

## Macroeconomics, Module 14: Inflation and Interest Rates

### *Homework Assignment: Statistical Relation Between Money Growth and Inflation*

(The attached PDF file has better formatting.)

The relation of inflation to money growth and real GDP is much debated by economists. After Milton Friedman published his *Monetary History of the United States* in 1963, the prevailing opinion shifted steadily to the monetarist perspective.

- Barro and many U.S. economists share Friedman's perspective. But other economists disagree, particularly in academia and outside the U.S.
- News magazines reflect a variety of perspectives. Journalists seek simple relations with clear story lines.

Barro shows the data to justify the monetarist perspective in the textbook. This homework assignment computes the regression lines linking the variables in the textbook.

### *INFLATION AND OVER-HEATING ECONOMIES*

Barro show the growth rate of real GDP in Table 11.1, along with the inflation rate and the growth rate of currency. If the inflation rate depends on currency growth, why show the growth rate of real GDP?

News magazines often say that inflation stems from an over-heating economy.

- If GDP grows rapidly, consumers have more income, which they spend on more goods.
- If the consumption goods are not available, too much money is chasing too few goods.
- The excess of demand over supply causes the price of goods to rise.

One often reads that a country – say, India or Peru or China – is growing rapidly, causing a danger of overheating and rising inflation. The policy prescriptions of this view are

- Central banks are supposed to dampen rapid growth so inflation does not accelerate.
- The U.S. FED should raise interest sensitive when the economy grows too rapidly, so that growth slows and inflation does not accelerate.

The Phillips curve of older economic theory assumed inflation was inversely related to unemployment. Higher inflation led to lower unemployment and a faster growing economy.

The original Phillips curve has been discredited. But a variant, the expectational Phillips curve, is still taught in many macroeconomics courses.

## *INFLATION AND MONEY GROWTH*

Barro's textbook does not discuss over-heating economies, Phillips curves, or relations of real economic activity with inflation. Short term relations may exist. In the long-run, Barro presumes inflation reflects the growth rate of currency.

- Over-heating is vague. Economies are not car engines that over-heat.
- Barro's textbook strives to be precise: What exactly causes inflation?

Barro says: Let us examine two relations:

- Economic growth (real GDP growth) and inflation.
- Money growth and inflation.

Barro uses long-term averages over forty years. He avoids short term relations that might have a one or two month effect and focuses on the long-term economic activity.

Friedman analyzed time series data for the U.S.: money growth and inflation each year. This analysis holds other economic variables constant, such as market system (socialist vs capitalist) and political systems (democracy vs autocracy).

Barro uses a more intriguing cross section of data: economic growth, money growth, and inflation over 40 years (1960 – 2000) from 82 countries. His conclusion is the same as Friedman's: Inflation stems from growth in the money supply, not growth in real economy.

[By the way: Friedman was an advocate of freedom. He believed that democracy was a pre-requisite for free markets and strong economic growth. Barro, examining the data from the last fifty years, finds that democracy promotes economic growth up to a point. Moderately democratic countries, such as Taiwan, Singapore, Indonesia, Brazil, do much better than autocratic countries, such as Russia, Cuba, Venezuela, and the Arab countries of the Middle East. But Western European countries that push democracy even further generally have lower growth rates than moderately democratic countries, when all other factors are held equal. Mainland China has separated political freedom from economic growth, and it has achieved high growth rates even with an autocratic government. Friedman's views are much liked by liberal democrats, but they do not apply once countries are moderately free.]

## CROSS COUNTRY DATA

Figure 11.1 shows data that support Friedman's perspective. This homework assignment compares two regression analyses.

- One analysis regresses inflation on real GDP growth. Do countries with higher GDP growth have higher inflation?
- The other analysis regresses inflation on growth in the money supply. Do countries with higher money growth rates have higher inflation?

To complete the homework assignment:

- Copy the Excel work-sheet with the data for 82 countries and three variables.
- Run the regression analyses using Excel's *regression* add-in.
- Copy the regression results from Excel to your written page:  $R^2$  and  $\beta$
- Explain what the results mean.

Barro says what the data imply. The homework assignment shows the regression coefficients which support the conclusions. For the homework assignment, explain the regression results.

The data are on the attached Excel spreadsheet. Use Excel's *REGRESSION* add-in:

- Click on the *TOOLS* menu, then click on *DATA ANALYSIS*, then click on *REGRESSION*.
- Excel 2007: select the *DATA* menu, click on *DATA ANALYSIS*, then click on *REGRESSION*.

The worksheet has range names for the data sets:

- InflationRate = B7:B89
- CurrencyGrowth = C7:C89
- RealGDP = D7:D89
- RealGDPCurrencyGrowth = C7:D89

Use either the range names or the cell references for the *REGRESSION* add-in.

*Part A:* Regress the inflation rate on real GDP growth.

- The Y values are InflationRate
- The X values are RealGDP.
- Select *LABELS* (the first cell in each named range is the label).
- Place the output on the same sheet beginning in Cell F7.

If faster growing economies have higher inflation rates, the regression coefficient should be positive, the  $p$  value should be low, and  $R^2$  should be high.

The regression has a negative slope coefficient and a low  $R^2$  (about 5%).

Explain what this implies about the relation between inflation and economic growth. The relation between inflation and real economic growth is weak. Can one infer that greater economic growth causes higher inflation? Should one infer the opposite? Or should one infer that the two variables have little relation with one another? Barro often mentions that it is hard to infer cause and effect from regression results.

*Part B:* Regress the inflation rate on growth of the money supply (currency).

- The Y values are InflationRate.
- The X values are CurrencyGrowth.
- Select *LABELS* (the first cell in each named range is the label).
- Place the output on the same sheet beginning in Cell F37.

If money growth causes inflation, faster growing economies have higher inflation rates, the regression coefficient should be positive, the  $p$  value should be low, and  $R^2$  should be high.

The regression has a positive slope coefficient, a  $p$  value that is extremely low, and an  $R^2$  that is high.

Explain what this implies about the relation between inflation and money growth.

*Jacob:* Barro says that a 1% increase in currency growth causes a 1% increase in inflation. But the regression equation has a slope coefficient of about 47%, not 100%. What causes this difference?

*Rachel:* The regression line does not pass through the origin. The intercept has an inflation rate of 5.3%. If we force the regression to pass through the origin, the slope coefficient is about 100%.

*Jacob:* Why doesn't the regression line pass through the origin?

*Rachel:* The data do not consider population growth and changes in the velocity of money.

*Illustration:* Suppose the true regression equation is Inflation = Currency growth per capita.

The sample has two countries:

- Developed country: inflation = 5%, currency growth per capita = 5%, population growth = 0%
- Developing country: inflation = 10%, currency growth per capita = 10%, population growth = 5%

The true regression line passes through the origin. But if we look at total currency growth, the two points are

- Developed country: inflation = 5%, currency growth = 5%
- Developing country: inflation = 10%, currency growth = 15%

Now the regression line has an intercept of 2.5% and a slope coefficient of 50%.

Developing countries often have high currency growth, high inflation, and high population growth. Many countries in Latin America and Africa have these characteristics. Developed countries often have low currency growth, low inflation, and zero population growth. Many Western European countries have these characteristics.

*Part C:* Optional: Regress the inflation rate on both real GDP growth and money growth.

- The Y values are InflationRate.
- The X values are RealGDPCurrencyGrowth. (This range has two columns.)
- Select *LABELS* (the first cell in each named range is the label).
- Place the output on the same sheet beginning in Cell F67.

The multiple regression equation confirms the result of the two previous regressions.

*Jacob:* The first regression equation has a negative slope coefficient. Does the regression imply that faster growing economies have less inflation?

*Rachel:* Not necessarily. The relation is weak and may be random fluctuation. It may also be that high inflation interferes with economic planning and dampens economic growth.

*Illustration:* Zimbabwe has enormous inflation and a deteriorating economy.

- The high inflation has hurt the economy, since firms can not set prices easily.
- But Zimbabwe has so many other attributes that ruin the economy (poor governance, price regulation, autocratic rule) that it doesn't prove a relation between inflation and the economy.

*Take heed:* If you have never used the *REGRESSION* add-in, see the instructions on the discussion forum for the regression analysis student project. This discussion forum may be found after the 24 modules in the regression analysis on-line course. The *REGRESSION* add-in is used in the regression analysis and time series on-line courses. If you have run regression analyses in Excel, the instructions here are superfluous; run the regressions however you like.

By the way, the data are ten years out of date. Countries which have changed from 1960-2000 vs 2000-2010. Japan was perhaps the world's best performer in 1960-1990, but it has been in recession for much of the past two decades. But this table does show overall economic growth and money growth rates for many countries.