Analyzing the impact of monetary policies on macro-economic variables, especially on real output

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Abstract
The objective of the study is to find whether there is any loophole in the theory about the impact of monetary policies on macro-economic variables, especially on real output. To achieve this objective, rigorous qualitative analysis of the secondary literature has been done. The findings of the study show that the literatures regarding the impact of the monetary policies on macro-economic variables are full of confusing, contradictory and uncertain remarks and conclusions. In other words, there is imminent need of intensive research about the issue.

Keywords: Business cycle, case studies, central bank, employment, endogenous, exogenous, expansionary or contractionary, fed, hyperinflations, inflation, macroeconomic variables, monetary policy, money supply, monetary theory, narrative indices, OLG models, output, rate of interest, regressions equations, time series, vector auto regression (VAR) framework.

Introduction

Monetary economics overlaps considerable with macroeconomics and these two fields shared a large degree of common history over most of the past 80 years. This testimony especially became true after the monetarist/Keynesian debates during the 1970s which led to the integration of monetary economics with macroeconomics[14]. Monetary economics analyses the relationship between the supply of money and real output, real rates of interest, real exchange rates, employment, nominal interest rates and nominal exchange rates.[44]

Monetary policy is the process by which the government, the central bank, or the monetary authority of a country controls the supply of money, the cost of money, output, exchange rate, employment, inflation etc. to attain a set of objectives oriented towards the growth and stability of the economy. Theory on monetary policy gives knowledge to prepare proper monetary policy[24].

There are variety of models influencing the way of thinking of the economists and the policy makers about the role of monetary policy[25]. These models are helpful in highlighting key issues affecting the linkages between monetary policy and real economic phenomena. No tool kit of the monetary policy authority is complete without them.

However, it is important to begin with specified models, so that it is understandable what is missing in the simpler models. In this way, it can be justified which models provide insight into particular questions.

Robert Lucas[45] explained in a seminar the theoretical foundations of the models of economic fluctuations and enlightened that the money is the fundamental driving factor for movements in real output. The real business cycle models proposed by Kydland and Prescott[40] focusing explicitly on nonmonetary factors as the driving forces behind business cycles, split monetary economics from macroeconomics. Recently, the real business cycle approach is used to incorporate monetary factors into dynamic general equilibrium models. Now both macroeconomics and monetary economics share the stochastic approaches to model the aggregate economy.

Despite the close connection, the contents of monetary economics and macroeconomics are different. The center attention of monetary economics is the price level determination i.e. inflation, output, rate of interest, employment and the role of monetary policy. This study limits itself on the most important issues in monetary policies that explain the interactions between real and monetary factors. It discusses briefly the issues of monetary theory and policy for institutions like the central banks, government etc. and analyzes their efficacy.

Monetary policy nowadays stresses the need to understand the strategic interactions between the central bank and the business sector. It focuses on interest rates and monetary policy of policy institutions. Some central banks orient toward the quantity of money, however, the most authorities of monetary policy emphasize on the control of money supply and money demand[14].

The content of monetary economics is vast; this study concentrates only on a brief but concrete and depth introduction to important theories. It is hoped that the reduction of the dimensionality of the respective issues has the right balance, insight, accessibility and rigor to analyze their applicability in praxis.

There are three alternative modeling strategies for monetary theories; these are the representative agent models and overlapping generations (OLG) models and the equilibrium relationships models. By critics, they are described as ad hoc, however, these models have helped economists and practitioners understand issues in monetary policies.

There are several reasons for ignoring the OLG approach. Sargent[56] and Champ and Freeman studied monetary

policies using OLG models. Many of the issues studied in OLG approach require understanding the time series behavior of inflation or the relationship between money and business cycles. The theoretical framework of OLG model is helpful to map the behavior with actual data. With infinite horizon representative agent models, this mapping can be done more easily than with OLG models. In principle, this advantage is one reason why the real business cycle models are popular. Other reason for the usefulness of the representative agent models is that they provide a close link between monetary economics and other popular frameworks for studying business cycle phenomena.

Generally, monetary policy issues are related to the dynamic behavior of the economy over time periods associated with business cycle frequencies. In this relationship, again the OLG framework is less directly applicable. OLG models stress on the store-of-value role of money at the expense of the medium of exchange where money plays a facilitating role. McCallum[47] argues that OLG models lack the medium of exchange role for money.

McCandless and Weber[48] use data of 110 countries covering 30 years and different definitions of money to examine the impact of monetary policy. They find proof of relationships between monetary policy and average rates of inflation, output growth and the growth rates of money. They draw two primary conclusions.

The first conclusion is that the correlation between the growth rate of the money supply and inflation is almost 1 (one). Actually, depending on the definition of the money, it varies between 0.92 and 0.96 which indicates strong positive correlation between inflation and money growth and it is consistent with studies made on smaller samples and different time periods in different other countries.[1,32,35,46,52] This correlation supports the basic doctrine of the quantity theory of money that a change in the growth rate of money induces ‘‘an equal change in the rate of price inflation’’.[46] Other explanation of the high correlation could be that other factors (price hike of production factors) generate the inflation and central banks adjust it with money supply.[34]

The explanation of correlations between money supply and inflation also depends on the statistical properties of the underlying series. However, the question is how a change in the growth rate of money causes inflation unless there is actually a shift in the growth of money[26]. McCallum[47] shows that regression tests of long run relationships between money and inflation may be misleading if expectational relationships are involved. McCandless and Weber[48] conclude that there is no correlation between either money growth and inflation or inflation and the growth rate of real output.

There are countries with low growth of money, low inflation rate and low growth of output. There are also countries with high growth of money and high rate of inflation and low growth of output. Again, there are countries with every other combination as well. For some OECD countries, McCandless and Weber[48] testify positive correlation between money growth and growth of real output, but no inflation. For a sample of 50 countries, Kormendi and Meguire[38] and for the USA, Geweke[32] found that there is no long run effect of growth of money on the growth of real output. In a cross-country sample, Barro[4,5] on the contrary, notice a negative correlation between the same.

Similarly, in the USA enduring monetary shocks could not ensure stable shifts in GDP. It means, in the long run regarding the relationship between real growth and inflation, there is greater uncertainty. However, there is general consensus which could be expressed by, ‘‘about which there is now little disagreement, … … that there is no long run tradeoff between the rate of inflation and the rate of unemployment’’.[62]

It is important also to investigate the relationships among money supply, interest rates and inflation. According to Fisher et al[26], the real rate of return plus the expected rate of inflation equals the nominal interest rate. In the case that the real rate of return is independent of inflation, the nominal interest rate would be positively related to expected inflation. This leads to suggest that the nominal interest rate is positively correlated with average rate of inflation in terms of long run correlations. It leads to conclude that the average rate of inflation is positively correlated with average growth rate of money.

Similarly, nominal interest rate and growth rate of money are positively correlated. From a survey on 31 countries, Monnet and Weber[50] find a correlation of 0.87 between money growth and long-term interest rates. They further find that the correlation between money growth and long-term interest rate for the developed countries is nearly 0.70 and it is 0.84 for the developing countries. These evidences support Fisher theory.

The types of long run relationship between money supply and other macroeconomic variables are important to test how well the steady state theory matches the data. Economists are also interested to understand how monetary phenomena and monetary policy affect the macroeconomic variables over time periods such as months or quarters i.e. in short run. In short run the monetary policy authority responds in different ways to similar economic disturbances. Hence, in short run the correlations between money supply and the macroeconomic variables are likely to vary across countries as the sources of economic disturbances vary.

Some survey has been done to find correlations between real GDP and three different monetary aggregates.[1] Survey in the USA shows that the real output changes substantially with the changes of the monetary base from M0 to M2 and M0 is positively correlated with real GDP at both leads and lags of the economic growth. However, M2 is positively correlated

at lags but negatively correlated at leads. It means high GDP is formed by high M2, but it is followed by low GDP. The positive correlation between GDP and money supply indicates that movements in money lead movements in output.[19]

Kydland and Prescott[39] compute cross correlations between real GDP and several interest rates[2] and between real GDP and the GDP deflator. They find that the three interest rate series has similar correlations with real output; however, the correlations are smaller for longer term rates. Low interest rate tends to lead to promote growth of output; nevertheless, a rise in the output tends to increase the interest rates. When output goes above the trends, the GDP deflator sinks below the trend and increase in real output is followed by increase in price. From this finding, Kydland and Prescott[39] suggest that supply shocks and not demand shocks are responsible for business cycle fluctuation. They conclude that aggregate supply shocks cause prices to be countercyclical and demand shocks cause prices to be pro-cyclical, but sticky prices may cause demand shock.

Nearly all economists agree that in the long run money supply effects mostly prices and it has little impact on real macroeconomic variables. They believe further that monetary disturbances can have important effects on real variables such as output in the short run[39]. The time series correlations suggest short run relationships between money and income, but the explanation of effects of money on real output needs more than these simple correlations.

Classic study of the relationship between money and business cycles by Friedman and Schwartz[29] represents the most influential empirical evidence that shows that money does matter for business cycle fluctuations. The study is based on 100 years of data from the USA. It provides the systematic evidence that change in the money growth rate leads to change in real economic activity which may be considered to support a causal relationship. It opposes the view that monetary factors play no important role on business cycles[39]. Friedman and Schwartz[28] conclude that faster money growth is followed by increases in output above trend and slowdowns in money growth are followed by declines in output. That means variations in money growth rates cause variations in real economic activity.

Evidences based on timing patterns and simple correlations do not explain the true causal role of money because the central bank and the banking sector respond to economic developments, the movements in the monetary aggregates are not exogenous and the correlation patterns need not reflect any causal effect of monetary policy on economic activity. If the central bank implements monetary policy by controlling the short-term market interest rate, the nominal stock of money is affected both by policy actions and by developments in the economy that are not related to policy actions. Economic expansion normally leads banks to expand lending in ways that increase the stock of money, though the central bank policy remains unchanged. So, if money stock is used to appraise monetary policy, the relationship observed in the data may reflect the impact of output on money and not the impact of money and monetary policy on output.

The positive correlation between money and output that Friedman and Schwartz interpreted as evidence that money supply causes output movements, can in fact reflect just the opposite. That means, growth of output may cause supply of money[63]. In this regard, King and Plosser provide a reverse causation argument. They explain that the monetary aggregate such as M1 includes the liabilities of the banking sector, which is highly correlated with output movements than the liabilities of the central bank. They argue that much of the correlation between M1 or M2 and output arises out of the endogenous response of the banking sector to economic disturbances and are not caused by the result of monetary policy actions. Coleman[19] finds that money in the model does not match the lead lag relationship in the data. Supply of M2 leads output whereas money is highly correlated with lagged output than with future output.

Changes in the money stock are endogenous and cannot be considered as the result of monetary policy actions. The behavior of short-term nominal interest rates, the three months treasury bill rate, the federal funds rate and detrended real GDP support the notion that monetary policy actions contribute to business cycles; and interest rates increase prior to economic downturns. However, it cannot be inferred whether this is evident that monetary policy causes or contributes to cyclical fluctuation. The movements in interest rates may simply reflect response of central bank to the state of the economy.

Trend diagrams and correlations are suggestive but cannot be decisive. The combined movements of output, monetary aggregates and interest rates may be caused by other factors. The comparisons with business cycles ignore information about long run behavior of money, output and interest rates which determine what impact monetary policy has on output. And the variables which are used to estimate the impact of monetary policy depend on the ways of implementation of the policy.

One of the earliest attempts to estimate the impact of money supply was time series econometric[30]. Friedman and Meiselman[30] try to find whether monetary or fiscal policy is relevant for nominal income. They find much more stable and statistically significant relationship between output and money than between output and expenditures.

In their finding, the impact of money on nominal income was quite strong and it was concluded that monetary actions play a more prominent role in economic stabilization.

Like St. Louis equation, the regressions equations[3,16,31] have been employed to investigate the connection between real

economic activity and money. Sims[58] introduced the notion of Granger causality to explain the real effects of money.

Using log levels of U.S. nominal GNP and money (both M1 and the monetary base) Sims finds evidence that money Granger causes GNP[57]. It means that past behavior of money helps to predict future GNP. He uses index of industrial production to measure real output and finds that the fraction of output variation explained by money is considerably reduced if a nominal interest rate is added to the equation. It explains that the conclusion is sensitive to the specification of the log price level and an interest rate.

Eichenbaum and Singleton[21] find that if the regressions are specified in log first difference form rather than in log levels with time trend, money appeared to be less important. In testing whether money Granger causes real output, Stock and Watson[60] use systematic treatment of the trend specification and find that money does help to predict future output even when prices and interest rates are included.

In forecasting output, numerous authors have examined different monetary indicators. Sims finds that interest rate reduces the apparent role of money. The reason is that short term interest rate provides a better measure of monetary policy action rather than money supply. In forecasting real output, Friedman and Kuttner[27] and Bernanke and Blinder[10] among others look at the role of alternative interest rate measures.

Barro[4-7] tested the impact of unanticipated money on real output and obtains that only the unanticipated part of money affects real variables. Mishkin[49], however, finds a role of anticipated money as well. Cover[20] uses a similar approach to find impact of money on real output and notice differences in the impacts of positive and negative monetary shocks. Negative shocks have significant effects on output, while the positive shocks have small effect and it is statistically insignificant.

At this stage of discussion, it is useful to ask whether regression equations proposed by Sims can be used for policy purposes. In other word, the question is, can Sims regression equation be used to design a policy rule for setting the central bank's policy. The answer of this query is negative and the search continues. And in these regards, subsequently dissatisfaction improved equations have been developed and tested[14].

The lesson learnt is that policy cannot be designed without a theory of how money affects the economy. "Theory should identify whether the coefficients in regression equation specified in this or other form remain invariant as policy changes".[15]

As estimated, output equations over a single policy regime do not allow us to identify the true structure, information from several policy regimes may help us to do so. A change in a policy regime means the change in the coefficients of the policy rule. This helps to identify whether an equation in this or other form is policy invariant.

To study monetary policy and real economic activity for estimating the impact of money on the economy, Sims[56,57] adopts vector auto regression (VAR) framework. The development of this approach has moved from bivariate[57] to trivariate[56] to larger and larger systems.[18,43] Estimating the impact of money, Christiano, Eichenbaum and Evans[18] make a thorough discussion about the use of VARs.

Sims[58] estimates different VAR evidences on money and output for France, Germany, Japan, the United Kingdom and the United States using a common specification that includes industrial production, consumer prices, a short-term interest rate as the measure of monetary policy, a measure of the money supply, an exchange rate index and an index of commodity prices. Sims orders the interest rate variable first. Sims find similar response of real output to an interest rate innovation for all five countries. In all five countries, the response of monetary shocks leads to an output that follows a hump-shaped pattern. The negative output has a contractionary shock and builds a peak after several months and then gradually dies out.

Eichenbaum[22] compared the effects of monetary policy in the USA using alternative policy shocks. He uses in VAR four variables: the price level, output, M1 and the federal funds rate as interest rates. He finds that a positive innovation to M1 is followed by an increase in the federal funds rate and a decline in output. The interest rate rises after a positive M1 shock. It is a puzzling result. Gordon and Leeper[33] find a similar puzzle using total reserves as monetary policy shocks. They suggest a rise in reserves raised market interest.[17,36,41,51,61] Again Eichenbaum[22] used measure of monetary policy actions the innovations in the short term interest rate.[23] In this case, he finds a positive shock to the funds rate representing a contractionary policy shock. No output puzzle was detected. However, there was a positive interest rate shock and a decline in the output.

Sims concludes that the ordering has little impact on the results because the correlations among the VAR residuals are small. The explanation for the price puzzle is that the variables included in the VAR do not cover the information. It may be case as for example that the funds rate has been raised forecasting that inflation may increase. So, if the factors are not offset that led to higher inflation, the prices rise. This explanation of the price puzzle is consistent, so the solution is to include commodity prices or other asset prices in the VAR.

Barth and Ramey[9] propose an alternative clarification of the price puzzle. They explain that contractionary monetary policy has impact both on aggregate supply and aggregate demand. Reduction of supply increases prices but lowers output. It is the so-called cost channel of monetary policy.

For Barth and Ramey[9], the price puzzle is the evidence of the cost channel rather than evidence that the VAR is not specified.

The federal funds rate is the key policy instrument in the USA. Some authors suggest that this provides good estimates of policy shocks.[10,11] Despite the fact that Fed's[13] operating procedures change over time, the funds rate is the best indicator of policy in the USA.

Though authors differ on the best means of identifying the policy shocks, there is a consensus on the nature of the responses to monetary policy shocks. VARs over a number of countries indicate that in response to a policy shock output follows a hump shaped pattern and there is a peak impact several quarters after the initial shock. Hence, in anticipation of inflation, monetary policy actions have to be taken considering that price puzzle occurs if commodity prices are not included in the analysis.

VAR Approach has been criticized on several grounds, especially, a contractionary policy by funds rate shock tends to increase price level which is troublesome. VAR ignores information that is available to policy makers. Many VAR models do not incorporate forward looking variables. Besides, the residuals of VAR regressions used to represent exogenous policy shocks fail to explain past policy actions and periods of contractionary and expansionary policy[54]. They claim as the objective is to know whether a recession is caused by a policy shock, it is important to know if and when the policy shock occurs. They differ in the specification of the VAR and conclude that if alternative specification gives different and inconsistent results about policy shocks, their usefulness as a tool would be limited.

In addition to the most commonly used VAR approach, other two approaches have gained academic importance. One such approach derives policy direct from the interpretation of policy statements, the other is based on case studies of disinflations.[12,53] Boschen and Mills[12] take integer values from - 2 (strong emphasis on inflation reduction) to + 2 (strong emphasis on ''promoting real growth'') to develop an index of policy stance alternative to VAR statistical approach. They translate the Fed's policy record directly. Their proposal instigated discussions and comparisons of some other indices of policy. Innovations in their index correspond to expansionary policy shifts which are followed by subsequent increases in monetary aggregates and declines in the federal funds rate. The narrative indices examined by them let draw similar conclusions about the impact of policy on monetary aggregates and the funds rates. They concluded that for monetary policy, funds rate is a good indicator.

In examining Fed's Record of Policy Actions, Romer and Romer[53] find six different months in which contractionary policy shifts occurred. These were designed to reduce inflation. Assessing Romers' narrative approach critically, Hoover and Perez[37] concluded that the dates were associated with oil price shocks. In this relationship, Leeper[42] states that Romers' policy variable does not generate dynamic effects on output and prices, which is the general belief about the effects of monetary policy. The narrative indices of Boschen and Mills along with the dating system of Romer and Romer to isolate episodes of contractionary policy present a useful alternative to the VAR approach which associates policy shocks with serially uncorrelated innovations.

The VAR approach attempts to identify exogenous shifts in policy and the estimated effects of these exogenous shifts. It proposes theoretical models for making predictions. To test whether the data are consistent with the predictions of a model, such exogenous shifts have to be isolated empirically. Isolating the data, the authors, however, do not consider whether the policy is expansionary or contractionary.

The narrative indices offer better assessment of the policy; however, they include both exogenous shifts in policy and the endogenous response of monetary policy to economic developments. For most of the changes in policy variables observed e.g. the funds rate as policy responds to current and future expected economic conditions, the latter accounts for the most. In principle, the case studies of disinflation of specific episodes give alternative ways of assessing the real impact of monetary policy. Method of dating periods of contractionary monetary policy is one form of case study introduced by Romer and Romer's. However, the most influential example of case study has been presented by Sargent[55] who examined several hyperinflations.

The discussion regarding the difference between anticipated and unanticipated changes in monetary policy has played formerly an important role among the academics and it has been accepted that that anticipated changes in monetary policy affect prices and inflation with little or no effect on real economic activity. In other words, it means that a credible monetary policy can reduce inflation without causing a recession which sharply contrasts the view that any monetary policy designed to reduce inflation caused economic slowdown and higher unemployment.

Sargent[56] examined the hyperinflations in Austria, Germany, Hungary and Poland after World War I that caused unemployment. He found that hyperinflations ended suddenly and the output cost was relatively low. On the contrary, he mentions that per one percentage point inflation reduction, the USA losses $220 billion GNP''.[55] After the experiences of the moderate inflations in the industrialized economies in the 70s and early 80s of the past century, Sargent's conclusion has been questioned. The case study approach can estimate real impacts of monetary policy. In the VAR approach it has to be addressed to what extent the disinflations are exogenous and the resulting output or unemployment movements attribute to inflation reduction. If the impacts of policy are to depend on whether they are anticipated or not, the estimates of the cost of disinflation are

to be computed by averaging of the episodes of considerably differences.

Findings and Conclusion

The literature review shows that explaining the relationship between monetary policy and macro-economic variables successively different models and equations have been developed and the literature is full of confusing, contradictory and disappointing conclusions. In brief the findings of the literature review could be expressed as follows:

- To explain the relationship between monetary policy and macroeconomic variable, various models are developed, by critics, the models are described as ad hoc, however, these models help to understand issues of monetary policies.
- Monetary policies are related to the dynamic behavior of the economic issues over time periods associated with business cycles. In this relationship, the OLG framework is less directly applicable and lacks the medium of exchange role for money.
- The regression tests of long run relationships between money and inflation are misleading.
- There is no reliable correlation between either money growth and inflation or inflation and the growth rate of real output.
- There are economies with low growth of money, low inflation rate and low growth of output. There are countries with high growth of money and high rate of inflation and low growth of output. Further, there are countries with every other combination as well. It means regarding the relationships between money supply, real growth of output and inflation in the long run perspective, there is greater uncertainty.
- There is little disagreement that there is no long run tradeoff between the rate of inflation and the rate of unemployment.
- There is a general consensus among the authors that in the long run, money supply has little expected impact on real macroeconomic variables; it affects mostly prices.
- If money stock is used to appraise monetary policy, the relationship observed reflects the impact of output on money and not the impact of money and monetary policy on output.
- The behavior of short-term nominal interest rates supports the notion that monetary policy actions contribute unexpectedly to business cycles.
- The movements of output, monetary aggregates and interest rates are caused probably by other unspecified factors but money supply.
- Interest rate policy reduces the apparent role of money. Short term interest rate provides a better measure of monetary policy action rather than money supply.
- The unanticipated part of money affects real output.
- Contractionary monetary policy has impact both on aggregate supply and aggregate demand and reduction in supply increases prices but lowers output.
- About VAR Approach, the authors conclude that if alternative specification gives different and inconsistent results, its usefulness as a tool is to be considered as limited.
- Regarding narrative approach, it is concluded that the policy variable does not generate dynamic effects on output and prices; it is however the general belief about the effects of monetary policy.
- Monetary policy designed to reduce inflation can cause economic slowdown and higher unemployment.
- Hyperinflations ended suddenly and has relatively low output cost; however, one percentage point inflation reduction using monetary policy can cost huge GNP.

The literature review shows that academicians attempted systematically to explain and measure the impact of the monetary policy on the different macroeconomic variables, especially on output. To achieve the objectives, different theories, models and equations have been proposed and tested mostly with dissatisfactions. It has been found that the impact of monetary policy on the growth of output depends on method how it is measured. If an incorrect measure of monetary policy is used, the empirical estimates can be significantly different.

About the effects of policy shocks, the disagreement is greater than the agreement. It means that the challenge of developing appropriate new models and equations is there and it is hoped that developed information technology and knowledge will enable some bright academicians to fill in this research gap.

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(Received 01st February 2020, accepted 22nd February 2020)

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