of a clear relationship in the short run raises an obvious question—How long is the long run? That is, over what time horizon, if any, does a direct link between money growth and inflation

In their efforts to maintain low inflation, policymakers currently pay relatively little attention to the growth rate of the money supply. Yet many studies have found a close relationship between money growth and inflation, at least in the long run. But how long must money growth be strong before it should be of concern to policymakers? That is, what is the shortest period of time over which money growth seems to be reliably associated with inflation?

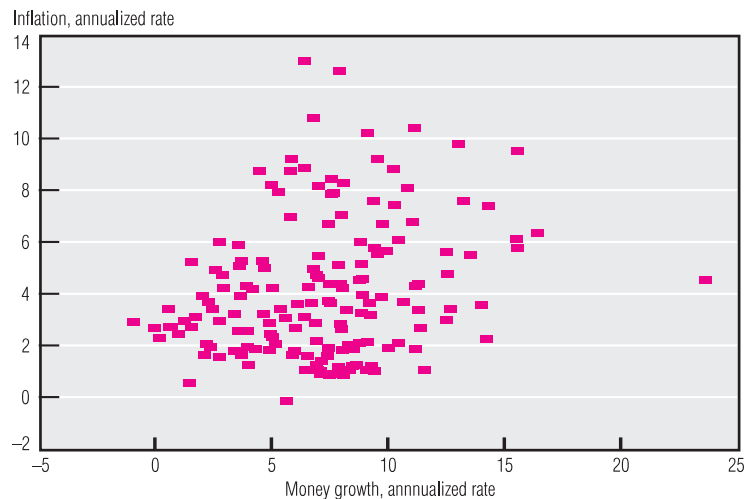
emerge? This *Economic Commentary* seeks to address that question for the United States.

Knowing the length of the long run is important for current policymaking. If there is a close relationship between money growth and inflation in the long run, then ignoring money growth in short-run policymaking poses a risk. The long run is, after all, a series of short runs. If rapid money growth is ignored for too many short runs, or too long a short run, then the long-run relationship could begin to take hold. That would force inflation-fighting policymakers to respond by reducing money growth rates, possibly creating an economic slowdown or a recession. This scenario is especially relevant in today's economic environment, where money growth as measured by some monetary aggregates has been relatively strong over the past couple of years. The shorter the long run is, the more troublesome ignoring high money growth over this period becomes.

On the other hand, if no close relationship emerges for the United States even over fairly long time periods, then that evidence would support ignoring money growth as an inflationary factor, at least within the ranges of money growth experienced over the past 40 years. This finding would not necessarily be inconsistent with studies that have found a close long-run relationship because many of those studies include data from countries with high and volatile money growth rates. It may be the case that while a close relationship is apparent in the data when large changes in money growth are observed, no clear relationship emerges when the changes are relatively modest, such as in the United States. In those cases, other inflationary factors may dominate the effect of relatively small changes in money growth.

To investigate the length of the long run, an analysis was conducted that compares the relationship between money growth and inflation over eight-, four-, and two-year periods in the United States since 1959. The findings depend greatly on the monetary aggregate used to measure money growth. Broader definitions of money, namely the M2 and M3 monetary aggregates, provide results that suggest a relatively close relationship between

FIGURE 1 MONEY GROWTH VS. INFLATION, QUARTERLY U.S. DATA



SOURCES: U.S. Department of Labor, Bureau of Labor Statistics; Board of Governors of the Federal Reserve System; and DRI/McGraw-Hill.

money and inflation over a “long run” as short as four years. However, results using narrower definitions of money, namely M1 and the monetary base, show no clear relationship over any of these time horizons.

■ **Too Many Dollars: A Simple Theory of Inflation**

Before discussing the results of the analysis, it will be helpful to have in mind a simple textbook theory that is widely thought to explain the basic relationship between the money supply and prices. Inflation occurs when the *average* level of prices increases. Individual price increases in and of themselves do not equal inflation, but an overall pattern of price increases does.

The price level observed in the economy is that which leads the quantity of money supplied to equal the quantity of money demanded. The quantity of money supplied is largely controlled by the Federal Reserve.³ When the supply of money increases or decreases, the price level must adjust to equate the quantity of money demanded throughout the economy with the quantity of money supplied. The quantity of money demanded depends not only on the price level but also on the level of real income, as measured by real gross domestic product (GDP), and a variety of other factors including the level of interest rates and technological advances such as the invention of automated teller machines. Money

demand is widely thought to increase roughly proportionally with the price level and with real income. That is, if prices go up by 10 percent, or if real income increases by 10 percent, empirical evidence suggests people want to hold 10 percent more money.

When the money supply grows faster than the money demand associated with rising real incomes and other factors, the price level must rise to equate supply and demand. That is, inflation occurs. This situation is often referred to as too many dollars chasing too few goods. Note that this theory does not predict that any money-supply growth will lead to inflation—only that part of money-supply growth that exceeds the increase in money demand associated with rising real GDP (holding the other factors constant). This observation is used in the following section.

■ **Evidence on the Long Run**

To answer the question of how long the long run is, the relationship between money growth and inflation is examined across three time periods—two, four, and eight years. The question is whether the relationship between money growth and inflation is notably close over any of these time horizons, and, if it is, how clearly that relationship holds up over shorter time horizons.

MONEY GROWTH AND INFLATION

FIGURE 2a 2-YEAR AVERAGES



FIGURE 2b 4-YEAR AVERAGES

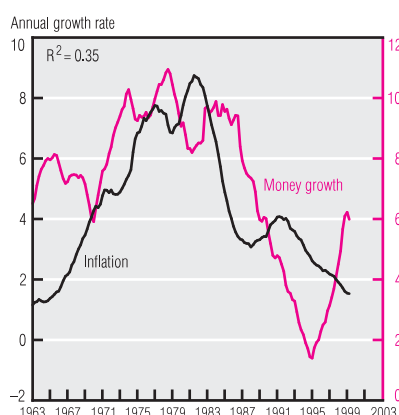
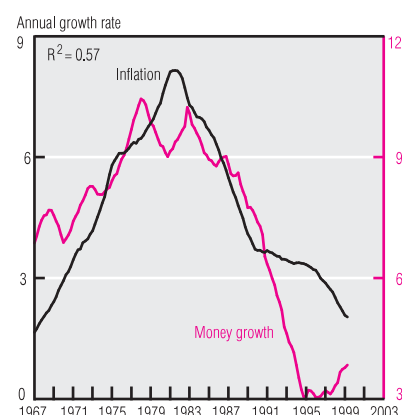


FIGURE 2c 8-YEAR AVERAGES



ADJUSTED MONEY GROWTH AND INFLATION

FIGURE 3a 2-YEAR AVERAGES

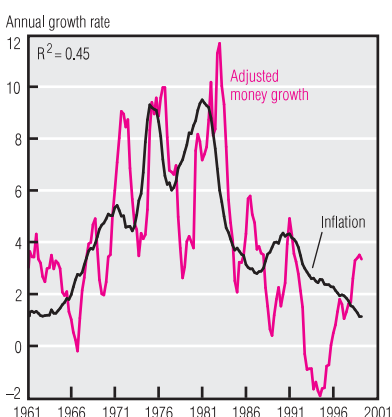


FIGURE 3b 4-YEAR AVERAGES

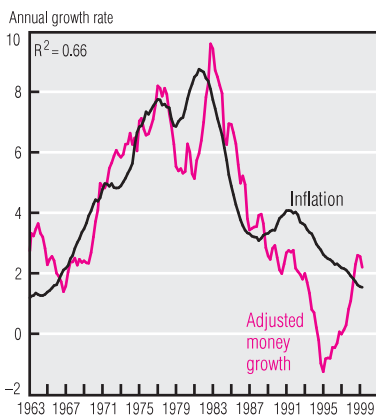
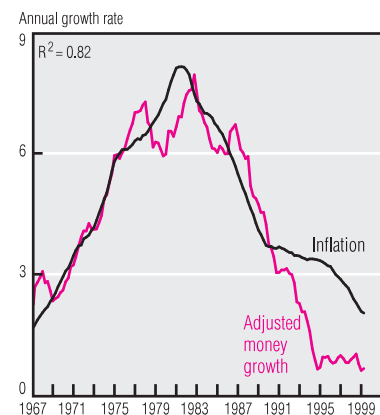


FIGURE 3c 8-YEAR AVERAGES



NOTE: Money is defined as M2. Inflation is defined using the implicit GDP price deflator (chained). Adjusted money growth is defined as money growth minus real GDP growth.

SOURCES: U.S. Department of Labor, Bureau of Labor Statistics; Board of Governors of the Federal Reserve System; and DRI/McGraw-Hill.

The strategy used to analyze the relationship is graphical. The analysis is conducted through a series of figures, each of which has the same basic form. The figures in the first set (2a, 2b, 2c) display averages of the inflation rate and money growth over time. What differs across the figures is the period over which the data are averaged. Each data point shows the average annual growth rate in inflation or money growth over the previous two, four, or eight years.

The figures in the second set (3a, 3b, 3c) are identical in form except that money growth minus real output growth is plotted instead of money growth alone.

Recall that the simple theory of inflation held that money growth in excess of real output growth should be more closely connected with inflation. It is of interest, then, to see whether adjusting for differences in real output growth across periods leads to a closer relationship.

The statistic labeled R^2 contained in each figure measures the fraction of the variation in inflation that can be accounted for by variations in money growth.⁴ An R^2 of 0 means that money growth accounts for none of the variation in inflation, while an R^2 of 1 says that money growth accounts for all of the variation in inflation.

Data since 1959 are used for the analysis. While data are available much farther back in time, the relationship between money growth and inflation was quite different in earlier years.⁵ Data from the most recent 40 years are likely to be more relevant to the current economic environment.

The simple theory of inflation outlined above provides no guidance as to the definition of money to be used. The M2 monetary aggregate, a fairly broad definition of money, is used in the graphical analysis. The results for other monetary aggregates are briefly discussed later.

Figure 2a shows two-year averages and illustrates again why policymakers are leery of relying on money growth to control inflation. It shows that even large movements in money growth have no clear relationship with movements in the inflation rate over two-year periods.

The relationship becomes somewhat closer for longer time averages, particularly the eight-year averages shown in figure 2c. There, the tent-shaped pattern of inflation, rising until the early 1980s and falling steadily since, is generally matched by the pattern of money growth. Slightly more than half of the eight-year movements in inflation are accounted for by changes in money growth (R^2 equals 0.57).

Figures 3a, 3b, and 3c display a parallel set of figures but with real output growth subtracted from money growth. These figures show that adjusting for differences in real output growth across periods provides a substantial tightening in the relationship between money growth and inflation. Figure 3c illustrates a strikingly close relationship between eight-year averages, with money growth accounting for more than 80 percent of the movements in inflation. Even using four-year averages, money growth accounts for two-thirds of the variation in inflation, and almost half using two-year averages.⁶

■ A Few Words of Caution

These results suggest that there is a close relationship between money growth and inflation in the long run. Furthermore, they suggest that the long run may not be long at all, perhaps as short as four years, once differences in real output growth across periods are taken into account. But before getting carried away with this apparently strong finding, it is important to note some qualifications.

First, to make use of the long-run relationship between inflation and money growth less real output growth, policymakers need accurate forecasts of real GDP growth over a relatively long horizon. Economic forecasters have had very limited success in providing them. Using the historical average of GDP growth as a forecast produces the same relationship displayed in figures 2a through 2c, a relationship that is substantially less clear.

Second, the results presented are based on only 40 years of data. There is a very limited amount of information one can extract from these data, especially regarding eight- and four-year averages. One should not be overconfident that the close relationship observed over these 40 years will continue into the future. Furthermore, the experience of the early 1990s illustrates that there can be notable deviations from the general relationship. For example, figure 3b shows that the four-year average of money growth minus real output growth slowed substantially from 1991 through 1995 and has increased rather sharply since. Despite the finding of a fairly close relationship between money growth and inflation using four-year averages, inflation fell steadily over this entire period. However, even taking into account these first two qualifications, the overall results reported in the figures are still rather compelling.

Perhaps the most important qualification is that the finding of a close long-run relationship is not consistent across various definitions of money. Recall that the monetary aggregate M2 was used in the previous analysis. When the analysis is repeated using M3, a broader definition of money, the results are similar to those reported for M2. However, when narrower definitions of money are used, namely M1 and the monetary base, the results are quite different. In particular, there is no clear relationship between money growth and inflation, even for eight-year averages.⁶

These qualifications demand that a more tempered view be taken of the findings reported in the previous section. While some long-run relationship appears to exist, at least for the broader monetary aggregates, it is difficult to state with much precision when this relationship begins to take hold.

■ The Current Situation

But suppose these qualifications are ignored for a moment. What would the close relationship between M2 growth and inflation using four- and eight-year averages tell us about the current economic situation? At first glance, the answer appears to be not much. The results simply describe historical relationships in the data, with economic forecasting playing no role. However, if the view is taken that the long run is a series of short runs, some insights might be gained by examining the recent behavior of money growth, output growth, and inflation.

Figure 2a shows that two-year average growth in M2 has increased substantially in recent years, up to about 7.5 percent. That represents the fastest two-year growth in M2 in over 10 years. Adjusting for the strong growth in real GDP in recent years, however, makes this rate of money growth appear less threatening. Figure 3a shows that money growth less output growth is only moderately greater than the current inflation rate and well within the historical pattern of fluctuations above and below the inflation rate.

However, if the recent growth rate of M2 were to continue in the next two-year short run, so that money growth averaged 7.5 percent over a four-year horizon, the findings reported here suggest that there may be an impending increase in inflation. Even if real GDP growth is assumed to continue at 4.0 percent over the next two years—a very optimistic assumption—the resulting increase in money growth less real GDP growth would average 3.5 percent over a four-year horizon.

Figure 3b shows that money growth less output growth of 3.5 percent over a four-year horizon has historically corresponded to an average inflation rate of roughly the same magnitude. A 3.5 percent inflation rate would represent a substantial increase over the 1.1 percent rate experienced over the last two years. If real GDP growth were to slow to less than 4 percent in the next two years, while M2 growth remained steady, the outlook for inflation would be more dire. Of course, if M2 growth slows over the next two-year short run, the implications for inflation are less negative, especially if output growth remains robust.

■ Conclusion

Little attention is currently paid to the growth rate of the money supply in formulating monetary policy—with obvious reason. The relationship between money growth and inflation from quarter to quarter and year to year is not well understood, and this is the time frame within which policymakers generally operate. In fact, it was the breakdown in a perceived short-run relationship during the early 1990s that led policymakers to largely de-emphasize money growth in formulating policy.

The graphical analysis presented here suggests that a relatively close relationship between money growth and inflation may exist over eight-year time horizons, at least for the broader monetary aggregates. This finding serves as a reminder that ignoring money growth for too long a period may be unwise. While money growth may not provide a particularly useful guide for short-run policymaking, long-run trends in inflation may still be largely determined by the long-run growth rate of the money supply.

■ Footnotes

1. For a recent example, see George T. McCandless, Jr. and Warren E. Weber, “Some Monetary Facts,” Federal Reserve Bank of Minneapolis, *Quarterly Review* (Summer 1995), pp. 2–11, which also provides a summary of other studies.
2. See, for example, the article by Robert E. Lucas, “Adaptive Behavior and Economic Theory,” *Journal of Business*, vol. 59, no. 4 (October 1986), p. 402. Lucas makes it clear that this assertion applies to long-run averages of money growth and inflation.
3. This statement abstracts from the difficulty inherent in controlling the money supply in practice. This is especially true for broader monetary aggregates such as M2 and M3, large parts of which respond to aggregate economic conditions.
4. For those readers familiar with regression analysis, this statistic is the regression R^2 obtained by regressing the inflation rate on the growth rate of the money supply and a constant. It is simply the square of the correlation between inflation and money growth.
5. See Lawrence J. Christiano and Terry J. Fitzgerald, “The Band-Pass Filter,” Federal Reserve Bank of Cleveland Working Paper No. 9906 (1999), for one illustration of the changing nature of the relationship between money growth and inflation before and after 1960.
6. The values of the R^2 statistic obtained by regressing the inflation rate on the growth rate of the money supply minus real output growth and a constant using eight-year averages of the growth rates of the monetary base, M1, and M3 are 0.20, 0.16, and 0.80, respectively.

Terry J. Fitzgerald is an economic advisor at the Federal Reserve Bank of Cleveland. He thanks Jeffrey C. Schwartz and Eduard Pelz for excellent research assistance.

The views stated herein are those of the author and not necessarily those of the Federal Reserve Bank of Cleveland or of the Board of Governors of the Federal Reserve System.

Economic Commentary is published by the Research Department of the Federal Reserve Bank of Cleveland. To receive copies or to be placed on the mailing list, e-mail your request to maryanne.kostal@clev.frb.org or fax it to 216-579-3050. Economic Commentary is also available at the Cleveland Fed's site on the World Wide Web: <http://www.clev.frb.org>.

We invite comments, questions, and suggestions. E-mail us at editor@clev.frb.org.

Now on our Web Site! See a glossary of terms used in this *Economic Commentary* when you visit us online.