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# Revival of Legacy of Tooke and Gibson: Further Evidence and Implications for Monetary Policy

**Abstract**: Traditional economics assumes that interest rate effects inflation by changing the aggregate demand (Barth and Ramay, 2002). On the other hand, many economists in recent years have explored the cost side effects of monetary transmission and found very strong evidences in favour of cost channel. One of such studies is that by Rehman (2015) which explores the relationship between interest rate and inflation for a large data set comprising various measures of interest rate and inflation from countries around the globe. Rehman (2015) computes the correlation between two variables and he finds that the correlation between two variables is either positive or insignificant. Rehman argues that the finding is quite robust and does not change with a change in measure of interest rate and/or inflation. If the correlation between interest rate and inflation is positive then using interest rate to control inflation would be counterproductive. Thus it will endorse the warning of Wright Patman, a US congressman and Chairman of Joint Economic Committee who argues that "senseless of trying to fight inflation by raising interest rate, throwing the gasoline on fire to put out the flames would be as logical". Findings of Rehman (2015) are based on correlation coefficients. The correlation without having control variables could only provide a clue and could be subject to serious missing variable bias. However, Rehman (2015) argues that thousands of similar clues from the entire globe collectively become very strong evidence. However, given the importance of the topic, it is necessary to do a more careful analysis and summarize the relationship between two variables which is not subject to missing variable bias. Therefore, this paper applies more sophisticated econometric techniques including Granger Causality and Static Long Run Solution to find the impact of interest rate and inflation.

**Keywords**: Cost Channel, Gibson Paradox, Tooke Banking School Theory, Monetary Transmission Mechanism, Monetary Policy Effectiveness

**JEL Classification**: E40, E42, E52

## 1. Background

Thomas Tooke, the forefather of monetary economics and the writer of the famous book 'Theory of Interest Rate and Prices' predicted a positive relationship between interest rate and prices. He argues that interest rate is a part of cost of production, therefore increasing interest rate would cause increase the price level. On contrary, the mainstream economics assumes that there should be negative relationship between interest rate and prices. The mainstream view is based on an indirect argument that by increasing the interest rate, the aggregate demand would be reduced, leading to a reduction in aggregate price level. This mechanism was labelled as demand channel of monetary transmission mechanism.

On the other hand, earliest empirical evidences have been supportive for Tooke's view and the mainstream economists have been searching excuses for what empirical evidences suggest. Gibson (1923) observed positive relationship between interest rate and prices in the UK over a period of 200 years. Keynes (1936) regards the evidence by provided Gibson as "one of the most completely established empirical facts in the whole field of quantitative economics'. However, mainstream economists could not absorb this observation, labelled it as a paradox not having a theory backup and have been searching explanations for this so called Gibson paradox.

Later on, economists have identified a large number of transmission mechanisms through which a monetary policy action could affect the price level and/or output. However, all of these channels ultimately affect the price level by change in aggregate demand or by change in aggregate supply curve. Therefore, these could be classified as demand side channels or the cost side channels. This classification could be found in Ghafari (2012).

After 1970s, the cost side economics attracted attention of economists and several economists explored the possibility of cost channel of monetary transmission mechanism and found strong evidence in favour of cost channel. Despite finding these evidences, monetary policy practices have been built on the assumption of demand channel and practices continued without paying any heed to the existence of cost channel. The famous Taylor Rule formalized the monetary policy and central banks converted the monetary policy instrument from money supply to interest rate. The Taylor rule is having its logical roots in the demand channel of monetary transmission mechanism.

In fact, the existence of cost side channels deserves the greatest attention because if the cost channel is there, the monetary policy could be counterproductive. There is no reason to assume that only demand sided channels of monetary transmission mechanism exist in an economy and it is also equally unreasonable to assume that there are only cost sided channels. An economy could have both types of channels working simultaneously. It may be quite interesting to explore how the economy will behave if both demand and cost sided channels are working simultaneously. A detailed discussion about impacts of monetary policy in presence of the two types of channels is given in Rehman (2015), which could be summarized as follow:

a. If the demand side channels are dominant, a tight monetary policy would lead to reduction in both prices and output.
b. If the cost side channels are dominant, a tight monetary policy would lead to increase in prices and a reduction in the output.
c. If the demand side channels and cost sided channels hold same strength, the effect of tight monetary policy on prices would be insignificant, and there would be twofold reduction in output.

Of course, the conduct of monetary policy is justified only when the demand channel dominates the cost channel and it could be counterproductive if cost channel is dominant. Therefore it is very important to explore what kind of transmission channel actually works or dominates. Rehman (2015) takes a big data set of interest rate and inflation for a large number of countries, and finds the correlation between the two variables. He concludes that the evidence support the dominance of cost channel. He shows that the evidence is robust to definition of interest rate and inflation, sample size, sample period, and the choice of a country.

The analysis of Rehman (2015) is based on simple Pearsonian correlation. No doubt the correlation without having a deeper structural model and control variables makes very week evidenc. But similar evidence collected from the entire globe strongly supports the dominance of cost channels. If the analysis was done for a single country, the unknown missing variable is more likely to affect the results, but when we are taking into account data from the entire globe, it is difficult to believe that there is a control variable which is pushing the correlation coefficient into positive direction for the entire world. However, since the data on monetary related variables are abundantly available, it would be quite reasonable to carry out more rigorous analysis of monetary policy actions of changing interest rate to control inflation. However to be more careful, the following section presents the results of Granger Causality between two variables taking into account different control variables. Therefore, this paper advances on Rehman (2015) and employs more sophisticated techniques, including Granger Causality and Static Long Run Solution, to unveil the nature of the relationship between interest rate and inflation. The details of this analysis and implied policy recommendations are summarized in this paper.

## 2. DATA AND METHODOLOGY

### a. DATA

The data used in this study are obtained from International Financial Statistics (IFS). All available data on prices and interest was utilized for the current study. The IFS provides data on seven measures of interest rate which are as follows:

1. Central Bank Policy Rate (CBPR)
2. Deposit Rate (DEPR)
3. Discount Rate (DR)
4. Government Bond Yield (GBY)
5. Lending Rate (LR)
6. Money Market Rate (MMR)
7. Treasury Bill Rate (TBR)

Similarly, data on two measure of inflation are available which are as follows:

1. Consumer Price Inflation (CPI)
2. GDP Deflator Inflation (GDPDEF)

The seven measures of interest rate and two measures of inflation formulate 14 combinations of measures of interest rate and inflation. The relationship between interest rate and inflation was calculated for all of these combinations, subject to availability of the respective series. Granger Causality and Static Long Run Solution were calculated without control variables and with various combinations of control variables separately. Following variables were used as control variables in the analysis.

1. Exchange Rate: Official Rate, End of Period (ER)
2. Industrial Production, unadjusted. (IP)
3. Import Unit Values / Import Prices (IUV)
4. Broad Money, Unadjusted (M2)

Exchange rate and import unit values were included as control variables to control the effects of prices of imported goods, industrial production was used as a proxy of GDP because for most of the countries, the quarterly GDP series are not available. Broad money was used to control the effect of monetary actions taken by central banks other than the change of interest rate. The quarter to quarter percent change of all control variables was used while calculating the Granger Causality and static long run solution, so that the issue of non-stationarity could be eliminated.

## b. SAMPLE PERIOD

For the fourteen combinations of interest rate and inflation mentioned above, I have collected data for the following sample specifications.

Time Series length =15 years i.e. 60 observations, for time period 1966-1980, 1976-1990, 1986-2000, 1996-2010.

Time Series length =20 years i.e. 80 observations, for time period 1965-1984, 1975-1994, 1985-2004, 1993-2012.

Time Series length =30 years i.e. 120 observations, for time period 1965-1994, 1975-2004, and 1983-2012

## c. ECONOMETRIC PROCEDURES

Following econometric tools were used to analyse the relationship between two variables.

1. Granger Causality
2. Contemporaneous Granger Causality
3. Static Long Run Solution

The Computational Details of these methods are given below:

## GRANGER CAUSALITY:

The concept of Granger Causality is based on the idea that the cause appears before its effects. Thus it tries to calculate the effect of past changes of the cause variable on the effect variable. Consider the following regression equation

$$\pi_t = a + \sum_{j=1}^{m} \left(\beta_j \pi_{t-j} + \gamma_j int_{t-j} + \delta_j X_{t-j}\right) + \varepsilon_t \quad (1)$$

Here $\pi$ represents inflation, *int* represents interest rate and $X$ represents the vector of control variables. The Granger Causality test is equivalent to the test of following restriction:

$$(\gamma_1, \gamma_2, \dots . \gamma_j) = 0$$

This restriction can be tested by standard F-test. Acceptance of restriction will imply that the lags of interest rate have no impact on inflation and the interest rate does not Granger Cause the inflation.

## CONTEMPORANEOUS CAUSALITY:

The Granger Causality is based on the idea that cause appear before its effects. However, in the era of perfect information, rational decision makers can make decisions instantly looking at the policy decisions of central banks. Thus no lag would be involved between monetary action and its impact. In this case, the equation of Granger Causality could be modified to take into account the current values of cause and control variable and equation takes following form:

$$\pi_t = a + \sum_{j=1}^{m} \beta_j \pi_{t-j} + \sum_{k=0}^{m} (\gamma_k i_{t-k} + \delta_k X_{t-k}) + \varepsilon_t \tag{2}$$

Here $X$ represents the vector of control variables. The Causality test is equivalent to the test of following restriction:

$$(\gamma_0, \gamma_1, \dots . \gamma_j) = 0$$

This restriction can be tested by standard F-test

## STATIC LONG RUN SOLUTION

The Granger Causality test can be used to explore whether or not the cause variable has some impact on the target variable. However, this test is not capable of giving the information about the direction (positive/negative) of the relationship. For this purpose the static long run solution could be used. The computational details are as follows:

Consider regression equation (1) or (2) again. Assume

$$\pi_t = \pi_{t-1} = \pi_{t-2} = \cdots = \pi$$

Similarly

$$i_t = i_{t-1} = i_{t-2} = \cdots = i$$

And

$$X_t = X_{t-1} = X_{t-2} = \cdots = X$$

And simplifying the equations, eq (1) will yield the static long run solution.

$$\pi = (1 - \beta_1 - \beta_2 - \cdots \beta_m)^{-1}\left[(\gamma_1 + \gamma_2 + \ \ldots . \gamma_j)i + (\delta_1 + \delta_2 + \ \ldots . \delta_j)X\right] + \varepsilon$$

This equation gives the static long run solution which also carries the direction of relationship between two variables.

Similar procedures could be applied to equation (2) which will give us the direction of relationship when zero lag term is also included among the regressors.

## RESULTS

For the data and econometrics procedures in section 2, I got thousands of results. It is really tough job to summarize the results of a large computation in a small volume; however, I have tried to summarize these results so that overall relationship between inflation and interest rate is uncovered. The results are divided into two sub-sections with the first sub-section summarizing the results of correlation analysis and the second one summarizing results of the Causality and Static Long Run solution.

It can also be seen that the results remain unchanged by changing the definition of interest rate and/or inflation, indicating robustness to the definitions of these variables.

The analysis of the distribution of correlation coefficients reveals that evidence for positive relationship between interest rate and inflation dominate the evidence of negative relationship and this evidence is robust to (1) sample size, (2) sample period, (3) definition of interest rate, (4) definition of inflation and (5) time lag between interest and inflation. However, the results may be subject to missing variable bias.

Table 3 presents the results of Granger Causality test and solved static long run solution for level relationship between interest rate and inflation. The Granger

Causality test is based on the logic that the cause variable occurs before its effect, therefore only lags of the cause variables are included in the regression as described in section 3. The first column in Table 3 gives the number of countries for which the data were available; next three columns present the quartiles of the coefficients of static long run solution. Column 6 gives information about the percentage of getting negative coefficient of static long run solution, column 7 gives information about significance of Granger Causality test. The last column gives information about percentage times we get a negative and significant relationship. For the pair (CPI, CBPR) and for period 76-90, we had data available for 10 countries. The coefficients of static long run relation for these 10 countries had first quartile on zero. This implies that the distribution is centred on positive side of the real line. Column 5 tells that 20% of these coefficients are negative, indicating that 80% of these coefficients are positive. Column 6 tells that 10% of the coefficients i.e. only one coefficient is significant and the last column tells that this one significant coefficient carries a negative sign.

**Table 1: Results of Coefficient of Static Long Run Level Relationship and Granger Causality Test Between Interest Rate and Inflation, without having control variables. Time Series Length= 15 years, 60 observations**

| Period | Inflation Type | Interest Type | Count | Q1 | Q 2 | Q 3 | Negative % | Significant % | Negative Significant % |
|---|---|---|---|---|---|---|---|---|---|
| **76-90** | CPI | CBPR | 10 | 0.00 | 0.29 | 1.03 | 20% | 10% | 10% |
| | | DEPR | 21 | -0.37 | 0.13 | 1.22 | 48% | 24% | 5% |
| | | DR | 19 | -2.16 | -0.11 | 0.69 | 53% | 37% | 16% |
| | | GBY | 21 | -1.08 | -0.12 | 0.73 | 52% | 24% | 10% |
| | | LR | 16 | -0.67 | 0.04 | 0.43 | 50% | 6% | 6% |
| | | MMR | 22 | -0.76 | -0.08 | 0.59 | 55% | 18% | 9% |
| | | TBR | 18 | -1.18 | -0.08 | 0.92 | 61% | 22% | 17% |
| | GDPDEF | CBPR | 5 | -0.13 | -0.01 | 0.08 | 60% | 20% | 20% |
| | | DEPR | 6 | -0.43 | 0.54 | 1.68 | 50% | 50% | 0% |
| | | DR | 3 | 0.81 | 1.33 | 2.73 | 0% | 67% | 0% |
| | | GBY | 12 | -0.11 | 0.46 | 0.90 | 25% | 17% | 0% |
| | | LR | 5 | 0.18 | 0.42 | 1.21 | 20% | 20% | 0% |
| | | MMR | 12 | -0.54 | 0.03 | 0.33 | 50% | 8% | 0% |
| | | TBR | 7 | -0.71 | 0.13 | 0.35 | 43% | 14% | 0% |
| **96-10** | CPI | CBPR | 25 | -0.09 | 0.13 | 0.46 | 36% | 28% | 0% |
| | | DEPR | 109 | -0.38 | 0.03 | 0.41 | 41% | 19% | 3% |
| | | DR | 57 | -0.26 | 0.06 | 0.34 | 44% | 23% | 5% |
| | | GBY | 29 | -0.16 | 0.07 | 0.23 | 41% | 7% | 0% |
| | | LR | 96 | -0.49 | 0.08 | 0.35 | 45% | 21% | 3% |
| | | MMR | 60 | -0.18 | 0.11 | 0.38 | 35% | 33% | 7% |
| | | TBR | 50 | -0.25 | 0.00 | 0.25 | 50% | 8% | 2% |
| | GDPDEF | CBPR | 11 | -0.15 | 0.15 | 0.35 | 45% | 18% | 0% |
| | | DEPR | 29 | -0.16 | 0.16 | 0.45 | 41% | 24% | 3% |
| | | DR | 16 | -0.03 | 0.32 | 1.01 | 31% | 6% | 0% |
| | | GBY | 23 | -0.23 | -0.04 | 0.27 | 52% | 9% | 4% |
| | | LR | 26 | -0.15 | 0.01 | 0.39 | 46% | 27% | 8% |
| | | MMR | 32 | -0.12 | 0.24 | 0.38 | 31% | 28% | 0% |
| | | TBR | 19 | -0.15 | 0.18 | 0.41 | 37% | 11% | 0% |

Q1, Q2, Q3: These columns present the quartiles of calculated coefficients of correlation for the respective row
Negative %: Percentage of negative coefficients
Significant %: Percentage of significant coefficients
Negative significant %: Percentage of significant coefficients carrying negative sign

If we analyse the results obtained for period 1996-2010, we see that data on the pair (CPI, CBPR) was available for 25 countries and median of the long run coefficients for these 25 countries is again on the positive side of real line indicating that the evidence of positive correlation is stronger than the evidence of negative relationship between these two variables. For the same pair, the Granger Causality test produced significant results for 28% of the countries and from these significant coefficients, all are associated with a positive sign. These results indicate that the relationship is insignificant for 72% of the countries, significant with positive coefficient for 28% of the countries and significant with negative sign for none of these countries. The pair (CPI, DEPR) for the same time period is available for 105 countries. For this pair, the relationship was insignificant for 81% of the countries, significant with positive sign for 16% of the countries and significant with negative sign for only 3% of the countries. The total results summarized in this Table 3 are 759, of which only 3% resulted in a significant coefficient with negative sign, whereas 17% of these coefficients were significant with a positive sign.

Table 2 presents results of Granger causality test and static long run solution calculated for longer data series. The results are not very different from the results obtained for shortened series. The median of the long run coefficients is positive in all cases indicating that the distributions of long run coefficients are positively centred for all of pairs of interest rate. In many cases, the first quartile is also positive, indicating that for these combinations, more than 75% of the long run coefficients are positive. Granger Causality test was significant for 38% of these coefficients and for only 3% of these coefficients; the results carried a negative sign. The results remained the same for two sample period summarized in the Table 2. Most importantly, the coefficient of Central Bank Policy Rate, which is the actual policy variable used by central bank, shows a similar behaviour, showing that this policy variable does not work as per the aim of the monetary policy but is rather counterproductive, and Granger Causes the inflation in positive direction, i.e. by increasing CBPR the inflation also rises.

**Table 2: Results of Granger Causality Test and Coefficient of Static Long Run Level Relationship Between Interest Rate and Inflation, Time Series Length= 30 years, 120 observations**

| | | | Count | Percentile 25 | Median | Percentile 75 | Negative | Significant | Negative Significant |
|---|---|---|---|---|---|---|---|---|---|
| **75-04** | CPI | CBPR | 8 | -0.20 | 0.41 | 0.52 | 25.0% | 37.5% | 12.5% |
| | | DEPR | 13 | 0.00 | 0.28 | 0.76 | 30.8% | 23.1% | 7.7% |
| | | DR | 16 | -0.02 | 0.45 | 1.19 | 25.0% | 50.0% | 12.5% |
| | | GBY | 18 | 0.41 | 0.50 | 0.59 | 16.7% | 38.9% | 5.6% |
| | | LR | 10 | -0.20 | 0.14 | 0.51 | 50.0% | 10.0% | 0.0% |
| | | MMR | 12 | -0.10 | 0.21 | 0.48 | 33.3% | 33.3% | 8.3% |
| | | TBR | 14 | -0.29 | 0.16 | 0.42 | 42.9% | 35.7% | 14.3% |
| | GDPDEF | CBPR | 5 | -0.01 | 0.02 | 0.35 | 40.0% | 40.0% | 0.0% |
| | | DEPR | 5 | 0.14 | 0.28 | 1.09 | 20.0% | 60.0% | 20.0% |
| | | DR | 3 | 0.34 | 0.82 | 1.35 | 0.0% | 66.7% | 0.0% |
| | | GBY | 12 | 0.07 | 0.71 | 0.79 | 25.0% | 33.3% | 0.0% |
| | | LR | 5 | 0.04 | 0.09 | 0.74 | 20.0% | 20.0% | 0.0% |
| | | MMR | 9 | 0.00 | 0.14 | 0.31 | 33.3% | 22.2% | 0.0% |
| | | TBR | 5 | 0.15 | 0.16 | 0.53 | 0.0% | 0.0% | 0.0% |
| **83-12** | CPI | CBPR | 10 | 0.23 | 0.43 | 0.57 | 10.0% | 70.0% | 0.0% |
| | | DEPR | 49 | 0.08 | 0.37 | 0.71 | 22.4% | 36.7% | 2.0% |
| | | DR | 28 | -0.02 | 0.30 | 0.64 | 25.0% | 35.7% | 7.1% |
| | | GBY | 21 | 0.24 | 0.33 | 0.46 | 4.8% | 57.1% | 0.0% |
| | | LR | 37 | -0.23 | 0.19 | 0.45 | 35.1% | 29.7% | 0.0% |
| | | MMR | 26 | 0.05 | 0.21 | 0.35 | 15.4% | 46.2% | 0.0% |
| | | TBR | 26 | -0.24 | 0.21 | 0.37 | 34.6% | 30.8% | 3.8% |
| | GDPDEF | CBPR | 7 | 0.09 | 0.31 | 0.47 | 14.3% | 28.6% | 0.0% |
| | | DEPR | 9 | 0.22 | 0.47 | 0.67 | 0.0% | 44.4% | 0.0% |
| | | DR | 6 | 0.25 | 0.45 | 1.09 | 0.0% | 66.7% | 0.0% |
| | | GBY | 19 | 0.24 | 0.44 | 0.56 | 5.3% | 36.8% | 0.0% |
| | | LR | 10 | 0.19 | 0.44 | 0.59 | 0.0% | 40.0% | 0.0% |
| | | MMR | 14 | 0.28 | 0.38 | 0.47 | 0.0% | 57.1% | 0.0% |
| | | TBR | 10 | 0.21 | 0.39 | 0.45 | 0.0% | 40.0% | 0.0% |

Q1, Q2, Q3: These columns present the quartiles of calculated coefficients of correlation for the respective row
Negative %: Percentage of negative coefficients
Significant %: Percentage of significant coefficients
Negative significant %: Percentage of significant coefficients carrying negative sign

Table 3 summarizes the coefficient of static long run solution and the significance of the Granger Causality test calculated with different sets of control variables. The Table summarizes the results for the Granger causality as well as for contemporaneous Granger causality. Computation of Granger causality is based on the assumption that cause occurs before the result, therefore does not involve the current value (zero lag) of the cause variable. On the other hand, contemporaneous Granger Causality is computed from a regression involving the current value of the cause variable as well. The results summarized in this table are calculated with five different sets of control variables and without any control variables.

Column 1 informs about numbers of sets for which we had the data to calculate the Granger Causality and Statics Long Run Solution. Therefore the Column 1 in Row 1 informs that for 34 data sets, we had the data on all control variables and therefore we get 34 results on Granger Causality. The Column 2 -4 give information about quartiles of the coefficients of interest rate in calculated regressions. Therefore, for the 34 sets we had, the first quartile of coefficients was -1.03, the median was 0.24 the third quartile was 0.81. The positive value of the median implies that more than half coefficients carry a positive sign, contrary to the conventional monetary theory. Colum 4 gives information of percentage of the coefficients of interest rate which was statistically significant. Therefore, column 5 of row 1 informs that out of the 34 sets, only 24% coefficients were found significant. This means for 76% of the data sets, the interest rate is not effective in changing inflation. The percentage of negative coefficients among is given in column 6 which includes both significant and insignificant coefficient. Therefore, for the 34 data sets summarized in row 1, only 41% of the coefficients were carrying negative signs. If the monetary policy was effective, the coefficient of interest rate as a determinant of inflation should be both negative and significant. The last columns gives information about the percentage of coefficients having negative sign and having statistical significance. The last column in row 1 informs that only 5% of the coefficients were negative and statistically significant. Therefore only 6% of regression carry an evidences of effectiveness of the monetary policy and remaining 94% coefficients indicate that monetary policy is either ineffective or counterproductive in achieving the monetary targets.

The Table shows that although the exact location of the quartiles of coefficient of interest rate is sensitive to the specification of control variable. However, the median remains on the positive side of real line for almost all the cases. This indicate that with every set of control variable, the evidence of positive correlation between interest rate and inflation is stronger. The finding that there is positive association between interest rate and inflation is robust to the control variables. For most of the cases, the percentage of significant coefficients remains less than 50%, indicating that insignificant relation between two variables is highly likely. The percentage of negative and significant coefficient is very small and it does not exceed 10%, except for one case. The difference between column 5 and 7 shows that the probability of getting a positive and significant coefficient is much higher compared to the probability of negative and significant coefficient.

**Table 3: Results of Granger Causality Test and Coefficient of Static Long Run Level Relationship Between Interest Rate and Inflation with different specifications of control variables, Time Series Length= 30 years, 120 observations**

| | | Control variables | Count | Q1 | Median | Q3 | Significant % | Negative % | Negative Significant % |
|---|---|---|---|---|---|---|---|---|---|
| **76-90** | Contemporaneous Granger Causality with four Control Variables | All | 34 | -1.03 | .24 | .81 | 24% | 41% | 6% |
| | Contemporaneous Granger Causality with three Control Variables | ER,IP,IUV | 55 | -.31 | .50 | .74 | 7% | 27% | 0% |
| | | MS,ER,IP | 34 | -.61 | .46 | 1.40 | 26% | 32% | 0% |
| | | MS,ER,IUV | 51 | .01 | .32 | .88 | 31% | 24% | 10% |
| | | MS,IP,IUV | 34 | -1.16 | .37 | .97 | 15% | 35% | 0% |
| | Contemporaneous Granger Causality Without Control Variables | None | 177 | -.46 | .17 | .89 | 25% | 40% | 9% |
| | Granger Causality (lagged) Without Control Variables | None | 177 | -.71 | .10 | .81 | 21% | 47% | 8% |
| | Granger Causality Test (lagged) with four control variables | All | 34 | -.40 | .19 | .90 | 38% | 44% | 9% |
| | Granger Causality Test (lagged) with three control variables | ER,IP,IUV | 55 | -.53 | .03 | .41 | 13% | 45% | 9% |
| | | MS,ER,IP | 34 | -.48 | .69 | 1.72 | 53% | 38% | 12% |
| | | MS,ER,IUV | 51 | -.25 | .32 | .96 | 33% | 31% | 8% |
| | | MS,IP,IUV | 34 | -.40 | .22 | .95 | 41% | 44% | 9% |
| **96-10** | Contemporaneous Granger Causality with four Control Variables | All | 56 | -.28 | .07 | .29 | 2% | 45% | 2% |
| | Contemporaneous Granger Causality with three Control Variables | ER,IP,IUV | 92 | -.13 | .15 | .38 | 25% | 39% | 10% |
| | | MS,ER,IP | 56 | -.19 | .09 | .40 | 11% | 43% | 7% |
| | | MS,ER,IUV | 81 | -.03 | .20 | .76 | 19% | 28% | 2% |
| | | MS,IP,IUV | 56 | -.04 | .24 | .50 | 21% | 34% | 2% |
| | Contemporaneous Granger Causality Without Control Variables | None | 582 | -.16 | .17 | .45 | 31% | 36% | 4% |
| | Granger Causality (lagged) Without Control Variables | None | 582 | -.23 | .07 | .37 | 20% | 42% | 3% |
| | Granger Causality Test (lagged) with four control variables | All | 56 | -.28 | .14 | .25 | 16% | 38% | 7% |
| | Granger Causality Test (lagged) with three control variables | ER,IP,IUV | 92 | -.15 | .08 | .25 | 16% | 43% | 10% |
| | | MS,ER,IP | 56 | -.32 | .06 | .26 | 13% | 41% | 4% |
| | | MS,ER,IUV | 81 | -.16 | .10 | .60 | 17% | 36% | 5% |
| | | MS,IP,IUV | 56 | -.23 | .15 | .28 | 14% | 36% | 4% |

## Summary and Conclusion

A change in interest rate can affect inflation in three ways:

1. If the demand side effects are dominant, then inflation shall reduce by increasing interest rate and the relationship between two variables should be negative. In this case, the use of tight of monetary policy shall be effective.
2. If the supply side (cost side) effects are dominant, then inflation shall increase by increasing interest rate and the relationship between two variables should be positive. The use of tight monetary policy in this case shall be counterproductive.
3. If the demand and supply side effects have similar strength, then the effects of interest rate on inflation shall be insignificant and only aggregate production will reduce by increasing interest rate. Use of tight monetary policy in this case would have no effect on price, but it would reduce the aggregate growth.

Analysing the relationship between two variables reveals that:

Using a variety of estimation techniques, a number of definitions of interest rate and inflation, different sample periods we find that the evidence for no relationship between interest rate and inflation are dominant. Including the control variables does not change the nature of results, no matter what kinds of control variables are used. The results supporting the dominance of demand channel of monetary transmission mechanism have very low percentage. The results reported in Table 1, 2 and 3 reveal that for many cases we did not find any single evidence in support of demand channel of monetary transmission mechanism. In cases where the relationship between two variables was found significant, the probability of getting a positive relationship is much higher, compared to probability of negative relationship. This relationship is robust to the definition of interest rate and inflation, sample size, sample period, estimation technique and presence, and specification of control variables.

Thus this analysis concludes that the history of monetary policy around the globe does not provide evidence of monetary policy functioning as anticipated by the authorities of central banks. On the contrary, evidence supports counterproductive results of monetary policy. Thus there is need to thoroughly revise monetary policy so that the desired targets could be achieved.

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