Can Monetary Policy Be Used To Extract cues of Financial Instability

Bhupesh Joshi

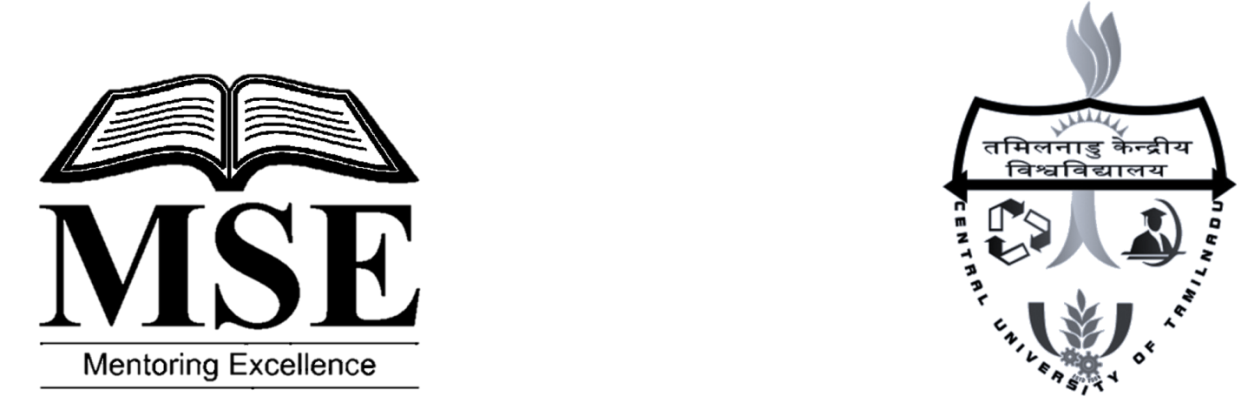
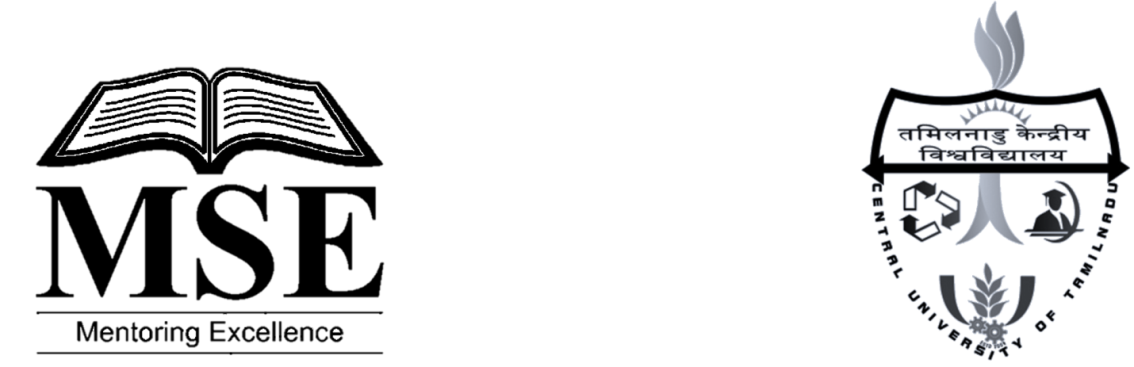
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**BONAFIDE CERTIFICATE**

Certified that this Project Report titled **“Can Monetary Policy Be Used to Extract cues of Financial Instability”** is the bonafide work of **Mr. Bhupesh Joshi** who carried out the project under my supervision. Certified further, that to the best of my knowledge the work reported herein does not form part of any other project report on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate

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# ABSTRACT

This paper is an attempt to understand the monetary policy during the period leading to the financial crisis of 2007-08. The financial crisis has been termed by many as consequence of the conduct of monetary policy by the Federal Reserves (FED). It has also increased the debate amongst the researchers about the role and objectives of FED. The deep integration of financial market in lives of general masses increases the impact of financial shocks. This has led many to ask for explicitly targeting the asset prices through monetary policy.

This study shows that indeed the monetary policy was too loose and significantly contributed to the housing boom. The FED must be held accountable for it. Moreover, we did not find any evidence from financial market indicators that could be explicitly incorporated in the policy rule and would have prevented the financial catastrophe. The paper is concluded on a note that business cycles are an integral part of the economy, hence cannot be completely avoided. However, FED should be cautious of its actions, to create a crisis as big as to cause the “Great Recession”.

# Introduction

Macroeconomics, in its current form, is a combination and interaction of business cycles and monetary policy. The history of business cycles can be traced back from Jevons and Juglar to Mitchell, and monetary theory, to the work of Hume, Thornton, Ricardo, Wicksell, and Fisher, supplemented by the circular flow analysis of Quesnay and Marx[[1]](#footnote-1).

Business cycles, an indigenous part of an economy have troubled economists for long. One of the primary aims of economics is to explain business cycles and to regulate it. Therefore, various economic institutions in an economy work in the direction “*to extend the period of expansion and curb down the effects of contraction*”. The central bank of a country is one such institution.

Federal Reserve, the central bank of the United States, was created by the Congress to provide the nation with a safer, more flexible, and more stable monetary and financial system[[2]](#footnote-2). One of the five functions, as listed by the Fed, is “Conducting the nation's monetary policy”.

Monetary theory, dealing with prices, money, and output was initially explained by the “Quantity theory of money” and it has evolved long way since then. Monetary theory suggests how different monetarypolicies can benefit nations depending on their unique set of resources and limitations. However, as Milton Friedman (1968) clearly articulates monetary policy has its limits.

The role of monetary policy and its independence has been debated since the establishment of Bank of England in 1694. However, since Paul Volcker, the former chairman of the Fed it has settled; at least in the United States, to keep inflation low and stable. This produced a prolonged period of stability (both economic and financial) from the mid-1980s through 2007. This period is often referred to as the period of “Great Moderation”[[3]](#footnote-3).

It is the kind of period that Minsky (1974) was referring about when he said “Stability breeds instability”. The financial markets which are heavily influenced by the monetary policy is one of the primary components of instability. The instability in economy originates from the financial market, be it the “Great Depression” or the “Great Recession”.

In this paper, we will try to examine the monetary policy rule. Section 2 and 3 briefly deals with the role of central bank and the financial crisis of 2007-08. A comparison is drawn between the policy rule followed by the FED and the Taylor Rule (proposed by John B. Taylor) in Section 4 of the paper. Section 5 further analyses the role of monetary policy in stabilizing the financial market and will try to answer the question “Whether monetary policy should explicitly target the asset prices”? Section 6 will provide a counterfactual scenario for the housing statistics with the various rule proposed. Section 7 concludes the paper by summarizing the main finding of the study.

# Economy, Crisis and Role of Central Bank

Business cycles are an integral part of almost every economy on this planet. Every boom is followed by a bust and every trough by a high. Business cycles and financial crisis are not a new phenomenon. The history of financial crisis in an economy can be traced back to 1st Century. It was a “financial panic” caused by mass issuance of unsecured loans by the Roman Banking houses. If we broadly analyse all financial crisis till date, we will find almost the same reason for a many of them. Whether be it the 1st Century Crisis or the 14th Century Banking Crisis or the Tulip Mania or the 19th and 20th Century crisis, they are all caused by the herd behaviour of individuals; usually preceded by a relatively long stability.

The recent “Housing Bubble” which led to the “Great Recession” can be easily compared to the “Tulip Bubble” of the 17th Century. Tulip bubble has been stated by historians as the “history’s most extreme example of a fundamentally irrational speculative fever”. It saw the price of a single tulip bulb rise to the value of a luxury house in 17th Century Amsterdam. It was primarily caused by failed attempts of the conversion of ordinary futures contracts to option contracts by the Dutch burgomasters to bail themselves out of the previously incurred speculative losses[[4]](#footnote-4). On the other hand, the housing bubble, which saw an unprecedented rise in prices of real estate, was caused by the unregulated betting through Mortgage-backed securities (MBSs); loose monetary policy; loosely regulated housing and financial sector. Like the 17th-century tulip bubble what lied in the heart of the recent housing bubble was also an unregulated financial market which promoted the risk-taking behaviour of the investors without strong fundamentals.

Crisis is closely associated with the business cycle. It is also the proof of its dynamic nature and need for actors in an economy to continuously react to these events.

In the United States, the Federal Reserve’s System, which is the central bank was established in 1913 with the enactment of the Federal Reserve’s Act by the Congress. The five general functions performed by the FED for effective operations of the US economy are:

1. Conducting the nation’s monetary policy
2. Promoting the stability of the financial system
3. Promoting the safety and soundness of individual financial institutions and monitors their impact on the financial system as a whole.
4. Fostering payment and settlement system safety and efficiency
5. Promoting consumer protection and community development

Like the banking panics of the 1930s, the financial crisis of 2007-08 is also attributed the FED by many. In words of J. B. Taylor (2009) “Financial crisis is caused by Excesses-frequently monetary excesses.”[[5]](#footnote-5) and the FED is mandated to conduct the monetary policy. It is clear from the financial crisis of 2007-08 that the FED failed in at least two of its functions. First, it failed to promote the financial stability. Second, it failed to ensure the soundness of financial institutions. With the FED mandated to conduct the monetary policy of the US it becomes extremely important to analyse the conduct of FEDs monetary policy to critically comment on the role of FED in the crisis. It is also necessary to analyse the monetary policy because many including Taylor (2007) have argued that the loose monetary policy of the Federal Reserve was one of the reasons for the financial crisis. The Monetary policy, directly and indirectly, affects the financial market therefore also needs to be analysed for the scope of capturing the signals of a crisis.

# FEDs Monetary Policy

The Federal Open Market Committee (FOMC) sets U.S. monetary policy in accordance with its mandate from the U.S. Congress i.e. to promote maximum sustainable employment; to stabilize prices and moderate long-term interest rates in the U.S. economy. The Federal Reserve conducts the nation’s monetary policy by managing the level of short-term interest rates and influencing the availability and cost of credit in the economy. It either uses Federal funds rate or Open Market Operations (OMOs) to do so. Monetary policy directly affects interest rates; it indirectly affects stock prices, wealth, and currency exchange rates, though with a lag. Through these channels, monetary policy influences spending, investment, production, employment, and inflation in the United States. Though not officially the FED has moved to a rule based system rather than a pure discretionary policy. However, since there is no public rule for the conduct of monetary policy put forth by the FED, there is a scope for discretion. Taylor (2010) called this “well intended” deviation from the policy rule as “discretionary fine-tuning”.

* + 1. **Monetary Policy Rule**

Apparently, the FED in the recent past has settled down to follow the twin objective of stabilizing inflation around its target and keeping the output close to its potential. The weights and variable in monetary policy rules suggested by different researchers have varied. Unemployment gap to output gap, the level of output, and the growth rate of output are some of the suggested variables. However, most of the models suggested by academicians and Federal Reserve’s researchers are consistent with the twin objective of the FED. It is also generally acceptable that there is a trade-off between the inflation and output, however, many disagree with the significance of this trade-off.

John B. Taylor (1993) proposed a policy rule which is commonly referred to as the “Taylor Rule” and is since then considered as the optimal policy rule by many. Taylor rule basically specifies by how much a central bank should change the nominal interest rate in response to a change in inflation or other macroeconomic variables. Adherence to such a rule can reduce uncertainty and thus improve an economy’s performance. Taylor (1993) argued that the monetary policy instrument which is the federal fund rate[[6]](#footnote-6) must respond to the deviation of inflation from its target (which was assumed to be 2%) and percentage deviation of output from its trend.

--***Equation 1***

where

*r is federal funds rate*

That is,

\*100

*Y is real GDP*

*Y` is trend real GDP*

Although not explicitly, the FED has followed the Taylor rule particularly under the chairmanship of Alan Greenspan. However, the rule is not free from criticism. Some argue for looking at only inflation for the policy rule whereas others propose including additional variables to explicitly capture the financial condition.

Now the questions that arise is “*Can we capture the cues of financial instability in the monetary policy rule and use the monetary policy instrument to regulate the financial market?*” or *“Is monetary policy instrument a blunt instrument or twelve people sitting in a room cannot decide better than the markets?”* All such questions can be answered by critically analysing the monetary policy and creating a counterfactual scenario.

The financial crisis of 2007-08 provides us with an opportunity to analyse

1. Whether or not we can incorporate the parameters giving cues of financial instability to enhance the Taylor rule.
2. Create a counterfactual scenario to create an alternate path.

# The “Great Recession”

Great Recession, the worst economic crisis since the Great Depression hit the world recently (the late 2000s). It is a result of U.S, subprime mortgage crisis. Though the epicenter of the crisis was the U.S. sub-prime mortgage market, its tremors were felt all across the world. Undoubtedly, the actual crisis started with the fall of Lehman Brothers but the seeds of the crisis were sown long back in the late 1990s. The blind-eyed regulators, lax lending standards, massive government intervention, loose monetary policy by the FED (2002-05) are amongst a few widely accepted causes of the crisis.

The housing sector was at the core of the crisis. It all started with the popularization of mortgage-backed securities (MBS) by Lewis Ranieri who is considered by many as one of greatest innovator[[7]](#footnote-7) and blamed by others for the sub-prime crisis. A mortgage-backed security (MBS) is a type of asset-backed security that is secured by a mortgage or a collection of mortgages. The mortgages generated by the commercial banks (or other Mortgage originators) were then sold to intermediaries (a government agency or investment bank) that securitizes, or packages, the loans together into a security that investors can buy.

It was considered to be safe investment. First, many of them were AAA rated. Second they were insured by Freddie Mac, Fannie Mae, AIG. Third, securitizers believed that they were bundling uncorrelated individual mortgages. As a result, demand for MBS soared. This induced banks and other mortgage originators to lend money without assessing the risk profile of an individual. Easy availability of credit over-rode the income constraint that most of the house purchasers were facing. As a result, house demand increased.

Huge investment in the housing market led an unprecedented growth of 124% in house prices between 1997-2006. The year on year house price inflation increased from 0% in 1997 close to 10% by 2005 as evident from Figure 1. The sudden and a continuous rise in house price inflation led to investors and households taking extra risk. This promoted the herd behaviour amongst the investor. Complementing it was the loose lending standards as well as the affordable housing programme by the Government of United States.

**Figure 1** The quarterly housing price inflation calculated based on the Shiller’s housing price index. The vertical axis shows the quarterly year on year inflation for housing.

High housing inflation was further supplemented by the low perceived risk in the market. The Ted Spread[[8]](#footnote-8) which captures the perceived credit risk in market was close to 0% as seen in Figure 2. The low perceived risk also indicate the common perception amongst investors that “everybody pays their mortgages”. A fall in investor sentiment is evident from the abrupt rise in the spread post-2007. This clearly indicates that the problem was indeed of credit risk[[9]](#footnote-9) rather than a liquidity problem.

**Figure 2** The quarterly average of TED Spread.

All this, along with loose monetary policies led to a U.S. housing bubble, which busted in 2006. The crisis which originated in the U.S. was transferred worldwide and was converted to the “Great Recession”.

# Various variants of Taylor Rule

# Taylor Rule with CPI

To establish the argument of loose monetary policy we will try to estimate the Taylor rule (equation 1) for the period of 1987-2008. It is aimed at capturing the response of the independent variables viz. inflation and output gap during the crisis as well as pre-crisis period. The year 1987 is marked as the start of a long period of the chairmanship of Alan Greenspan and the period of “Great Moderation”. This allows us to fully capture the dynamics of economy including the period of advent of crisis. Post 2008 the monetary policy instrument viz. the federal fund's rate was forcefully kept close to 0% to support the recovery of the economy. Therefore, the period of study seems appropriate to cover most of the aspect of the study. The extended period will allow us to accommodate dynamic i.e. both loose and tight monetary policy.

The estimated Taylor rule for the period with CPI based inflation is:

**1.5** --***Equation 2***

where

*r is federal funds rate*

That is,

\*100

*Y is real GDP*

*Y` is potential GDP as estimated by the Congressional Budget’s Office*

This is in line with the Taylor Rule (1993) in equation 1 with increased weight to output gap. If we compare the actual federal fund's rate to that with estimated rate from equation 2, we see a clear deviation from the policy rule post 2002-Q2.

The difference between the actual Federal Funds rate and estimated Taylor Rule, is significant only for a period of 2002-Q2 to 2006-Q3. This estimation is also in line with the estimations of Taylor (2007) despite accounting for a broader and a relatively dynamic period. This clearly indicates the discretionary nature of policy by the FED. Though there are many competing arguments given by the various researchers included the then chairmen Ben S. Bernanke. Some of the prominent arguments by researchers include the presence of “Saving Glut” and fear of deflation but none of that changes the fact that the monetary policy was loose. The deviation was as high as 3 percentage point particularly after 2004.

**Figure 3** The graph compares Federal Funds Rate i.e. the actual policy rate with the estimated rate as per equation 2. From 1987-2002 the difference between the actual and estimate rate is insignificant.

It was a “well intended”, “purposeful” deviation from the regular course. The FED was clear in its part to inform the market about its “discretionary” policy. According to the economic synopsis by FRED[[10]](#footnote-10) at its Aug 12, 2003 meeting, the FOMC announced that its current “highly accommodative monetary policy” could be maintained “for a considerable period”. The FOMCs minutes note that it was to “encourage progress towards closing the economy’s output gap”. These statement by FOMC are a clear indication that there was a deviation from some sort of rule. The credibility gained by the FED in last two decades was put to test at this phrase.

The consequences of this deviation can be logically analysed and argued upon. The loose monetary policy led to excess money supply in the economy and hence investors taking extra risk. The money pushed out by FED due to low interest rate made its way back to US economy in form of investment in Freddie Mac and Fannie Mae. The excess investment in perceived “safe” assets like housing led to distortion in the sector which eventually became a bubble and busted in 2006-07.

# Taylor Rule with Personal Consumption Expenditure (PCE)

However, the erstwhile chairman of the FED Ben S. Bernanke argued that the use of GDP deflator (as used by John Taylor) or CPI is not what the FOMC prefers to target. It has always been clear to target the core personal consumption expenditure (PCE). If we change the measure of inflation from CPI to core-PCE and re-estimate the Taylor rule we get the following result.

The estimated Taylor rule for the period with PCE based inflation is:

--***Equation 3***

where

*r is federal funds rate*

That is,

\*100

*Y is real GDP*

*Y` is potential GDP as estimated by the Congressional Budget’s Office*

***Figure 4*** *The graph compares federal funds rate with the estimated rate from equation 3 and equation 2. The graph for estimated rate with PCE though below the estimate for CPI based Taylor Rule but far above the Federal Funds Rate.*

The results reject Ben Bernanke’s claim that the FED never deviated from the policy rule. Careful manoeuvring by Ben Bernanke like changing the time period of study[[11]](#footnote-11) etc. reduced the blame of the crisis (loose monetary policy) from FED to some extent. Even if we accept his argument, it is difficult to explain the sustained low Adjustable Rate Mortgages (ARM) which were indexed to the federal fund’s rate and low long term rates. Further, the biasness problem associated with different inflation indicators is no justification for the rejecting the rule on itself.

Even with PCE as a measure of inflation the actual federal fund’s rate were significantly below the estimated policy rule.

# Policy Rule with Asset Prices

Till now, it is clear that the FED’s monetary policy was loose (2002-05) though the magnitude may be debatable. Now we will try to look for the cues of the crisis that could be incorporated in the Taylor Rule and change the policy instrument accordingly.

The housing market is generally considered as one of the safest market. This “safe haven” of investment was what caused the crisis. Since the housing market was one of the hot sectors during the financial crisis of 2008 it is logical to search for the hint of a crisis in the housing sector.

For this we used the housed price index developed by Robert Shiller. The additional variable added to the Taylor rule is the percentage deviation of house price index from its trend[[12]](#footnote-12).

The estimated Taylor rule for the period with Housing price indicator is:

-- ***Equation 4***

where

*r is federal funds rate*

That is,

\*100

*Y is real GDP*

*Y` is potential GDP as estimated by the Congressional Budget’s Office*

The estimated rule is plotted along with the actual federal funds rate and the rate estimated form CPI based Taylor rule form equation 1 in fig 5.

**Figure 5** The graph compares federal funds rate with the estimated rate from equation 4 and equation 2. The graph for estimated rate with house price indicator almost overlaps the estimates for estimates without house price indicator.

Figure 5 clears up a few things

1. Even though the weights for inflation and output gap changes in equation 4 but still there is no significant difference between the estimated Taylor Rule in equation 2 and Taylor Rule that includes housing price indicator in equation 4.
2. The Taylor Rule with housing also suggests monetary policy was loose during the period. It calls for half a percentage higher rate than the Taylor Rule from equation 2 after 2005.

Incorporating measures of perceived risk in financial market like TED Spread or LIBOR-OSI spread also yields similar result. It is clear that it is very difficult to extract cues from the financial indicators and incorporate in the policy rule. Further, it would kill the “hunger” amongst investors if the FED starts directly intervening to market signals. Macro-prudential norms aimed at correcting the fundamentals of the financial institutions seems to be a better way of providing financial stability.

The other important variable like stock market bubble has already been discarded by Bernanke and Gertler in 2001. They argued and simulated that reacting to stock prices results in inferior economic performance.

However, there is a scope of analysing monetary policy rule further with the inclusion of various kind of shock and bubbles like technology shock. We certainly believe that the FED should use important information from asset price movement and use it to improve the health of the financial sector by its regulatory powers.

# Counterfactual Housing Scenario

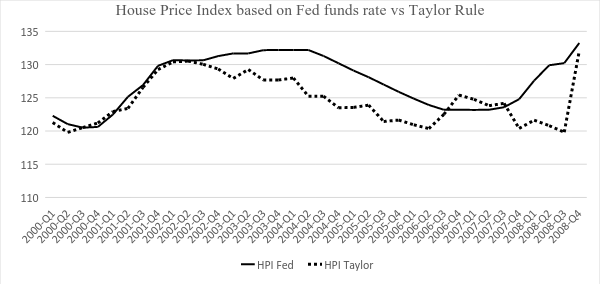
As of now, it is clear that the monetary policy was loose during the period preceding the housing crisis. And also, there is a little scope for inclusion of variables (giving information on the financial sector) in the policy rule. Now, we want to know what if the rule was followed.

To know this, we create a counterfactual scenario to estimate the house price index if the rule would have been followed. For this, we took a straightforward approach and estimated the house price equation with federal funds rate as an independent variable. The equation is estimated with quarterly data from 1956-2014. The model shows a statistically strong significance with housing prices being negatively related with federal funds rates.

**---Equation 5**

Where,

Since the actual data for house price index is impacted by other variables as well, therefore we cannot directly compare the actual house price index and house price index if Taylor rule was followed. So, we will be simulating two series one with actual federal funds rate and other with the rate estimated from equation 2.



**Figure 6** The graph compares house price index actual fed funds rate and suggested rate from equation 2.

This graph is also in line with the counterfactual scenario presented by John Taylor in 2007 though it was with housing starts. It is clear from the figure that had the FED followed Taylor Rule, the house prices would not have gone to an extent it went. In terms of housing inflation, it would have been a mere 3% in 2005 instead of 10% with actual Fed funds rate. Hence we can safely assume that a higher federal funds rate whether be it with Taylor (1993) or Taylor Rule with CPI or PCE much of the housing boom would have been avoided.

Though it is a very basic model but gives a clue that the abrupt rise in the housing price would have been avoided, had FED followed the rule.

# Conclusion

Monetary policy is one of the most important aspects of policy making in an economy. Monetary policymakers attract more criticism than praise; sometimes for their actions and sometimes for their inaction. After the recent financial crisis also the FED was criticised by many for its loose monetary policy. Further, the impact of financial shocks felt in our lives has fanned the debate regulating and targeting the asset market. Though this has been out rightly rejected by many including Ben S. Bernanke as early as 2001, but still finds support from many economists.

The result presented above clearly articulates that the monetary policy was loose during the period preceding the crisis. One thing is for sure, whatever be the measure of inflation, the policy was not in course of a rule and hence “discretionary” in nature. Though the FED tried to convey this to the market, but a long period of stability made investors “deaf” to understand its language. The argument for the loose monetary policy does not stand up to the harm caused by them. The “discretionary” policy has led to a considerable loss in credibility of the FED.

The rule as suggested by Taylor in 1993 stands out to be the optimal rule for the conduct of monetary policy. Asset market, in particular, did not provided any general clues of a brewing crisis that could be incorporated in the policy rule.

The counterfactual scenario from housing prices helps our claim that loose monetary policy was one of the factor contributing to a housing bubble. We cannot neglect the role played by government, bankers, and regulators. It is very difficult to say that the monetary policy alone would have corrected the mistakes of all these actors, but it had a role to play. It complemented and promoted the behaviour of government, bankers, and regulators. If it was not for the loose monetary policy, the financial crisis would have been avoided or a at least delayed. Surely we would not have experienced a “Great Recession”.

With the deep integration of the financial market in our lives, it is necessary for the government and its agencies to maintain the health of the financial sector and its institution. Monetary policy is not a way out for this problem. A better way would be to maintain the health of the financial institutions through regulatory mechanism.

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# Appendix

* All the estimation is from period 1987-08
* Summary statistics of equation 2:  **1.5**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SUMMARY OUTPUT | |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| *Regression Statistics* | |  |  |  |  |  |  |  |
| Multiple R | 0.685112 |  |  |  |  |  |  |  |
| R Square | 0.469379 |  |  |  |  |  |  |  |
| Adjusted R Square | 0.456894 |  |  |  |  |  |  |  |
| Standard Error | 1.608576 |  |  |  |  |  |  |  |
| Observations | 88 |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| ANOVA |  |  |  |  |  |  |  |  |
|  | *df* | *SS* | *MS* | *F* | *Significance F* |  |  |  |
| Regression | 2 | 194.5545 | 97.27727 | 37.59482 | 2.01E-12 |  |  |  |
| Residual | 85 | 219.9391 | 2.587518 |  |  |  |  |  |
| Total | 87 | 414.4936 |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95.0%* | *Upper 95.0%* |
| Intercept | 1.859988 | 0.539107 | 3.450125 | 0.000875 | 0.788098 | 2.931878 | 0.788098 | 2.931878 |
| y | 0.647018 | 0.127438 | 5.077106 | 2.23E-06 | 0.393637 | 0.9004 | 0.393637 | 0.9004 |
| Rate of inflation (p) | 1.124705 | 0.159128 | 7.067908 | 4.08E-10 | 0.808315 | 1.441094 | 0.808315 | 1.441094 |

* Summary statistics of equation 3:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SUMMARY OUTPUT | |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| *Regression Statistics* | |  |  |  |  |  |  |  |
| Multiple R | 0.826521 |  |  |  |  |  |  |  |
| R Square | 0.683137 |  |  |  |  |  |  |  |
| Adjusted R Square | 0.675682 |  |  |  |  |  |  |  |
| Standard Error | 1.243039 |  |  |  |  |  |  |  |
| Observations | 88 |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| ANOVA |  |  |  |  |  |  |  |  |
|  | *df* | *SS* | *MS* | *F* | *Significance F* |  |  |  |
| Regression | 2 | 283.1561 | 141.5781 | 91.62756 | 6.12E-22 |  |  |  |
| Residual | 85 | 131.3375 | 1.545147 |  |  |  |  |  |
| Total | 87 | 414.4936 |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95.0%* | *Upper 95.0%* |
| Intercept | 1.303439 | 0.379105 | 3.438204 | 0.000909 | 0.549677 | 2.057201 | 0.549677 | 2.057201 |
| y | 0.922893 | 0.101314 | 9.109236 | 3.24E-14 | 0.721453 | 1.124332 | 0.721453 | 1.124332 |
| core-PCE | 1.815715 | 0.152912 | 11.87424 | 9.69E-20 | 1.511685 | 2.119745 | 1.511685 | 2.119745 |

* Summary statistics of equation 4:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SUMMARY OUTPUT | |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| *Regression Statistics* | |  |  |  |  |  |  |  |
| Multiple R | 0.698587 |  |  |  |  |  |  |  |
| R Square | 0.488024 |  |  |  |  |  |  |  |
| Adjusted R Square | 0.46974 |  |  |  |  |  |  |  |
| Standard Error | 1.589439 |  |  |  |  |  |  |  |
| Observations | 88 |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| ANOVA |  |  |  |  |  |  |  |  |
|  | *df* | *SS* | *MS* | *F* | *Significance F* |  |  |  |
| Regression | 3 | 202.283 | 67.42766 | 26.69011 | 3.2E-12 |  |  |  |
| Residual | 84 | 212.2106 | 2.526317 |  |  |  |  |  |
| Total | 87 | 414.4936 |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95.0%* | *Upper 95.0%* |
| Intercept | 1.93 | 0.5342 | 3.6151 | 0.0005 | 0.868993 | 2.9938 | 0.8689 | 2.9938 |
| Percent deviation from HP Index trend | 0.10 | 0.05897 | 1.74904 | 0.08393 | -0.01413 | 0.2204 | -0.014 | 0.2204 |
| Y | 0.53 | 0.14167 | 3.76552 | 0.00030 | 0.25174 | 0.8152 | 0.2517 | 0.8152 |
| CPI Inflation | 1.068 | 0.16043 | 6.66314 | 2.63E-9 | 0.74994 | 1.3880 | 0.7499 | 1.3880 |

1. Dimand, Robert W., "macroeconomics, origins and history of", "The New Palgrave Dictionary of Economics", Eds. Steven N. Durlauf and Lawrence E. Blume, Palgrave Macmillan, 2008, The New Palgrave Dictionary of Economics Online, Palgrave Macmillan. 06 April 2017 [↑](#footnote-ref-1)
2. As listed by the Federal Reserve System. [↑](#footnote-ref-2)
3. Stock, James; Mark Watson (2002). "Has the business cycle changed and why?" (PDF). NBER Macroeconomics Annual. [↑](#footnote-ref-3)
4. Thompson, E.A. Public Choice (2007) 130: 99. doi:10.1007/s11127-006-9074-4. [↑](#footnote-ref-4)
5. Getting off the Track by J B Taylor. [↑](#footnote-ref-5)
6. Fed funds rate is the interest rate at which banks make overnight loans to each other. [↑](#footnote-ref-6)
7. BusinessWeek presented him as the greatest innovators of the past 75 years in 2004. [↑](#footnote-ref-7)
8. Ted spread is calculated as the spread between 3-Month LIBOR based on US dollars and 3-Month Treasury Bill. [↑](#footnote-ref-8)
9. Getting off the Track by J B Taylor. [↑](#footnote-ref-9)
10. Federal Reserve Economic Data (FRED) is a database maintained by the Research division of the Federal Reserve Bank of St. Louis. [↑](#footnote-ref-10)
11. The time period of study by Bernanke was from 1993. [↑](#footnote-ref-11)
12. The trend in housing price index is calculated using HP filter. [↑](#footnote-ref-12)