

**Estimation of output Gap using Financial Variables and Monetary**

**Policy Response: The Case Study of Pakistan**



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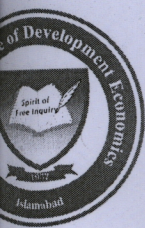
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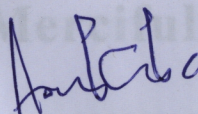


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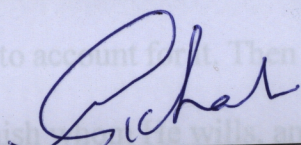
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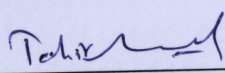
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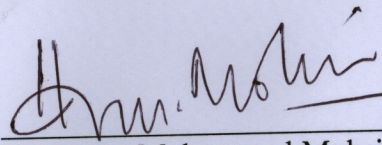
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**IN THE NAME OF**

**ALLAH**

**The Most Beneficent**

**The Most Merciful**

“To Allah belongs whatever is in the heavens and whatever is in the earth. Whether you show what is within yourselves or conceal it, Allah will bring you to account for it. Then He will forgive whom He wills and punish whom He wills, and Allah is over all things competent.”

(Al-Baqarah, 2:284)

# **GOLDEN SAYING OF THE HOLY PROPHET**

**(Peace and Blessings of Allah be Upon Him)**

“The Prophet Muhammad (peace be upon him) said: "If anyone travels on a road in search of knowledge, Allah will cause him to travel on one of the roads of Paradise. The angels will lower their wings in their great pleasure with one who seeks knowledge. The inhabitants of the heavens and the Earth and (even) the fish in the deep waters will ask forgiveness for the learned man. The superiority of the learned over the devout is like that of the moon, on the night when it is full, over the rest of the stars. The learned are the heirs of the Prophets, and the Prophets leave (no monetary inheritance), they leave only knowledge, and he who takes it takes an abundant portion”.

(Sunan of Abu-Dawood, Hadith 1631)

***DEDICATED***

***TO***

***My Father***

***Mr. Muhammad Musaddiq***

***For his endless support and motivation.***



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## ABSTRACT

*This study estimate the output gap by using financial variables and monetary policy reaction function using financial output gap for the case of Pakistan by using the quarterly data of 1991 to 2015. Our methodology based on Borio (2013), which incorporate the role of financial cycle proxies like Domestic Credit, housing prices, equity prices and real exchange rate in the output gap estimation and we also check the long run and short run relationship of these financial variables with the conventional output gap (estimated from HP filter) by using ARDL approach. Our results shows that financial output gap behaves differently than the traditionally estimated output gap during financial crises of 2000s. And monetary policy reaction function better explained the variation of interest rate in response to financial output gap and inflation gap instead of using conventional output gap which does not have any effect of financial variables.*

# CHAPTER I

## INTRODUCTION

### 1.1 Background of the Study

Potential output and output gap is a key concept in the macroeconomics and monetary policy decisions. There are different economic sustainability criterion discussed in the literature, potential output estimation is one of them. The output gap variable is important because it tells the economic position of the country but this variable is difficult to estimate accurately because the potential output is not directly observable, so need to make some assumptions regarding the working of the economy for its estimations (Torres et al. (2015)). The correct estimation of output gap is very important for effective monetary policy.

The concept of potential output introduced by Okun in 1962 at the annual conference held by American Statistical Association in which he defines the potential output as the capability of production of the economy without the existence of shocks. It is very common practice to estimate potential output by different techniques but none of the technique incorporate the role of financial cycles. However, the financial sustainability is very important for understanding the economic sustainability (Adrian et al. (2012)) Moreover, the financial variables takes very important part in the economic activity and for the development of output overtime. And by incorporating these financial cycles in the measure of potential output and output gaps yields statistically significant, precise and more robust results in the real time (Borio et. al. (2013)). But when these financial factors are not incorporated, then the output gap is miss-specified and many important financial imbalances that pushes the economy to

recession cannot be identified (Toress et al. (2015)). The ignorance of financial factors are very common due to conceptual perspective and measurement perspective (Borio et al. (2013)). Conceptual perspective i.e. sustainability is the explained by the potential output. If so, concept of potential output as non-inflationary output is preventive. Historical evidences shows that the due to financial imbalances, the inflation remains low and consistent and the output moves on the unsustainable path. The measurement perspective is that, there is possibility that the financial factors holds information regarding the cyclical component of output and ignoring them, does not provide efficient estimates of potential output (Borio et al. (2013)), Different criteria for addressing the sustainability have been suggested overtime but no consensus has been reached in order to decide which one is better than other (Billmeier (2004)). Recent international financial crises of 2007-2008 is evident for considering the financial stability is very important for understanding the economic stability (Adrian et al. (2012)).

This study incorporate the role of financial cycles<sup>1</sup> in the output gap. Because the key concept of macroeconomic theory and policy decisions are primarily based on minimization of the output gap as a large number of macroeconomic decisions pivot around the evaluation of the difference between actual and potential output – the output gap. So when we have the properly estimated output gap then its minimization policies works effectively. The ignorance of financial cycles for estimating potential output causes the output gap not determined accurately. A positive or negative value of output

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<sup>1</sup> “The term will denote self-reinforcing interactions between perceptions of value and risk, attitudes towards risk and financing constraints, which translate into booms followed by busts. These interactions can amplify economic fluctuations and possibly lead to serious financial distress and economic dislocations. The focus on business fluctuations and financial crises.”(Borio, 2012 ).



gap is the indication of incompetent utilization of resources until the output gap becomes zero or close to zero.

## **1.2 Output Gap and Monetary Policy**

Output gap is defined as the percentage change between actual output and potential output level of an economy. This gap can be positive or negative. Positive output gap indicates boom in the economy and it arises when there is high demand of goods and services and the economy is producing beyond its potential level. The negative output gap which reflects recession arises when there is lack of demand for goods and services and the economy works below its potential. Both the positive/negative output gaps creates imbalances in the economy i.e. positive output gap creates when the economic agents works beyond their efficiency in order to meet the excess demand which leads to inflation and over investment in the economy, On the other hand the negative output gap creates slowdown the working of economy which leads high unemployment and the economic activity below than its efficiency level which create the sluggish in the economy due to deflationary pressures and low demand. Due to inflationary/deflationary pressures in the economy the unemployment also effects which creates the policy makers not to take good policy decisions.

In the modern Macroeconomic the output gap is used as a major variable for defining the monetary policy rules. Simon (1936) favored the rules based policies first time for economic stability. The policy rules are preferred over the discretionary policies for better economic performance because of time inconsistencies of discretionary policies [Taylor (1993) and (Kydland and Prescott (1977))]. Taylor (1993) resolve the problem of time inconsistencies by giving a rule known as Taylor rule in

which he investigates that how the changes in the interest rate in response to the output gap and inflation deviation from the target by giving them equal weightage in the monetary policy reaction function. And the other common rule McCullum (1988) which use the money supply as an instrument and target the nominal GDP. For the purpose of better monetary policy decisions, the output gap is estimated by this study by including important missing financial variables. Then estimate the Taylor rule in order to define the monetary policy. For this purpose we will estimate Taylor rule to investigate that how the interest rate behaves differently by incorporating the financial gap and HP gap in it. And compare the trajectory of interest rates and also compare the results of incorporating lagged interest rate as an independent variable in the Taylor rule called as interest rate smoothing with the standard Taylor rule without interest rate smoothing.

### **1.3 Methodologies for Estimating Output Gap**

Output gap is estimated by different methodologies whereas some methodologies even do not follow the economic theory and take certain assumptions for the technological production that may not be true. Besides, some techniques may not incorporate the true picture of the severity of business cycle which causes the results as sample biased. Second is the ex-post revision of the GDP data creates the difference, but the actual data available to policy maker is different because the data of GDP for the last quarter is not available and estimated figure used, and in modification, data becomes different. Third reason for inaccuracy of the output gap is that it is an autoregressive process and next year forecast may be downward or upward biased in the boom and recession respectively.

In order to find the output gap it is necessary to find the potential output which is not directly observable. There are three elementary classifications discussed in the literature for the estimation of the output gap i.e. structural approaches, pure statistical approaches and the mixed approaches. Structural approach of measuring the output gap use the economic variables like inflation, unemployment etc. this approach uses some specific production function with particular assumptions about the technological progress. This approach, isolate the effect of cyclical and structural influence on the output (Saxena and Cerra (2000)). On the other hand Statistical approach does not follow the economic theory (Cogley (1997)). It separated the time series into two components i.e. cyclical component and permanent component by using statistical procedure. The third approach that is the mixed approach use both the statistical procedure and theoretical linkages under certain assumptions.

In this study the mixed approach is used in which the along with the economic variables, financial variables are used which are missing from the estimation of output gap in case of Pakistan because the output Gap is the major component in the rules which defines the monetary policy. And these financial variables are Domestic credit, real exchange rate, housing prices and equity prices.

#### **1.4 Literature Gap**

Massive research is available for estimating the output gap, but the financial factors including domestic credit, real exchange rate, housing prices and equity prices are missing from the estimation of output gap in case of Pakistan, and these financial variables plays an important role in the economic activity and sustainability of output paths. so if we ignore the financial variables then monetary policy rules with the

traditional estimation of output gap results specification errors and may mislead the monetary policy approvals which also leads to harmful macroeconomic outcomes [Borio (2013), Torres et al. (2015)]. The monetary policy reaction function estimated by different studies for the case of Pakistan Economy; Malik and Ahmad, (2010), Fatima and Malik, (2015). First, Based on the comparison of different Scenarios of Taylor rule and compare the rule based policies with the actual policies followed by the Central Bank of Pakistan. The second Study discusses different forms of reaction function, linear and nonlinear and conclude that the nonlinear presentation of Taylor rule are best fitted the criteria to estimate the monetary policy reaction function. These studies leaves the gap of incorporating the role of financial cycles in the monetary policy reaction function. The results of these studies suggests that, it is need to incorporate financial sector stability, interest rate smoothing and Exchange rate stability in order to do the better forecasts of monetary policy.

### **1.5 Objectives of the Study**

In order to resolve this deficiency regarding the output gap with financial variables in the literature for the case of Pakistan, this study have the following three objectives:

1. To analyses the impact of financial variables on the conventional output gap estimated by the statistical procedure.
2. . Estimations of the output gap by incorporating the financial factors and compare it with the conventional output gap estimated by previous literature for the case of Pakistan.

3. Estimation of monetary policy reaction function from the output gap estimate from the financial variables.

## **1.6 Significance of the Study**

Pakistan has practiced too much ups and downs in the economic activity and inflation in the history. Output growth varies between 8.7% (as in 1980) to -0.1% in 1997. Similarly the inflation varies between the highest rates i.e. 23% as in 1974 to lowest rate 2.44% in 2002. This indicates the deprived macroeconomic performance so that the country cannot shift from low income to middle income economy until it follows persistent high growth and stable inflation (fisher (1993)). Being a developing country, Pakistan does not have the independent and strong institutions with fiscal pressure and endless struggle for stabilization of Exchange rate by monetary authority. So the incorporation of financial factors plays a central role in the economic activity and if these factors are not incorporated in the output gap estimation which is the major variable in the monetary policy decisions then many important information that may lead to recession may be neglected.

## **1.7 Plan of Study:**

This study comprises of five Chapters. The first chapter is introduction, second chapter contains the theoretical and empirical literature review on the financial output gap and monetary policy decisions. Data and Methodology can be explored in the third chapter and results and discussions are in fourth chapter and the final chapter conclude the study.

## **CHAPTER II**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

In this chapter we introduce different definitions of potential output as explained in the previous literature and then review different studies regarding methodologies and the estimation of financial output gap in developed as well as developing countries and its response to monetary policy.

Generally the economic information is used to estimate the potential output for reporting the sustainability conditions because This approach is considered as by giving impressive and significant statistical and economic improvements (Borio, 2013) The discussion on the role of financial factors in the economic development has been enduring one. This started from the work of Schumpeter (1911) who promoted the concept “finance led growth”. The role of financial intermediaries is mostly performed by the financial sector which networks savings in to fruitful investment.

#### **2.2. Theoretical Review**

Potential output which is required for the estimation of output gap is defined by different studies in different ways. This concept of Okun (1962) about the potential output explained as the output attainable by the economy without generating inflation or with consistent unemployment with inflation remains zero (Hauptmeister et al. (2009)). Okun’s Definition explores different ideas regarding potential output as it is the stable component of GDP or the level of output gained after full utilizing the resources of the economy with flexible mode of wages and prices or the level at which



satisfaction of financial sustainability is obtained (Lancaster and Tulip (2015)). Other economists who follow micro foundations for their macroeconomic models gave the concept of potential output as the level of output produced without any nominal rigidities. So the potential output refers to the natural level of Gross domestic product maintained over the long run without any external shock.

As the potential output is very much related with the inflation and unemployment which are very strong economic variables to decide the position of the country. Whereas the inflation tends to rise and fall when the actual output is above or below the potential output because the inflation is a basic indicator for unsustainability. There is strong association between the potential output and inflation so no one questioned about this portrayal, but with regards to unemployment when financial variables like real estate is ignored then this may lead us to biased results. For example when investment in housing sector increases it creates more jobs and it may lead to decrease in the output gap so its ignorance may mislead the output gap and the policies proposed may not give the desired results. Torres et al. (2015) estimates the output gap for the Latin American countries by including financial variables along with the economic variables like the real total credit growth, real growth in Asset price, the real exchange rate and the terms of trade. He found that the terms of trade and real exchange rate are very important factors for the determination of financial imbalances that make emerging economies more susceptible to financial shocks. By incorporating the financial variables he conclude that the financial factors are the significant role in the estimation of the output gap which support for decision of monetary policy.

According to World Bank survey the real estate in all over the world represents the half or about three quarters of the national income of an economy similarly in case

of Pakistan large number of industries (like bricks, cement steel and other building material etc.) are dependent on the real estate industry. Real estate industry plays a major role in growth of the economy and also help to stabilize the economic condition of the country by creating more jobs in the construction sector, material and financial services but in Pakistan this sector do not got much attention even this industry develops as the second prime employer next to agriculture (Niazi and Khetran (2012)). We can use house rent index uses as a proxy for the housing prices as a financial variable in the estimation of the output gap because the decline in the housing prices can adversely affect the output Hilde and Henning (2010), and check the effect of housing on the potential output level of the country. On the other hand this real estate industry increase the investment activities which is the major determinant of the country's output.

It is hard to estimate the exact contribution of real estate to GDP because it appears as the dispersed and disaggregated form in the national account statistics but the Federal beauro of Statistics shows the role of output from construction are two percent of GDP and housing denotes less than half of that figure (Niazi and Khetran (2012)).

Similar to the real estate industry the credit growth also effect the output of the country. Changes in the growth rate of loan or credit, the GDP is significantly affected and it is important to incorporate the credit development as a tool in the monetary policy analysis (Cappiello et al. (2010)). He explained the model given by Driscoll (2004) in order to derive the link between output and bank loan by using the Keynesian model of simple aggregate demand. In Contrast to the finding of US, his findings about the Euro Area are that the changes in credit supply in terms of credit standards and sizes applied on loan to enterprises has significantly positive effects on the economic activity in real

terms. European Central Banks also incorporate the credit development as a tool in the monetary policy analysis. If the financial crises of 2007 in the euro Area are considered then the supply of loan creates the negative and unpleasant effects on the real economic activity.

Domestic credit is also one of the financial resource that is used to support the private sector as well as the public sector. But the linkages between the Domestic credit and growth of the economy are very difficult to explain by the literature because from the empirical evidences the literature is inconclusive on this issue. Some studies shows there is positive relationship between Credit and growth of the economy. [Levine (1997), Emecheta and Ibe (2014) and Demirguc-Kunt and Levine (2008)]. And some find negative relations [Driscoll (2004), Loening et al. (2008)] and (Soderbom (2000)), it depends on the efficiency of financial system. Competent system of providing credit has significantly positive impact on the economic growth and enhances output by creating more employment opportunities by financing large number of economic projects and if the system not works effectively then weak financial development create distortion of economic growth. (Olowofeso et.al (2015)). Moinescu (2012) analyze the impact of credit growth on the economy on Romania, and found that the credit growth leads to inflation and increases the deviation of potential output from actual leads to increase in the output gap. The transmission network of the output gap is established on the credit accelerator theory (Bernanke (2007)), according to which, credit flow enhances consumption and investment Creating space for growing the value added in the economy.

Similar to other financial variables, real exchange rate also effect on the output even there is controversy on the sign of impact that whether depreciation of currency

creates positive or negative impact on the output level. Generally, in order to defense against macroeconomic shocks, mounting trade deficit, deteriorating import export situation, the economy needs to depreciate the currencies in order to stabilize the macroeconomic conditions. Different studies like Dornbusch (1988) and Gylfason and Schmid (1983) explored the links that currency depreciation will help to increase in the output level. But the literature on this issue is highly controversial. Nawaz (2012) checks the effect of changes in Exchange rate on the country's output level by using the bound testing approach and using the annual time series data set of 1972-2010 for the case of Pakistan. He found that nominal exchange rate will help in the contraction of output in the long run which can be explored by the combination of demand side and supply side channels and is opposite in the short run which are also supported by the Dornbusch (1988). Nawaz (2012), also found positive and significant impact of terms of trade on the output level in the short run but have contractionary effect in the long run. Borio et al. (1994) explored the reasons behind the movement in the index of real asset prices during the period of 1970s and 1980s. He used the combination of residential and commercial properties and share prices of the numerous industrialized countries and suggested that for the prediction of movement in the real asset price index, the ratio of private credit to nominal GDP plays a key role in determining the movements and further he explains that nominal GDP growth, real profits and long term nominal interest rates and relaxation in the restrictions on credit creates the impact on the development of aggregate price index during the period of 1980s.

Similarly by giving the importance of financial with economic variables, Borio et al. (2013) review the measurement of the output gap for United states, United kingdom and Spain and use the quarterly data from 1980 to 2011, by incorporating the

financial cycles in the economic development and explored that output gap is estimated more precisely and accurately by incorporating financial variables which gives more strong results which serve better forecast in the monetary policy decisions he also compare the results of finance neutral output gap with the traditional HP filters and production function approach, from where he conclude that financial output gap gives more better estimates regarding statistical precision and matching with the real time and provide better guide for the fiscal or give more consistent evaluations of cyclically adjusted budget balances and monetary policy by minimizing the output gap and inflation gap.

So with all these evidences about the effects of financial variables on the output it is important to incorporate these variables in the estimation of output gap in order to get proper response from monetary policy. Because the monetary policy reaction function which are generally based on two rules Taylor rule and MacCullum rule majorly based on the output gap in which policy basically respond to two major factors i.e. the deviation of output from potential and secondly the deviation of inflation from the target. The monetary authorities stabilize the economy by minimizing the output gap which strongly influence in conducting monetary policy decisions and the discussion of the output gap got importance in the literature of monetary policy.

### **2.3. Empirical Review**

On the basis of different classification criteria, there are number of techniques used in the literature in order to find the potential output like HP filter (Hodrick and Prescott (1997)), Unobserved Component model (Watson (1986) and Kutnar (1994)), Beverage Nelson decomposition (Beveridge and Nelson (1981)), Band Pass filter

(Baxter and King (1999)), Blanchard Quah decomposition and frequency domain filter. These are statistical techniques. Other techniques that follow the economic theory for the identification of output gap are Vector Autoregressive model, production function approach and other multivariate models. But none of the technique uses financial variables to find the gap for the case of Pakistan.

### **Empirical Review for Pakistan Economy**

In Pakistan the output gap is estimated by different studies with different techniques like univariate filter and other multivariate models but this selection of modeling does not reached to any conclusion [Chagny and Lemoine (2004), Dennis et al. (2006) and Billemeier (2004)]. The main issue is that, none of the study incorporate the role of financial cycles like Bukhari and Khan (2008) estimate the output gap for Pakistan and compare the difference in the output gaps estimated by different techniques i.e. Structural vector Auto regressive, Production Function, Linear trend, Kalman Filter, HP filter and Baxter King but not incorporate the role of financial cycles in any technique. Tahir (2014) estimates the output gap of Pakistan by using the technique of Structural VAR model, Wavelet filter and State–Space model and conclude that demand pressure have moderated since third quarter of fiscal year 2009 and negative output gap since third quarter of the fiscal year 2011 was due to down fall in the real activity or aggregate supply. He also found that estimating output gap have significant impact in making of the fiscal and monetary policy. But this discussion do not incorporate the financial cycles. Tahir and Ahmad (2017) estimate the potential output and output gap for Pakistan by using different techniques and found the potential output of Pakistan falls during the time period of 2009 to 2013 has increase the economic susceptibility by making it more vulnerable to demand shock. He also



forecast the output gap for FY2017. Sherbaz, Amjad and Khan (2009) also estimate the output gap for Pakistan by using macro-economic variables. Their results show that some variables like imports and money supply heighten the output gap while public sector investment and exports help to reduce it. So ultimately these macroeconomic variables do not show the consistency of intervention in the estimation of output gap. In view of literature we conclude that there is no study in Pakistan which incorporates the role of financial cycle in the output gap.

In order to estimate the monetary policy reaction function for Pakistan Economy, Malik and Ahmad (2010) use the data of 1991 to 2005 and estimate the Taylor rule by using both the stochastic and historic simulation and get the better response of monetary policy than the actual policy of State bank. Their results show that by following Taylor rule based monetary policy better macroeconomic performance and the variability in output and inflation are decreasing and loss to the society would be condensed. But inflation and the output gap explore 1/4<sup>th</sup> of the variation in interest rate (Malik and Ahmad (2010)). This shows that there are some other factors that may explain the monetary policy rule in a better way like interest rate smoothing, exchange rate stability and financial sector stability etc. This might be one of the reasons that State Bank of Pakistan does not follow the rule based policy.

### **Empirical Review for other Economies.**

Now in order to check, the importance of financial variables in the output gap estimations and whether, the significant effect of these variables on the output gap or not we will go through the existing literature for different economies. Goodhart and Hofmann (2008) estimate the fixed effect panel VAR by using the data for the period

of 1970 to 2006. He used quarterly data of 17 industrialized nations. He found the multidirectional links between the monetary variables, economic variables and house prices. He also found the strong association between the monetary variables and house prices after 1985 and further he explains that during the period of boom in prices of houses, macroeconomic shock to credit and money will have severe effect.

Gerdesmeier et al. (2011) investigated the impact of boom or bust cycles comes from financial crises on the economy by using the quarterly data of seventeen OECD industrialized economies from the period 1969 to 2010. He made the composite indicator of asset prices including the development of house prices and stock prices. His empirical analysis based on the probit approach including the numerous financial monetary and real variables. On the basis of some statistical techniques he found that, the investment-to-GDP ratio, credit aggregates, the interest rate spread, development in stock prices and the growth gap in house prices are the major predictors of booms and bust cycles which leads to macroeconomic instability and financial imbalances of the economy.

Kara et al. (2007) have done the work on output gap estimation in fluctuating economy by taking the sample of Turkey by using the technique of extended Kalman Filter and provide the significant result regarding the output gap and analysis of dynamics on the macroeconomic level and also allowed the parameters to be time varying. This methodology based on the Ozbek and Ozale, (2004) who found that the output and inflation are negatively correlated in Turkish economy which contradicts the view that inflation in the Trunkey was primarily determined from the forces of demand side. He criticized the univariate filter techniques for the measurement of the output gap

as this technique have no content of economics and is totally statistical and also put the restriction on the parameters of the system to remains constant over time.

Furlanetto et.al (2014) investigates the effect of financial resistances on the stabilization of monetary policy and also check the causes of inefficiency in the economy and explored that financial frictions are the major source for the instability in the economy. He work on the quarterly time series data of US economy. Data ranges from second quarter of 1964 to fourth quarter of 2009. And he estimates Dynamic stochastic general equilibrium modeling by using Bayesian technique. He measures the output gap by incorporating the financial frictions and found that ideal monetary policy help in the reduction of variation in wage inflation and prices but does not play significant role in the decrease of output gap volatility. So need to make the financial regulations the lesson the systematic risk or the risk of financial system.

Furthermore in order to check the in efficiency of the economy by the extension of new Keynesian model by the channel of financial accelerator mechanism and financial shock. He includes two inefficient financial shocks (“two inefficient financial shocks as in (Gilchrist et al., 2009): a shock to the net worth of firm, that directly affects the availability of credit for the production sector and a shock to the external finance premium that reacts possible tensions in the financial markets”) along with standard inefficient economic shocks to wages and prices as in New Keynesian study and found that major sources for inefficiencies wage rigidities, price, capital accumulation, habit persistence, cost push shocks and financial frictions. And he resulted that positive output gap during the Great Moderation, until the outbreak of the financial crisis.

Juselius et al. (2016) checks the impact of financial factors on the economic variations, to suggest the rules for monetary policy by incorporating the position of financial cycles and measurement of natural interest rate and also helps to explain the decline in real interest rates by instituting a link between monetary policy and long run output trails. He used the time series quarterly data of United States from 1985 to 2015. He used the vector autoregressive technique to find the relationship between real and financial variables. He found that monetary policy made by incorporating the financial cycles have a long term impact on the output and on the real interest rates and also by indulging the financial development in the monetary policy rules could help to damp down the financial cycles which results higher output in the long run so it is very difficult to ignore the financial factors.

Drehmann et al. (2012) identified the medium term components of the financial cycles and its comparison with the business cycles used in the macroeconomics and found that financial crises are very much relevant with the financial cycles and argue that this reveals the changes in the framework of monetary policy and financial liberalization. He also found that the business cycle is very much shorter than the financial cycles and the recession phase of business cycle becomes very much deeper when the overlap with the financial cycle contraction phase. He characterize the financial cycles by using two statistical techniques i.e. turning point analysis and frequency based filter. His work based on quarterly data from 1960 to 2011 of seven countries (United States, United Kingdom, Sweden Norway, Japan, Germany and Australia). He Used five financial variables “(the ratio of credit to GDP, equity prices, credit to the private, non-financial sector, residential property prices; and an index of

aggregate asset prices, which combines residential and commercial property and equity prices)” along with one economic variables that is GDP.

Virkola (2014) compares the real time estimates of the output gap and fiscal policy effect with the estimations given by the International monetary funds and European commission for the European Union countries for the sample period of 2000 to 2013 by using simple OLS technique. He found that all the policy making is soundly base on the estimates given by the EC and IMF but there is significant differences arises between the real time measures and the estimations given by these institutions. This differences arises due to differences in the measurement of the potential growth. These differences arises due to variation in time which is very common for all countries. He give the reason of these differences is that the national governments of EU are hypothetically more motivated regarding forecasts of potential output due to threats to their autonomous economic policy making.

Armeanu et al. (2016) models the potential growth and output gap for Romania by using two techniques i.e. Hodrick Prescott filter to estimate the HP model and the Kalman filter to estimate the Ozbek and Ozlale model for the period of 2003 to 2015 and compare their results. He found that estimations through HP filter is quite simple but it does not incorporate the macroeconomic fundamentals in the estimations of the output gap and potential GDP but the OO model properly manages all the conditionalities of the emerging economies and provide reliable estimates of the potential growth and the output gap. The size of the output gap and the sign that whether positive or negative have a critical role in the monetary policy making. (Weidner and William, 2011).

## 2.4. Conclusion

In respect of all of the existing literature the estimation of the output gap is generally depends upon three factors; power to forecast the inflation, Economic possibility of the estimates and theoretical framework of the method. There is no final consensus on any one method in the output gap estimation and some follows simple univariate filters and some follows multivariate [(Chagny and Lemoine (2004), Dennis et.al (2006) and Billemeier, (2004)]. But none of the technique incorporating the financial cycles in the output gap estimation even though this inclusion has a very strong economic and theoretical background.

We understand from the existing literature, the importance of financial variable and how these variables effect the output gap and monetary policy of the developed economies, [(Borio (2013), Furlanetto et.al (2014) and Torres (2015)]. There are different channels through which all the financial variables including Real Exchange Rate, housing, Domestic Credit, and Equity prices have a severe effect on the output level of the economy [Niazi and Khetran (2012), Levine (1997), Emecheta and Ibe (2014), Demirguc-Kunt and Levine (2008), Soderbom (2000), Dornbusch (1988) and Nawaz (2012)]. These financial variables are incorporated in the output gap estimation in the developed countries which yields efficient estimates. In view of the existing literature for the case of Pakistan like Bukhari and Khan (2008) Tahir (2014) Tahir and Ahmad (2017) etc. Does not explores these variables in the output gap estimation and these financial cycle proxies are very important in the monetary policy forecasts.

The State bank of Pakistan hesitated to follow the rule based policy like Taylor rule as estimated by different studies [Malik and Ahmad (2010), Fatima and Malik

(2015)]. One of the reason is that, the independent variables of the model for the policy rule explained only 1/4<sup>th</sup> portion of the variation in the interest rate. This is due to the missing of financial sector stability, Exchange rate stability and interest rate smoothing (Malik and Ahmad (2010)).

## **CHAPTER III**

### **DATA AND METHODOLOGY**

#### **3.1 Introduction**

In this study our objective is to make the better monetary policy which is responded by the prevalent output gap in the economy. Over the passage of time financial sector became an important sector in the economy of the Pakistan. The economic theory suggest that financial development affect the economic growth both actual as well as potential GDP of the country subject to financial development. The consideration of the financial development for actual and potential GDP is crucial as it affects the output gap which will subsequently affect the optimal monetary rule. In order to capture the implications of financial development for output gap I have used various financial variables following the methodology of Borio (2013) and also check the impact of financial variables on the conventional output gap in case of Pakistan. The detail description of the variables used for the study along with the methodology are explained in this chapter.

#### **3.2 Data**

I have used the quarterly data for all variables for the period of 1991Q1 to 2015Q4, where the financial sector is incorporated by using real exchange rate, Domestic credit to private sector by financial institutions, Equity prices, and Property prices as a proxies for financial system. The Data set of financial variables are taken from the statistical Bulletin of State Bank of Pakistan, Pakistan Beauru of Statistics and Pakistan Stock Exchange and the quarterly data of GDP is taken from the SBP Working Papers Hanif et.al. (2013) and the missing data of quarterly GDP after 2012 can be



made on the basis of methodology of Arby (2008). House rent index is used as a proxy for housing prices because the house rent is proportional to the housing prices, KSE - 100 index is used as a proxy for equity prices and Money market rate is used as interest rate and data of rest of the variables including Real Exchange rate and Domestic Credit are directly available. Rest of the variables used to estimate the monetary policy reaction function are interest rate, inflation and the output gap. The interest rate used by the central bank is KIBOR for their policy decision but due to unavailability of data we have used the call money rate as its proxy. The output gap variable is difference of the actual and potential output and the potential is estimated using smoothing technique HP filter and the fitted value is used as proxy of potential output. For inflation, we take the data of CPI from International Financial Statistics and inflation rate is calculated as year on year growth rate of quarterly values of CPI. And for comparison of the estimated Taylor rule the output gap estimated from financial variables is also used in Taylor rule estimation for comparing the results.

### **3.3 Methodology.**

In this study the output gap is estimated by financial variables along with economic variables and then this output gap used in the monetary policy rule to get the monetary policy reaction function and compare the results with the conventional output gap estimated policies. For this purpose we follow the HP filter because it is estimated more precisely, much more robust results in real time which becomes helpful in policy making.

The estimates of output gap and potential output obtained from HP filter largely depends upon the de-trending which is traditionally captured with the parameter  $\lambda$  that

calculates the trend's degree of smoothness implying the removal of cyclicity. The setting of the value for this parameter is generally based on arbitrary number, prominent arbitrary selection for  $\lambda$  set 1600 in case of quarterly data while 100 in case of annual data series in the literature [brussels (2001) & Borio (2013)]. The state space equations based on the methodology of Borio (2013) are as follows:

$$\Delta x_t^* = \Delta x_{t-1}^* + \varepsilon_{0,t} \dots \dots \dots 1$$

$$x_t = x_t^* + \varepsilon_{1,t} \dots \dots \dots 2$$

Where  $x_t = \ln(X_t)$ ,  $X_t$  is the real GDP ,  $\varepsilon_{0,t}$  and  $\varepsilon_{1,t}$  are assumed to be independent and normally distributed error with mean zero and variance  $\sigma_i^2$  . In the 1<sup>st</sup> equation parameter  $\lambda_1 = \frac{\sigma_1^2}{\sigma_2^2}$  which is called as noise to signal ratio which is used to find the comparative variability of the estimated series of potential output. If the value of this parameter  $\lambda_1$  is large then the series of potential output shadow linear trend and if it is close to zero then the series of potential output becomes close to the actual output.

In equation 1 those financial factors that have a directly effects the potential output are not included. It consists of information only about the transitory or cyclical components of output.

Now in order to incorporate the financial variables information in the output gap estimate rewrite the 2<sup>nd</sup> equation as

$$x_t - x_t^* = \theta' y_t + \varepsilon_{2,t} \dots \dots \dots 3$$

Where  $y_t$  is the vector of economic and financial variables, which includes the lags of the output gap and  $\varepsilon_{2,t}$  are assumed to be independent and normally distributed error with mean zero and variance  $\sigma_2^2$ .

When the  $y_t$  in equation 3 consists of real interest rate then this equation is somehow comes in the extension of Investment saving (IS) curve. Woodford (2012) shows this consistency in which financial frictions becomes the part of the Investment saving curve of a New Keynesian Model. According to this, the approach of Borio (2013) based on equation 1 and 3 shows a settlement between statistics and theory in the estimates of potential output and does not solely relying on the full specification of general equilibrium model. The benefit of doing this is that the standard parameters in equation 3 will give no weight to any information or variable in  $y_t$  which shortfall to explain the fluctuations in the business cycle.

The drawback of this approach is that, it completely depends on the theoretical model which results more accurate estimates of the parameters of equation 3 and the model becomes well specified. And since equation 3 the constraints is that the potential output is proportionate to actual output and if there is any permanent effect present then it will reflected in the potential output also. Now consider the numerous specification of equation 3, five financial variables are considered i.e property prices, domestic credit, equity price index, real exchange rate and interest rate. Which help to explain the interrelation between wealth effect, collateral values and financing constraints (Kiyotaki and Moore (1997)). Now general form of equation 3 becomes

$$z_t = \alpha_0 + \beta_1 z_{t-1} + \beta_2 \ln hr_t + \beta_3 \ln ep_t + \beta_4 \ln cr_t + \beta_5 \ln rert + \beta_6 ir_t + \varepsilon_t \dots \dots \dots 4$$

Equation 4 represent the general specification of the model used to capture the relationship of financial variables and output gap. The dependent variable  $z_t$  shows output gap which is denoted by  $x_t - x_t^*$  in the previous section. The independent variables are log of house rent index as  $lnhr_t$ , log of equity price index denoted by  $lnep_t$ , log of domestic credit as  $lncr_t$ , Moreover,  $lnrer_t$  is the log of real exchange rate and  $i_t$  is the interest rate. These financial variables broadly capture the dynamic and structural path of the financial sector in Pakistan over the sample period.

The first three variables explored the chemistry of financial frictions (credit and collateral values) and the fourth variable explain the balance of payment behavior. The interlinks of these variables are very important, the property prices and equity prices influence the apparent wealth of the house hold in response of which the credit demand was effected i.e. creation of abnormal credit growth which mainly predicts the financial crises [(Kiyotaki and Moore (1997) Schularick and Taylor 2012)]. And the real exchange rate predicts the probable external imbalances which explain the business cycle fluctuations of open and small economies.

The different variables used in equation 4 used to explain financial and business cycles. If any of these variable explain certain features of the cycle the potential output would behave neutrally towards the motion of that specific variable. There is no consensus upon the definition of the financial cycle but a lot of studies explain it in terms of asset prices including equity prices and stock prices and credits [Borio (2013), Torres (2015)].

In order to estimate equation 4 the conventional Ordinary Least Square (OLS) method may subject to spurious relationship among variables due to time series nature

of the data. Moreover the variables are used in non-stationary and level which also led to cast doubt on the results obtained from OLS method. In order to assess the relationship between financial development and conventional output gap I have used the Autoregressive Distributive Lagged model (ARDL) for its several plausible merits explored in the literature [Banerjee et al. (1993), Pesaran and Pesaran, (1997), Pesaran and Shin (1999), Laurenceson and Chai (2003)]. This technique provides consistent and reliable results in case of small sample and the endogeneity problem is no more there (Jalil et al. (2014)).

The use of ARDL model encompass the fact that order of co-integration of financial variables is mixed with stationary at level and first difference. So the basic requirement of ARDL Approach is to check the unit root in the series. There are many tests that are proposed for testing seasonal unit roots in a series; OCSB test, HEGY test and Dickey-Hasza- Fuller (DHF) test are two widely used test for checking the unit root. Among these seasonal unit root tests, the HEGY test which was proposed for quarterly data by Hylleberg, Engle, Granger and Yoo (1990) has the advantage of testing seasonal unit root at each frequency separately which is the most plausible merit of HEGY test.

I have used HEGY test to check the stationarity of all variables used in the analysis and log form of each variable is used. In order to apply the HEGY test for the financial variables; firstly all variables are constructed as per the criteria of quarter data the models can be written as:

$$\ln Y_1 = \ln Y + \ln Y_{t-1} + \ln Y_{t-2} + \ln Y_{t-3} \quad (a)$$

$$\ln Y_2 = -(\ln Y - \ln Y_{t-1} + \ln Y_{t-2} - \ln Y_{t-3}) \quad (b)$$

$$\ln Y_3 = -(\ln Y - \ln Y_{t-2}) \quad (c)$$

$$\ln Y_4 = \ln Y - \ln Y_{t-4} \quad (d)$$

After constructing these variables; various lags of each variable was used to proceed with and the estimation of the model carried out as follows:

$$\begin{aligned} \text{LnY}_4 = & \alpha + \beta t + S1 + S2 + S3 + \pi_1 \text{LnY}_{1,t-1} + \pi_2 \text{LnY}_{2,t-1} + \pi_3 \text{LnY}_{3,t-1} \\ & + \pi_4 \text{LnY}_{3,t-2} + \varepsilon_t \end{aligned}$$

As per our model I am using 4 variables namely Domestic Credit, Real exchange rate, Equity prices and housing prices. The house rent index was used as a proxy for housing prices due to non-availability of Data of housing prices or residential property price index for Pakistan. In order to test for unit root of these variables the hypothesis for HEGY Test are given below:

**Test seasonal unit root at zero frequency.**

**Hypothesis**

- Null  $H_0: \pi_1 = 0$  (seasonal unit root at zero frequency)  
 Alternative  $H_1: \pi_1 \neq 0$  (no seasonal unit root at zero frequency)

**Test seasonal unit root at Bi-annual frequency.**

**Hypothesis**

- Null  $H_0: \pi_2 = 0$  (seasonal unit root at biannual frequency)  
 Alternative  $H_1: \pi_2 \neq 0$  (no seasonal unit root at biannual frequency)

**Test seasonal unit root at Annual frequency.**

**Hypothesis**

- Null  $H_0: \pi_3 = \pi_4 = 0$  (seasonal unit root at annual frequency)  
 Alternative  $H_1: \pi_3 = \pi_4 \neq 0$  (no seasonal unit root at annual frequency)

After confirming the mixed order of integration of I (0) and I (1) we are allowed to use the ARDL approach because the basic assumption of ARDL approach is that the order of integration of all variables must not be more than one (Ouattara (2004)). The baseline specification of the ARDL model in this case is the variant of equation 4 as follows:

$$z_{ti} = \alpha_0 + \sum_{i=1}^p \beta z_{t-i} + \sum_{i=1}^p \gamma \Delta \ln hr_{t-i} + \sum_{i=1}^p \delta \Delta \ln ep_{t-i} + \sum_{i=1}^p \theta \Delta \ln cr_{t-i} + \sum_{i=1}^p \omega \Delta \ln r_{t-i} + \sum_{i=1}^p \Delta \varphi ir_{t-i} + \beta_1 z_{t-1} + \beta_2 \ln hr_{t-1} + \beta_3 \ln ep_{t-1} + \beta_4 \ln cr_{t-1} + \beta_5 \ln r_{t-1} + \beta_6 ir_{t-1} + \varepsilon_t \dots\dots\dots 5$$

Where  $\alpha_0$  is the drift component and  $\varepsilon_t$  is the white noise and the summation sign shows the error correction dynamics. While the terms with  $\beta_i$  represent the longrun relationship. This is the error correction representation. Then we will estimate the following error correction model in the next step.

$$z_{ti} = \alpha_0 + \sum_{i=1}^p \beta z_{t-i} + \sum_{i=1}^p \gamma \Delta \ln hr_{t-i} + \sum_{i=1}^p \delta \Delta \ln ep_{t-i} + \sum_{i=1}^p \theta \Delta \ln cr_{t-i} + \sum_{i=1}^p \omega \Delta \ln r_{t-i} + \sum_{i=1}^p \Delta \varphi ir_{t-i} + \phi ECM_{t-1} + \varepsilon_t \dots\dots\dots 6$$

This model represents the speed of adjustment back to longrun after any shortrun shock. In order to check the goodness of fit of the model the stability and diagnostic testing will be conducted through which normality, functional form of the model and serial correlation will be examined. For checking the stability of coefficients Cummulative sum (CUSUM) and commulative sum of square (CUSUMSQ) statistics updated recursively and plotted against the break point as suggested by Pesaran and Pesaran (1997). If these statistics are well adjusted with in the critical bound of 5% significance level then the null hypothesis of stability in coefficients can't be rejected.

After estimating the output Gap using financial variables, our second objective is to estimate the reaction function by using the financial output gap in the monetary policy rules. This policy rule can be defined as: the description which expressed in the form of algebra, numeric or graphs in order to explain the changes comes in the instruments of policy, such as discount rate or monetary base in response to change in economic variable (Taylor 1999b). In order to improve macroeconomic performance, the rule based policies are more advantageous over the discretion (Taylor (1993)). There are different studies which gives different way to control the monetary policy instruments. Examples are, McCallum (1988), Meltzer (1987), Henderson and McKibbin (1993), Taylor (1993) etc.

The most well-known and the one that concerned with a lot of research in 1990s is the Taylor (1993) rule which is basically the approximation of response of nominal interest rate set by the central bank to a change in output, inflation or other macroeconomic changes. The Taylor rule can be defined by the following equation

$$i_t = r^* + \pi_t + \varphi_1 X_t + \varphi_2 (\pi_t - \pi^*)$$

$r^*$  = *real interest rate of the longrun equilibrium*

$\pi_t$  = *current inflation rate* (Taylors uses averages of the last four quarters including the current.

$\pi^*$  = *target inflation rate*

$X_t$  = *deviation of the output from its longrun trend* (Here the output gap with financial variables is used). These four parameters  $\varphi_1$   $\varphi_2$   $r^*$ ,  $\pi^*$  value as taken by the Taylor are 0.5, 0.5, 2% and 2% respectively. And assumed that State Bank has the



information about the inflation and current output. Now we need to convert this equation in the estimable form

$$i_t = \varphi_0 + \varphi_1 X_t + \varphi_2 \pi_t \dots\dots\dots 6$$

$$\varphi_0 = r^* + \varphi_2 \pi^*$$

$$\varphi_2 = (1 + \varphi_2^*)$$

Now the parameters values of standard Taylor rule  $\varphi_0 = 1$  and  $\varphi_1 = 0.5$  and  $\varphi_2 = 1.5$

These values met if the central bank strictly following the rules based policies.

However, if opposite the case then following condition must hold to make system stable

$$\varphi_1 > 0 \quad \text{and} \quad \varphi_2 \geq 1$$

The equation 6 can be simply estimated by the OLS other approaches like GMM or VAR estimate the equation more efficiently but at the cost of “loss of rule’s theory” (Malik (2007)). As the rule explored it as the interest rate is a linear function of inflation and output gap. However, the statistical inference make logic if the variable in equation 6 are stationary but if the estimated residuals are stationary then OLS estimates of equation 6 are very stable and if there is integration exist among the variables then it does not creates any problem. (Enders (2004)).

## CHAPTER IV

### EMPIRICAL RESULTS AND DISCUSSION.

This chapter detailed the empirical results and discussion regarding the output gap estimated from financial variables and then the response of monetary policy with estimated gap. Also compare the results of monetary policy reaction function obtained by using output gap calculated by HP filter and the output gap estimated by using financial variables. First we start our discussion from the descriptive statistics.

#### 4.1 Descriptive Statistics

The examination of the behavior of time series data is the preamble of its characterization as it assist to adopt the suitable model in order to check the statistical relationship between the variable of interest. The procedure starts with the determination of the behavior of variables over time in the business cycle specifically during different phases of business cycle; whether linear like upward or down ward trendy and nonlinear or cyclical. The most basic way to check the behavior is to plot a series against time which explicit the visual pattern of series, but it could be problematic for future testing due to unknown implicit properties of the series.

Different statistical techniques and methods are used to observe the behavior of the series apart from graphical methods. In addition, the arithmetic mean, standard deviation and stability ratios (the ratio of standard deviation to mean) are the elementary statistical operations that help us to analyze the underlying behavior of a series. Moreover, an important aspect of the behavior inspection is to confirm the predictability pattern of the business cycle with the help of our data series. This can be checked by detecting the presence of Autocorrelation in which the error term of one period correlate

with the error term of other period. The problem of serial correlation lead to violate the assumption of OLS which in turn leads to cast doubt on the reliability of the OLS estimates.

We can identify this cyclical behavior by using ACFs and PACFs plots and then HP filter to separate the cyclical components from the long term trend components. Furthermore, we will check the unit root of the data by using Dicky fuller test, Phillips Perron or HEGY test to confirm the mean reversion property of a series. Lastly we will check the structural break in the data by using state space approach or Chow test as if there is any structural break in the data then the method for future forecasting follow a completely different path.

The benefit of stability ratio (S.R) over the standard deviation is that it identifies the magnitude of the difference in the volatility in each subsamples. If we use the S.D instead of S.R as a criteria for checking the volatility then the S.D of 2001 Q1-2005 Q4 is highest and 1991Q1-1995Q4 has the lowest S.D which means the subsample of 2005 Q1 to 2010 Q4 period is more volatile and 1991Q1-1995Q4 period is less volatile. On the other hand this criteria does not incorporate the mean value in the analysis so the use of stability ratio is better way to analyze the volatility of the series especially when the data is divided in to subsamples and the mean of each subsample is also different.

**Table 1: Descriptive Statistics**

<b>GROUPS</b>	<b>MEAN</b>	<b>STANDARD DEVIATION</b>	<b>STABILITY RATIO</b>	<b>MEAN</b>	<b>STANDARD DEVIATION</b>	<b>STABILITY RATIO</b>
<b>HOUSE RENT</b>			<b>REALEXCHANGE RATE</b>			
1991-1995	96.43618	24.23196	25.12745516	9.009683	2.120081	23.53113374
1996-2000	125.2864	15.07522	12.03260748	20.4955	4.9366	24.08625777
2001-2005	111.7857	10.91523	9.764422703	32.56453	2.0256	6.220264718
2006-2010	176.053	30.72652	17.45299311	49.14442	14.82077	30.15757947
2011-2015	246.5298	20.88065	8.469828126	109.398	19.11594	17.4737608
1991-2015	151.2182	58.82269	38.89920995	49.36994	40.5231	82.08051469
<b>EQUITY PRICES</b>			<b>DOMESTIC CREDIT</b>			
1991-1995	124.8726	45.10332	36.11945517	282774.9	70018.98	24.76138751
1996-2000	471.2864	92.40404	19.60676865	590180.1	106287.6	18.00934536
2001-2005	1363.537	873.8002	64.08334874	1141459	403291.5	35.33123133
2006-2010	3899.558	828.5056	21.24614125	2725752	356189.4	13.06756505
2011-2015	8091.95	3269.933	40.40970656	3565664	315169.5	8.839014649
1991-2015	2831.286	3419.395	120.7717729	1661166	1307501	78.7098416
<b>CALL MONEY RATE</b>			<b>INFLATION</b>			
1991-1995	9.208	2.321723	25.21418974	0.112147	0.017229	15.36269126
1996-2000	10.373	2.869434	27.66253142	0.073079	0.032743	44.80539137
2001-2005	5.1385	2.670157	51.96374914	0.051748	0.028319	54.7245896
2006-2010	10.8345	1.819272	16.79147615	0.126867	0.056249	44.33669572
2011-2015	9.6155	1.952018	20.30074132	0.077533	0.036172	46.65369476
1991-2015	9.0339	3.083297	34.13030282	0.088275	0.045061	51.0461686

Source: Author calculation.

The table 1.1 shows that the mean of the complete sample of Domestic Credit of Pakistan is Rs. 1661166 million with the standard deviation of Rs. 1307501 million and the stability ratio is 78.70984. The stability ratio shows the volatility of the data: larger the value of ratio higher will be the volatility which means the standard deviation is 78 percent of the average in case for Credit to private sector. In each subsample the descriptive shows the behavior of the series where series is stable in the each subsample. The mean value of credit growth for the period of 1991Q1 to 1995 Q4 is different from the mean value of rest of the sub-samples mean values and on average it is Rs. 282774.85 million.

The descriptive statistics of House rent variable shows an increasing trend in terms of rising subsample means and the series is less volatile across various subsample groups as compared to the whole sample period. Table 1.2 enlists the detailed descriptive measure of house rent for five yearly subsample groups and for the whole sample as well. Table 1.3 shows the descriptive stat of Equity prices shows increasing trend over the whole subsamples except in the subsample of 2006Q1 to 2010Q4 in which decreasing during 2007 to 2008 due to impact of financial crises. Similarly the Table 1.4 provide the summary statistics (mean, standard deviation and stability ratio) of the real exchange rate variable for complete sample period as well as for five yearly subsample periods. The statistics reveal that real exchange rate have the increasing trend over the sample period.

#### **4.2 Unit root Testing**

In the beginning of estimating time series data set the level of co integration is tested for all variables under our analysis. However, ARDL approach works for the data

series whose order of integration are I (0) or I (1). ARDL does not support for I (2) series. For this purpose we will go for HEGY test. The reason for the application of HEGY test, explored in section of methodology. The results of HEGY test of all variables are documented in Table 4.1 which reveals at a first glance that variables follows a mixed order of integration and thus lead to bolster the argument of using ARDL model.

**Table 2: Unit Root Tests**

Variable	$\pi_1$		$\pi_2$		$(\pi_3 = \pi_4)$		Seasonal Dummy	Constant	Trend	Stationary decision
	Cal.	Cri.	Cal.	Cri.	Cal.	Cri.				
DC	-3.51	-2.83	-5.55	-2.82	122.6	6.39	yes	yes	no	I(0)
DEP	-3.31	-1.90	-4.07	-1.90	27.54	3.15	No	no	yes	I(1)
DHR	-3.27	-2.84	-3.59	-1.91	26.06	3.98	No	yes	no	I(1)
RER	-2.90	-2.84	-7.08	-1.91	67.84	3.98	yes	yes	yes	I(0)
IR	-2.00	-1.99	-3.19	-1.94	25.67	3.01	No	yes	no	I(0)

**Source:** Author calculation.

The table contains values of  $\pi_1$  and  $\pi_2$  of all variables in which if critical value is greater than calculated then reject Ho (Ho=seasonal unit root at zero and biannual frequency) and by rejecting Ho we conclude that there is no seasonal unit root at zero and biannual frequency., and for  $(\pi_3 = \pi_4)$  the calculated is need to be greater than critical for rejecting Ho, and concluded that there is no seasonal unit root at annual frequency.

These results of the table exposes that the series Domestic Credit, Real Exchange rate and interest rate does not have a seasonal unit root at zero, bi-annual frequency and annual frequency. The series of House rent and equity prices indicate a seasonal unit root at zero frequency and does not exhibit seasonal unit root at bi-annual and annual frequency thus lead to stationarity of both series except zero frequency. In order to make these variables we take the first difference and then again check the

results then we conclude from the values of  $\pi_s$  that the series of house rents and equity prices are stationary at first difference. The results confirm the mixed order of co-integration of financial variables. Some variables are stationary at level and some are at first difference which provides support for the application of ARDL approach for estimation.

### 4.3. Long Run Relationship

The analysis proceed with the examination of long run relationship by using bound testing procedure. Before testing the existence of co-integration we go to choose the optimal lag length for which we go for AIC and SIC criteria on e-views which supported for four lag length and then we move from general to specific modeling and compared the critical values. Then we also estimate the co-integration test by using F-stat which provides strong support to the existence of long run relationship among the variables. The F statistics value is 6.86866 which is greater than the I(0) bound and I(1) bound so the null hypothesis “no long run relationship exist” is rejected on all significant level from 1% to 10%. As shown in the table.

**Table 3: Bound Testing**

F-statistic	Significance level	Critical Value Bounds	
		I0 Bound	I1 Bound
6.86866	10%	2.08	3
	5%	2.39	3.38
	2.50%	2.7	3.73
	1%	3.06	4.15

**Source:** Author’s calculation.

### 4.4. Model Estimation

In the Next Step we estimate Equation 5 by using ARDL co integration for long run estimates. Initial estimations included all four lags followed by AIC and SIC

criteria. However, by using general to specific approach, in table 4.2 only coefficients of those lags are explored that are economically and statistically significant. The results shows that all variables are statistically and economically significant and the fourth lag of dependent variable and real exchange rate are remains in the results rest of all lags of all variables are dropped because of its insignificance. The presence of these 4<sup>th</sup> lag confirms that the previous year value effect on the current value because our analysis is quarterly based. The signs of the coefficients of all variables are positive which means these variables are positively related to the output gap except real exchange rate which bearer negative sign. The positive effect of the domestic credit on the output gap means by the increase in domestic credit our output gap is also increasing which means the potential output effects negatively and in case of Pakistan and this potential moves away from the actual which leads to increase in the output gap. But it depend on the efficiency of financial system.

**Table 4: ARDL Estimates of Final Model**

<b>Regressors</b>	<b>Coefficients</b>
Domestic Credit	0.257 (0.077)
House Rent Index	0.224 (0.094)
Equity Price Index	0.111 (0.038)
Real Exchange Rate	-0.383 (0.183)
Money Market Rate	0.011 (0.006)
Lagged GDP Gap	0.292 (0.089)
Lagged Real Exchange rate	-0.223 (0.172)
Constant	-3.443 (0.885)
<b>Diagnostic Tests</b>	
Normality	0.51
Functional Form	0.10
Serial Correlation	0.19
CUSUM	Stable
CUSUMSQ	Stable

Source: Authors Calculation.

Standard error are in Parenthesis



Domestic credit is one of the financial resource that is used to support the private sector as well as the public sector. But the linkages between the Domestic credit and growth of the economy are very difficult to explain by the literature because from the empirical evidences the literature is inconclusive on this issue. Some studies shows there is positive relationship between Credit and growth of the economy. [Levine (1997), Emecheta and Ibe (2014) and Demirguc-Kunt and Levine, (2008)]. And some find negative relations [Driscoll (2004), Loening et al. (2008) and Soderbom (2000)], it depends on the efficiency of financial system. Competent system of providing credit has significantly positive impact on the economic growth and enhances potential output by creating more employment opportunities by financing large number of economic projects and if the system not works effectively then weak financial development create distortion of economic growth. (Olowofeso et.al 2015). Public sector work for the capacity building and human capital growth due to which potential is increasing and when this credit received by the private sector business activity is increasing and it also enhances the potential level of the economy so the potential is moving away from the actual and the gap is increasing and the positive impact of credit on the output gap and we need to work for increasing actual output level of the economy.

Secondly the house rent variable actually shows the housing prices this variable also become the part of financial cycle because the housing variable effect the overall economic activity (Lee and Chen (2015)). In our model this variable have a significant and positive relation with the output gap in case of Pakistan. Because in case of Pakistan the prices of the housing sector is increasing, and increase in housing actually increase in the wealth which leads to more consumption and investment which ultimately increase in the living standard and this lead to enhance the potential of the economy to

install more businesses and also peoples move to housing sector due to more profit there and hence the construction sector also better off (Niazi and Khetran 2012). The increase in real house price significantly affect the crest and trough of the business cycles. Increase in housing enhances the potential of the economy though the wealth effect and higher collateral values, through which it is easy to access to mortgage financing<sup>2</sup>.

Equity prices are also the part of financial cycles as incorporated by many studies as it effects the real economy<sup>3</sup> [Borio (2013), Torres (2015)]. In our model it will affect the output gap by significantly positive sign. Which means that it affects the output. Higher stock prices reveals increase in expected future earning which provides the useful information about future growth of the economy. This provides the confidence to the house hold and firms and it reduces uncertainty about the future economic situation.<sup>4</sup> Higher the stock prices also increase the value of Tobin's Q ("ratio between the market value of installed capital and the replacement cost of capital") which encourage the investor to do more investment of the capital. Also the availability of more credit due to better financial position of the firms or house hold. With all these reasons the equity risk premium affords more degree of risk averse behavior in the economy which ultimately effect the real economic activity<sup>5</sup>

Real exchange rate is a significant part of financial cycle (Torress (2015)) it creates negative and significant effect on the output gap increase in Exchange rate means our local currency depreciates and due to which exports are increasing because of cheap and imports are decreasing because it becomes expensive in terms of foreign

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<sup>2</sup> <http://www.oecd.org/eco/> ECO/WKP(2004)17

<sup>3</sup> See the box entitled [STOCK PRICES AND ECONOMIC GROWTH](#) ECB Monthly Bulletin October 2012 of ECB

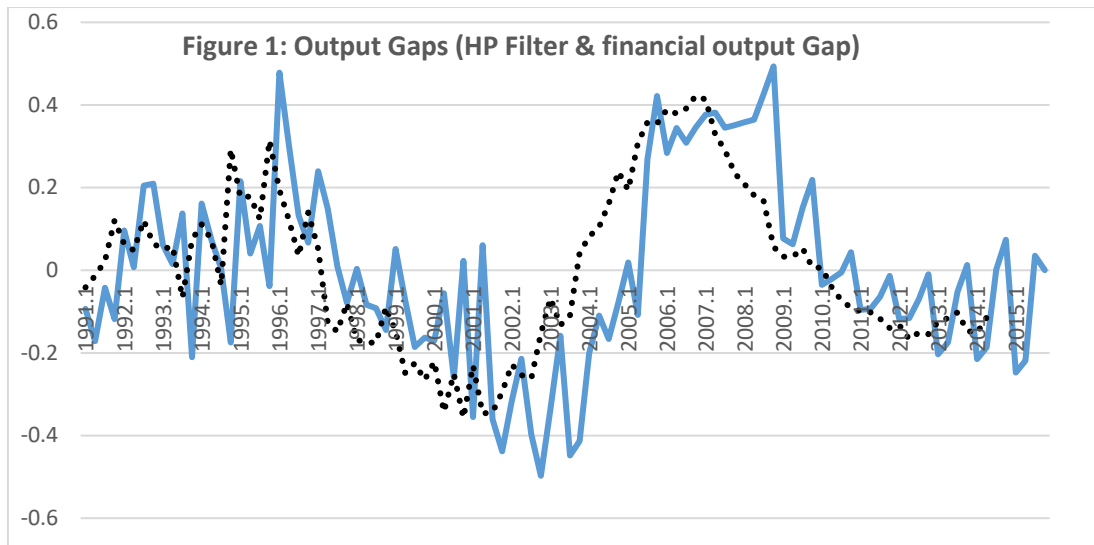
<sup>4</sup> See the box entitled [STOCK PRICES AND ECONOMIC GROWTH](#) ECB Monthly Bulletin October 2012 of ECB

<sup>5</sup> "See the box entitled "Risk-taking and risk compensation as elements in the monetary policy transmission process", *Monthly Bulletin*, ECB, August 2008"

currency and it enhances actual output in order to meet the excess demand of the local products (as explored by J-Curve effect), which leads to decrease in the output gap. Different studies like Gylfason and Schmid (1983) and Dornbusch (1988) explored the links that currency depreciation will help to increase in the output level.

When we analyse the interest rate in the estimation of output gap it is significant but if we compare its significance level with other financial variables then it will be less significant as compared to the others which shows that in Pakistan interest rate is less important factor in order to take decision. Amount of risk and business expectation matters much.

All conventional diagnostic tests are also applied on the final model. The p-values of chi-square in the table confirm the normal distribution, and well specification of functional form and also there is no problem of the serial correlation. The final results of the estimated model explored that the proxies of the financial cycle contain extensive information about the fluctuations of the business cycles and this information outperforms that of the interest rate. All the coefficients of the financial variables are highly significant and the coefficient of interest rate is only significant which means that the financial variables work more efficiently in explaining the perceived changes in the cyclical component of output and changes over time in the duration and amplitude of the business cycle.



This graph explored that the financial factors significantly modifies the output gap estimates. Here blue line represents the HP filter output gap and red dotted line represents the output gap estimated by including financial cycles. The cycles of the output gaps are almost identical from 1990 to 1995 after 1995 financial gap is less than the HP filter gap and in 1997 the bust phase starts and in the bust phase the financial gap is deeper than the HP filter gap. This information contents is particularly important during financial boom as shown after 2000s. this reduce the evaluations of potential output comparative to the actual output and also the gap is a bit larger in the bust time period as compared to the hp filter as shown after 2010.

These results shows that by incorporating information about the financial cycle the justifiable output estimates are obtained and also incorporate the degree to which the financial sector are taking part in the economic activity.

#### 4.5. Short Run Analysis

After checking the long run relationship between variables we move to the short run relationship through error correction mechanism (ECM) the important result in the ECM is the sign and significance of the term  $Ect-1$ . The negative sign of this  $Ect-1$  term

shows that if there is disequilibrium then it will converge back to long run equilibrium. Its significance shows that there is short run relationship exist among the variables. Ect-1 is basically the speed of adjustment from disequilibrium in the short run to the equilibrium of the long run as the result shows in the table.

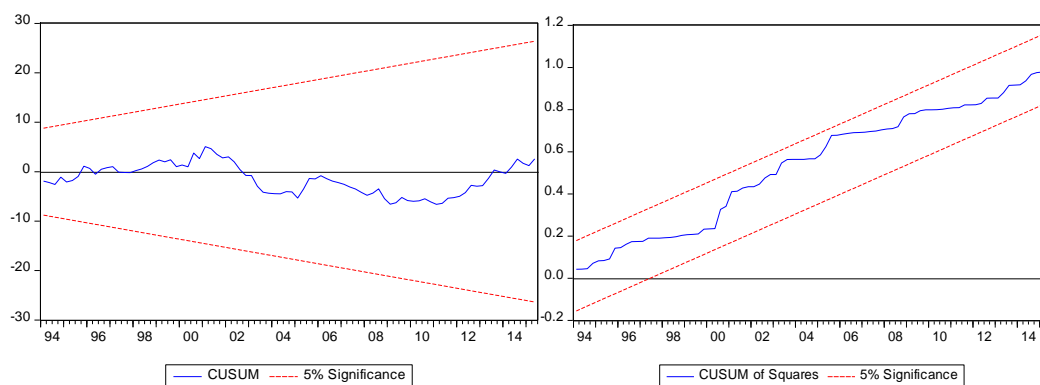
**Table 5: Short Run Analysis.**

Variable	Coefficients
C	-0.012 (0.023)
DGAP(-4)	0.441 (0.072)
DLCPS	0.407 (0.297)
DLHR	0.009 (0.254)
DLRER	0.162 (0.345)
DLRER(-4)	-0.240 (0.371)
DIR	0.010 (0.005)
ECTM(-1)	-0.929 (0.110)

Source: Authors Calculation: Standard error in parenthesis

Furthermore in order to check the stability, the graph of COSUM and COSUMSQ are also within the required bounds which shows the stability of all the coefficients in the ECM.

**Figure 1: Stability Test**



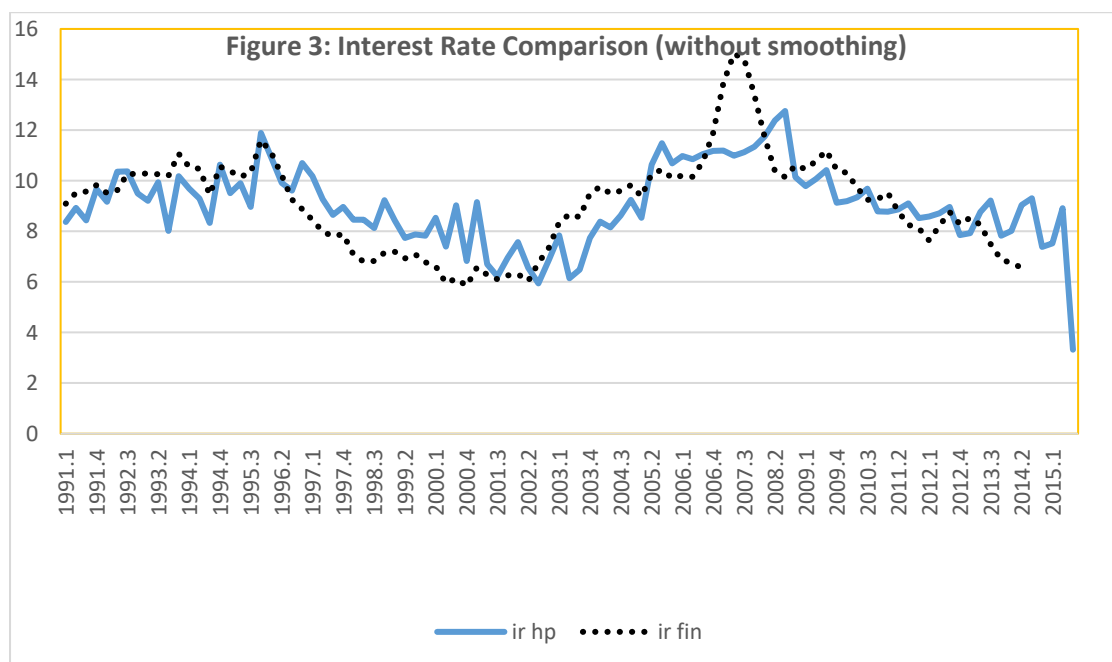
#### **4.6. Monetary Policy Response by Taylor Rule**

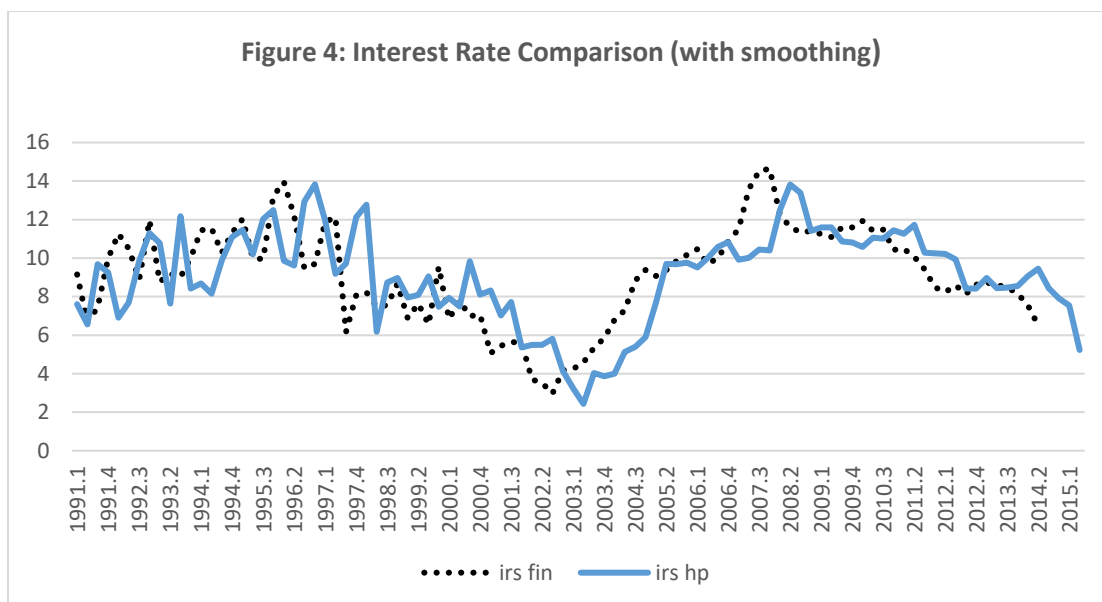
After estimating the output gap using financial variable we will move to the monetary policy response to both the gaps; HP gap and the financial gap. Due to global financial crises the debate on incorporating the financial stability concerns very much to formulate the monetary policy. The main argument of the debate is that the focus on the minimizing the inflation gap and the output gap is only possible when monetary policy is seriously concerned with the financial imbalances because these imbalances strongly correlated with the inflation gap and the output gap (Borio (2013)). The forecasting of the inflation and output must incorporate the relevant information related to the risk of financial sustainability (Svensson, (2011)). However the problem is that in real practice the financial stability is ignored during macroeconomic forecasts.

There are several ways to check the monetary policy response to the financial imbalances. One way is that to check the respond of monetary policy directly to the financial cycle proxies. This can be amount to presenting a term in the central banks' loss function that aims to avoid the accumulation of financial disparities in addition to inflation and output [Woodford (2012) and Disyatat (2010)]. The other way is to incorporate the financial cycles in the output gap and then check the monetary policy reaction function in response to that output gap in order to capture endogeneity of financial instability risk and financial cycle's proxies. Taylor rule might be the feasible option to move from discretion to explain the inflation targeting framework. (Malik and Ahmad (2007)). So the Taylor rule is estimated in which interest rate is used as a function of output gap and inflation gap and then compare the variation of interest rate against the output gap estimates by using HP filter and the output gap estimated by using financial variables.

In case of Pakistan, Malik and Ahmad (2007) use the data of 1991 to 2005 and estimate the Taylor rule by using both the stochastic and historic simulation and get the better response of monetary policy than the actual policy of State bank. Their results shows that by following Taylor rule based monetary policy better macroeconomic performance and the variability in output and inflation are decreasing and loss to the society would be condensed. But inflation and the output gap explained only 1/4<sup>th</sup> of the variation in interest rate (Malik and Ahmad (2007)). This shows that there are some other factors that may explain the monetary policy rule in better way like interest rate smoothing, exchange rate stability and financial sector stability etc. this might be one of the reason that State Bank of Pakistan does not follow the rule based policy.

The interest rate behaves differently by incorporating the financial gap and HP gap in the monetary rules and we easily compare the trajectory of interest rates and also compare the results of incorporating lagged interest rate as an independent variable in the Taylor rule called as interest rate smoothing with the standard Taylor rule without interest rate smoothing.





The graph 1 shows that when tight monetary policy is suggested by the Taylor rule estimated by previous studies then this monetary policy needs to further tight if incorporate the role of financial sector in it and similar to the case of loose monetary policy. so by incorporating the financial sector in the monetary policy the amplitude of the interest rate increases in both the directions. And the difference between both the interest rates are very clear which means the interest rates behaves differently by incorporating the role of financial cycles. The validity of this explanation can be explored by the statistics as given in the table.

**Table 6: Taylor rule using HP filter output Gap**

Variables	Without interest rate smoothing coefficient estimates	With interest rate smoothing coefficient estimates
Constant	8.62 (0.00)	2.87 (0.00)
Output Gap	5.74 (0.00)	2.97 (0.00)
Inflation Gap	5.30 (0.02)	1.98 (0.25)
lagged interest rate		0.66 (0.00)
Adjusted R-squared	0.22	0.60
DW- stats	0.72	2.28
F-stats	15.59 (0.00)	51.03 (0.00)

Source: Authors Calculations, P value in parenthesis



**Table 7: Taylor Rule Using Financial Output Gap**

Variables	Without interest rate smoothing coefficient estimates	With interest rate smoothing coefficient estimates
Constant	6.55 (0.00)	2.45 (0.00)
Output Gap	4.09 (0.01)	2.62 (0.04)
Inflation Gap	29.04 (0.00)	12.73 (0.03)
lagged interest rate		0.60 (0.00)
Adjusted R-squared	0.36	0.63
DW- stats	0.66	2.15
F-stats	27.55 (0.00)	55.67 (0.00)

Source: Authors Calculation, P values are in parenthesis

In this Study the addition to this rule for Pakistan Economy is that we incorporate the financial cycle proxies to the output gap and this output gap is then used in the Taylor rule which betters the result of interest rate response to 14% more because our Adjusted R-square value increases from 0.22 to 0.36. And also it gives more weight to the inflation gap than the output gap as shown by the results given in the table

Also when we use the technique of interest rate smoothing then our R square increases to 0.64 which means that almost 3/4<sup>th</sup> of the variation in interest rate is explained by this financial output gap, inflation and interest rate smoothing. It also gives more weight to the inflation and all coefficients are still significant. And when we compare our results with the standard estimated Taylor rule in which output gap does not have any effect of financial cycles then coefficient of the output and inflation have an equal weightage to both of these variables. But in our results the inflation gap get more weightage than the output gap.

Moreover, when interest rate smoothing is applied in the standard Taylor rule the coefficient of inflation gap becomes insignificant means there is no role of inflation in the variation of interest rate. And there is serial correlation of the error term as shown by the Durban Watson Statistics which suggests for the interest rate smoothing objective which is one of the objective of State Bank of Pakistan (Malik (2007)). Alternatively, when interest rate smoothing is applied in that case where financial output gap is used in the Taylor rule instead of using conventional output gap estimates without financial variables then the model becomes better and Adjusted R-squared value becomes increase from 0.36 to 0.64. In this way our study fills the gap of the estimated monetary rules for the case of Pakistan.

## CHAPTER V

### CONCLUSION

It is common practice to use economic variables or standard smoothing techniques in order to find the potential output and output gaps for the case of Pakistan and the financial sectors are ignored from the estimation of output gap and this output gap variable is very important for the estimation of monetary policy reaction function. If we ignore these variables then we mislead the macro economic forecasts and many important information that may lead to recession are ignored from the analysis.

This study focus on the importance of financial factors to determine the output gap and these financial factors plays a vital role in explaining the fluctuation of cyclical output at traditional business cycle and in determining which output gap trails are stable and which are not. If we ignore the role of financial factors from the output gap estimation then the macroeconomic forecasts does not provides the reliable estimates. For this purpose we incorporate the financial variables used as a financial cycle proxies like Domestic Credit, Housing Prices, Equity prices and Real Exchange rate. All these variables are significant and contains the long run relationship with the output gap in case of Pakistan as given by the estimated results.

In this study, we compare the results of output gap estimated by standard HP filter and the financial output gap and this financial output gap used in the Taylor rule in order to check the variation in interest rate. The estimated monetary policy rule using financial output gap shows better explained variation than the rule estimated by the HP filter gap.

Our contribution to the literature is that the financial variables are incorporated in the estimation of output gap for the case of Pakistan and Taylor rule estimated by this study gives better results than the standard estimated Taylor rule. Our estimated Taylor rule explored the variation  $2/4^{\text{th}}$  and the previous estimated Taylor rules explained the variation in the interest rate by only  $1/4^{\text{th}}$  and our estimated rule also allow interest rate smoothing which increase the explained variation of interest rate to  $3/4^{\text{th}}$  for the case of Pakistan.

This study concludes that if we ignore the role of financial variables then policy makers does not properly evaluate the macroeconomic risk and external imbalances which may lead our economy to further recession.

### **Policy Recommendation:**

The results of this study shows that financial cycles plays a vital role in explaining the fluctuation of cyclical output. This recommended that financial variables must incorporated in the estimation of output gap in order to get the better macroeconomic forecasts. Central bank need to follow the monetary policy rule instead of discretionary policy because when financial cycles are incorporated in the monetary policy reaction function then interest rate will response better and the explained variation are also increases because of incorporating the financial cycles.

### **Limitation of Study**

Limitation to study is that the data of residential property price index is not available for the case of Pakistan so we use the house rent index as a proxy for the property price index so if any one constructed the residential property price index then may be some difference come in the results.

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