Model Specification and inflation forecast uncertainty in case of Pakistan

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CERTIFICATE

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Abstract

Although there exist many models for the monetary sector in Pakistan, we applied three classes of inflation models Standard Phillips curves (PCM), New Keynesian Phillips curves (NPCM) and Incomplete Competition models (ICM). We used annual time series data from 1980 to 2016. PCM includes the output gap and unemployment rate, NPCM has the forward looking expectations and used labor income share instead of output gap, and ICM identifies the importance of incomplete information of labor and product markets, and used some ECM to forecast inflation. The relevant ECM has overcome the omitted variable bias. ICM is better in visualization forecasting and has the lower root mean square error and mean absolute percentage error as compared to other inflation models. In conclusion, wage prices dynamics model (ICM) offers the best prospect of successful inflation forecast in case of Pakistan.

Keywords: Monetary policy, Inflation targeting, wages and price model specification, inflation uncertainty, inflation forecasting

JEL classification: C32, C51, C52, C53, E31 and E52.

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Chapter 1

Introduction

The inflation and inflation uncertainty relationship is frequently argued by economists. Friedman (1977) argued first about inflation and inflation forecast uncertainty. Because of welfare cost of inflation, inflation is extremely unpopular with the public. Inflation has indirect real cost through its effects on uncertainty that lowers welfare.

Since the 1970 controlling inflation is very important phenomena for the policy makers. This is because of the high and adverse effect of persistent inflation that is of utmost important to control inflation. For a developing country like Pakistan uncontrolled inflation is even more deter-mental because of high proportion of population that's falls in the lower and middle income groups.

Phillips curve shows inverse relationship between inflation and unemployment. Phillips (1958) showed that wages has inverse relationship with unemployment in UK. Samulson and Solow (1960) found negative association among unemployment and inflation in US. Friedman (1968) claimed that trade-off among inflation and unemployment valid in only short run and in long run inflationary policies will not affect rate of unemployment due to vertical aggregate supply curve. The rate of inflation has no effect on the rate of unemployment. To bridge this gap between the introduced new variables expected inflation.

Theoretical research has explored the implications for the monetary policy of uncertainty about the inflation process, Batini et al. (1999). So far, some specific and limited forms of uncertainty have been considered: for example, if the exact specification of the inflation process is known,

but the parameters are not known and need to be estimated. However, the uncertainty is quite ubiquitous as the policy makers face a different model, all of which claim to represent the true model of the economy properly. So there is a strong link between forecasts and policy analysis. The statistical basis of the conditional prediction as an operational goal is that the predictions are calculated as conditional unbiased, which means that no other predictor (conditional on the same set of information) has lower mean-square prediction error (MSFE) and mean absolute percentage error (MAPE).

There are two relevant predictors for inflation targeting. First, the inflation process should be recorded as accurately as possible. Second, the forecast should reflect the fact that structural changes may occur. Regarding the first point, policy makers are faced with several complementary economic statements and sometimes compete in the inflation process. According to Granger (1990, 1999), usually the selection procedure place, where not only the econometric tests, but also the conviction that it plays an important role. However, the specific feature common inflation explains the inflation growth rates not only of other growth rate, but also by the amount of the combination of co-integration variables. Thus, they are explicitly and implicitly error-correction models designated by the ECM leading to the second element, namely ECM.

We consider inflation models, namely Phillips curves and wage curve specifications. The Standard Phillips Curve model denoted (PCM) might come with PCM of forecast robustness of a VAR because the Philips curve is similar to VAR and only included the output gap and unemployment rate. The New Keynesian Phillips Curve Model (NPCM). The modern theory of wage and price. In the ICM model error correction mechanism ECM used to forecast the

inflation. In PCM used the output gap and unemployment as an additional part in the traditional Philips curve model.

The New Philips Curve model (NPCM) has forward looking expectations that dominate theoretical literature of inflation. Gali and Getler (1999) argues that the inclusion of real labor costs instead of output gap. The modern theory of price structuring of wage and price refers to the model of In-complete Competition Model (ICM) and the wage curve model includes specifications ECM error correction mechanism. The ICM model also deals with incomplete competition and incomplete information of price and labor markets.

1.1 Research Gap

The estimation of inflation forecast uncertainty has remain very important tool for policy makers. Hence, there are various economic specifications to forecast uncertainty including the Philips curve, New Philips curve and In-complete Competition Model, for the wage and price equations with different specifications.

Number of studies reviewed about the inflation and inflation forecast uncertainty and mostly studies used one of the traditional methods to estimate the inflation and inflation forecast. To the best of our knowledge In-complete Competition Model are not yet applied in case of Pakistan relevant to wage and price specifications. Similarly, the comparison between these three models and finally choose the best model on the bases of minimum Root Mean Square Error (RMSE) and means absolute percentage error (MAPE) has also not been done so far.

1.2 Objective of the Study

The objective of the study is to specify the model for inflation and inflation forecast uncertainty among the Standard Philips Curve, New Keynesian Philips Curve and In-complete Competition Model in case of Pakistan.

The second objective of the study is to compare the forecast abilities of Standard Philips Curve, New Keynesian Philips Curve and In-complete Competition Model and select the most appropriate model which gives better forecast in case of Pakistan.

1.3 Significance of the Study

The control on Inflation is the major tool of monetary policy to control unemployment level and growth of a country. The increase in inflation leads to increase the inflation uncertainty which ultimately upsurge the unemployment level according to different economists. Due to increase in the unemployment level decrease the economic growth, so there is inverse relationship between unemployment and growth. To control inflation the important tool is to control inflation uncertainty. Hence the better forecasting plays vital role to control inflation and when policy makers forecast accurate then they will easily handle inflation uncertainty and control inflation level, which leads to tackle the problem of unemployment and increase the growth of economy.

According to finding of this study with regards to Phillips Curve, New Keynesian Phillips Curve and Incomplete Competition Model with specification, will guide/help the monetarist's, policy makers, investors and firms honours in forecasting inflation and applying appropriate specification.

This study includes the time series data of Pakistan over the time period of 1981 to 2015. The data will be estimated through the time series methods which are GMM and FIML[1]. Therefore, this study will give a good source of reference on the subject for the student of econometrics as well as economics.

Rest of the thesis proceeds as follows: Chapter 2 Literature reviews theoretical as well as different methodologies in different countries. Theoretical framework and Methodology is discussed in Chapter 3. This chapter also shed some light on the conduct of monetary policy in Pakistan. Chapter 4 deals with data and description. Results of PCM, NPCM and ICM and which model has good forecasting is discussed in Chapter 5. At the end, Chapter 6 concludes the thesis and some policy implications are discussed as well in that Chapter.

[1] Full information maximum likelihood (FIML)

Chapter 2

Literature review

Introduction

Both national and international studies are reviewed. For inflation forecasting many different studies used different variables and different methodologies. These studies analysed inflation based on the univariate models from the family of auto regressive moving average (ARMA), Auto Regressive Conditional Heteroskedasticity (ARCH), Ordinary Least square (OLS), Vector Auto regressive (VAR), Generalized method of movements and one study used P-star methodology. In addition to that, the studies reviewed included the most famous Philips curve model to forecast inflation. Mostly studies used consumer price index (CPI). Some studies used whole sale price index (WPI) and other macro variables. Section 2.2 reviews studies on inflation based on Auto Regressive Moving Average (ARMA) and family. Section 2.3 reviews studies on inflation based on Auto Regressive Conditional Heteroskedasticity (ARCH) and family. Section 2.4 reviews studies on inflation based on Full Information Maximum Likelihood Method (FIML). Section 2.5 reviews studies on inflation based on Ordinary Least Square (OLS). Section 2.6 reviews studies on inflation based on Vector Error Correction Mechanism (VECM). Section 2.7 reviews studies on inflation based on P-star. Section 2.8 reviews studies on inflation based on Recursive weights (RW) and Equal weights (EW) and section 2.9 studies on inflation based on Generalized Methods of Movements (GMM).

2.1 Theoretical

Friedman (1977) discussed in his Nobel lecture on the adverse effects of inflation uncertainty and inflation on economic growth. Developing the additional channel said Friedman that an increase in the rate of inflation will lead to a inconsistent in prices stabilizing response by the

monetary authority, which leads to the uncertainty of inflation in future. His idea was that this increase in uncertainty will complicate the process of stabilization of the relative policy that interferes with the allocation of economic resources efficiently and accurately.

Ball (1992) theoretically examined why high inflation raises inflation uncertainty. The primary target of his study that represented a model of monetary policy in which an ascent in inflation raises instability about future inflation. While genuine and expected inflation is low, which are the agreement that the monetary authority will attempt to keep them low. This study tried to enhance our understanding the connection about inflation and inflation anticipating by displayed a model that predicts it on account of USA. The essential thought behind this situation is extremely basic, high inflation makes vulnerability in the economy about future monetary policy. Also, to comprehend that situation first consider the low inflation in the principal time frame like in this study in the mid-60s in the United States. In that circumstance it regards wager that the Fed was with the present state of affairs and endeavoured to draw out it. Inflation may be raised at a few focuses for a reason exogenous to the Fed. It is far-fetched however the Fed had the choice whether it is alluring or not. In real economies it gave the idea that high inflation additionally made vulnerability about whether inflation will ascend in further.

Okun contended that if the Fed acknowledges high inflation to suit a shock, the public feelings of trepidation that inflation will rise again if there is another shock. Interestingly, a non-accommodative policy demonstrates that the Fed is focused on monitoring inflation. At the point when inflation is high policymakers confronted a predicament, they might want to disinflation, however fear the retreat that would come about. The public does not know the tastes of future policymakers, and along these lines does not know whether disinflation will happen.

2.2 Auto Regressive Moving Average (ARMA) and Family

Baciu (2015) examined inflation and inflation forecast for Romania. He used monthly data from JAN 1997 to AUG 2013. The main objective is to find the best mode, which gives best predictions. He used AR, MA, ARIMA and ARCH to investigate inflation forecast. And according to him ARCH provides best predictions. Moser et al. (2007) discussed forecasting inflation and inflation uncertainty for Austrian Economy. Also used monthly data from 1980 Jan to 2002 Dec. He used VAR and ARIMA models and used 12 step ahead from the sample data for forecast purpose. He suggested VAR and Factor model had best inflation forecasting. Duarte et al (2007) forecast inflation through bottom up approach. And their main focus on to forecast inflation over short time period by using SARIMA model. Results indicated that, there exists opposite relationship between inflation forecast and information used.

Clark et al (2014) examined alternative models of trend inflation. They used quarterly from 1960 Q1 to mid of 2012. Price index (PCE) and GDP price index used to investigate the models of trended inflation. Data taken from the Federal Reserve Bank of Philadelphia's. To understand the accuracy of the long term inflation forecast evaluates elective model of trend inflation. Determined rang of inflation models that consolidated diverse trends and specifications. Analysed the models on the premise on their exactness's in out of test. Forecasting both the point and density. As indicated by the outcomes it's hard to state which model of trend inflation is best over others. Univariate demonstrate AR and multivariate model VAR both utilized as a part of this review and both models had diverse trend specifications which is by all accounts about similarly exact, and the relative precision is to some degree inclined to hazards after some time.

Karahan (2012) examined the relationship among inflation and inflation uncertainty for Turkish. He used monthly time series data from JAN 2002 to DEC 2011, by using the Auto Regressive Moving Average (ARMA) and Generalized Autoregressive conditional Heteroscedasticity (GARCH). According to his results Turkish economy supports the Friedman hypothesis which is inflation causes inflation uncertainty. While Caporale et al (2010), Payne (2008) and Hwang (2001) also discussed inflation and inflation uncertainty for Euro area and Caribbean region. Caporale et al (2010), Payne (2008) also support Friedman hypothesis but Hwang (2001) indicated that inflation affected its uncertainty negative and the uncertainty affected the inflation insignificant, so inflation increase and there will be decrease in the inflation uncertainty which is opposite to Friedman hypothesis.

Salam et al (2006) examined forecasting inflation in developing countries especially in case of Pakistan. They used monthly data from July1993 to June 2004. Used the adjusted consumer price index (CPI) as the proxy of inflation. They used Autoregressive Integrated Moving Average (ARIMA) methodology to investigate the inflation forecasting in developing nations. Results indicating that, there is positive association in between the inflation and inflation uncertainty. Past inflation had positive impact on the uncertainty of the future inflation which was describe by the Fried man hypothesis. And Bokil et al (2005) also examined forecasting inflation for Pakistan. They used monthly time series data from JAN 1980 to DEC 2004, broad money and credit private sector used to forecast inflation. They measure different fundamental changes in Pakistan by different parameters. Mainly Islamic and Gregorian aspects are used, by using 12 months moving average. VAR used to forecast inflation and also suggested that lone time spam data is not required for decent forecasting.

2.3 Auto Regressive Conditional Heteroskedasticity (ARCH) and Family

Buth et al (2015) examined the inflation and its uncertainty for three countries which are Cambodia, Lao PDR, and Vietnam. They used monthly time series data, VAR and GARCH econometric model used to find the relationship among inflation and inflation uncertainty, Granger causality used to check the bidirectional relationship among them. And they found that there exists the relationship among inflation and inflation uncertainty which supports Friedman Hypothesis, while in single country Lao PDR found bidirectional association between them. According to Caporale et al (2010) in Euro area exists the Friedman hypothesis which is inflation causes high inflation uncertainty, by using AR-GARCH and VAR according to him in steady state condition inflation and inflation uncertainty decline steadily, while short run uncertainty has been increased. While in case of Ghana results supports the Cukierman Meltzer hypothesis which is there exists bidirectional relationship between inflation and inflation uncertainty [Oten Abayie et al (2013)]

Asghar et al (2011) estimated the relationship among inflation and inflation uncertainty for SAARC countries. They used quarterly data for Pakistan, India and Sri Lanka. EGARCH methodology used to find the asymmetric behavior among inflation and its uncertainty, Results indicated that Cukierman Meltzer hypothesis exists in SAARC region countries. Which shows bidirectional relationship among inflation and inflation uncertainty, which means inflation positive effects inflation uncertainty and inflation uncertainty also has positive effects inflation.

Arabi et al. (2010) found the association among inflation and its uncertainty for Sudan. They used annual time series data, GARCH and EGARCH used to estimate the inflation uncertainty. They found positive and significant relationship between them. Nazar et al. (2010) also found

that Friedman hypothesis exists in Iran. And granger test also verified that inflation positively effects inflation uncertainty.

Rizvi et al (2009) estimated the behaviour of inflation and inflation uncertainty. They used quarterly time series data and data taken from International Financial Statistics (IFS). CPI, GDP and GDP deflator used in this study with EGARCH methodology. Results indicated Friedman hypothesis in cases of Pakistan, Granger causality also verifies that. EGARCH successfully captures asymmetric behaviour of inflation and inflation uncertainty.

In case of Latvia, Ajevskis (2007) investigated inflation and inflation uncertainty. Monthly data of Consumer price index (CPI) from January 1994 to 2007 used to estimate uncertainty. GARCH methodology used to investigate the relationship. The results indicated significant and positive relationship among inflation and inflation uncertainty.

Fountas et al (2007) examined inflation and output growth uncertainty for G7 region. They used monthly data from FEB 1957 – AUG 2000. In G7 countries Canada, France, Germany, Italy, Japan and UK included. GARCH used to estimate the relationship among inflation and growth. According to results inflation positively effects inflation uncertainty. While according to Daal et al (2005) also estimated the effect of inflation on inflation uncertainty in G7 countries including all developed countries. GARCH and PGARCH methods used to estimate the relationship among inflation and inflation uncertainty. The PGARCH model showed a moderate targeted approach for evaluating the instability of asymmetric inflation and the clustering of deviations related to inflation rates. They found strong evidence of Friedman hypothesis, inflation strongly positive effects inflation uncertainty. According to Markov switching heteroscedasticity shows high inflation increase inflation uncertainty in future, and it depends on whether the shock is

permanent and transitory[Bhar et al (2004)], so in case of G7 countries there is strong evidence of Friedman hypothesis.

Thornton (2006) examined inflation and inflation uncertainty in case of India. He used monthly data from January 1957 to September 2005. Whole sale price index (WPI) used for inflation and inflation uncertainty. The main objective of the study was Friedman Ball or Cukierman Meltzer hypothesis holds true for Indian data. Which means that high inflation causes inflation uncertainty and asymmetric behaviour of inflation uncertainty. GARCH model used to estimate inflation behaviour, granger causality used for causality. Results indicated that there is evidence of Friedman hypothesis and no evidence for Cukierman Meltzer, there is positive relationship between inflation and inflation uncertainty. While in case of Iran, there exists Friedman hypothesis as well as Cukierman and Meltzer hypothesis. Which means inflation significant and positive effect inflation uncertainty and inflation uncertainty positively and significant effects inflation, there exists bi-directional association among them [Moradi (2006)].

In European countries which includes France, Germany, Italy, Spain and Netherland showed Expect Germany and Netherland there exists positive and significant relationship between inflation and inflation uncertainty. In Germany and Netherland negative relationship between inflation and inflation uncertainty, while other countries (Italy, Spain and France) have positive and significant relationship between inflation and inflation uncertainty [Fountas et al (2004)].

Kontonikas (2004) and Fountas (2001) examined inflation and inflation uncertainty in case of UK. Kontonikas used both monthly and annually time series data from 1972 to 2002 and used ARCH and GARCH models, while Fountas used annual time series data from 1985 to 1998 and used GARCH model. According to both of results there exists positive relationship among

inflation and inflation forecast uncertainty in UK, which means that in UK there is strong evidence of Friedman hypothesis.

For US economy Fountas et al (2000) examined inflation and inflation uncertainty by GARCH methodology. They used monthly data from January 1960 to February 1999. Results indicated that positive bi-directional relationship between inflation and inflation uncertainty. While in case of Turkey there is also evidence of Friedman hypothesis, increase in inflation leads to increase in inflation uncertainty which mainly depends over time period [Nas et al (2000)].

2.4 Full Information Maximum Likelihood Method (FIML)

Chan (2013) examined inflation forecast by the moving average stochastic volatility models. He used quarterly data from the 1947Q1 to 2011Q3. Consumer price index (CPI) used for inflation, The prime objective of the study was they introduced new class of models that has stochastic volatility and moving average errors and there the conditional mean has a state space representation. Used maximum likelihood and Bayesian approach to examine the volatility. The result indicated that US inflation moving average stochastic volatility models provide better result in sample fitness and out of sample forecast performance than the standard variants with only stochastic volatility.

Berument, H., & Dincer, N. N. (2005) studied Inflation and inflation uncertainty in the G7 countries. They used monthly data from January 1957 December 2001. Consumer price index (CPI) used, they used Full Information Maximum Likelihood Method (FIML) methodology with extended lags to examine the inflation and inflation forecasting. According to results there strongly evidence of Friedman hypothesis which is inflation caused inflation uncertainty for G7 countries.

2.5 Ordinary Least Square (OLS)

Khan et al (2007) reviewed basic determinants of inflation for Pakistan. He used annual timer series data from 1952 to 2005. He used different factors for inflation like government and private sector borrowing, wheat prices, inflation, exchange rate and tax revenues. Model estimated by simple OLS, results indicating that money supply and import prices has significantly affected by private sector market. And impact on inflation of fiscal policies are not statistically significant.

2.6 Vector Error Correction Mechanism (VECM)

Khan and Schimmelpfennig (2006) examined the inflation in Pakistan using monthly data from 1998 to 2005. In study they used monetary factors[2], interest rate, wheat prices and exchange rate. VECM methodology to inspect the inflation, if there should be an occurrence of Pakistan. They found that monetary factors have assumed a predominant part in late inflation, influencing inflation. Further additional tools for driving inflation like private sector credit and money growth plays also vital role also for predicting inflation in future.

2.7 P-star

Czudaj (2011) examined inflation and inflation forecast as a P-star for euro area. He used monthly data from January 1995 to April 2010. The data from ECS Statistical Data Warehouse. The main objective of the study was that the new P-star technique on AR and VAR and other Univariate and multivariate techniques are or was not appropriate in the forecast of inflation. Thus he used three empirically verifiable versions of the common p-star model and assessed their prognosis performance using conventional techniques. And the result of the P-star is appropriate to achieve short-term inflation forecasts. Their results showed that the repetition of the relevance of the monetary pillar of the framework of the two pillars of the ECB. They then examined the

[2] Money supply, credit to the private sector.

impact of the current financial and economic crisis that began in 2007 on the forecasted performance with two periods of sub-samples being excluded and others being applied to them and they analysed the impact of the technique applied to the required balance of values to calculate. Thus the technique P * is valuable to estimate the inflation forecast.

2.8 Recursive weights (RW) and Equal Weights (EW)

Garratt et al (2011) analysed inflation and uncertainty of inflation in the inflation forecast density in real time from the curves of all Phillips. They used four samples for the United States, Australia, New Zealand and Norway. Real-time quarterly data refer to real GDP and deflator prices from 1987Q1 to 2007Q3 GDP for the United States. The quarterly real GDP data for the season from 1991Q3 to 2007Q4 adjusted. For 1998Q1 Quarterly the real GDP in 2007Q4 to New Zealand Seasonally-adjusted data. And Norway, quarterly data of real GDP for seasonal fluctuations adjusted in the years 2001-2002 to 2008Q2. And the goal of the study was to investigate the effectiveness of recursive weight and equal weight of combination strategies for predictive models with many time varying the relationship between inflation and the gap production. Methods of recursive weight (RW) and equal weights (EW) to find the inflation forecast density in real-time. The result showed that the weight recursive strategy was indeed functional. In both American and Australian cases, the same weighting strategy brings a projected failure.

2.9 Generalized Methods of Movements (GMM)

Mazumder (2011) examined the empirical validity of the New Keynesian Phillips curve using survey forecasts of inflation used survey data on inflation expectations with the new Keynesian Philips Curve Model (NKPC) with the based on survey forecast inflation model. Used GMM methodology with number of instruments. In this study the model is estimated with the labor

income share and manufacturing's marginal cost used for the proxy for marginal cost with each survey forecast of inflation. That approach employed the use of the labor income share as the proxy for real marginal cost. In this study developed and tests a pro-cyclical marginal cost variable alongside various survey measures of inflation forecasts in the new Keynesian Philips Curve Model (NKPC). They found that the NKPC produced negative and significant coefficient on pro-cyclical marginal cost under the survey of inflation forecast. While Rumler et al (2010) analysed comparing the New Keynesian Phillips Curve with time series models to forecast inflation by using the Austrian quarterly data from1980Q1 to 2006Q4. New Keynesian Philips curve equation is estimated from 1980Q1 to 1999Q4 and the period 2000Q1 to 2006Q4 is reserved for the evaluation for the inflation forecast. According to results New Keynesian Philips curve model beats the forecasts derived from all the time series model like Vector Auto Regressive, Bayesian VAR, Auto Regressive and other models in term of the lower root means square error (RMSE).

2.10 Concluding Remarks

The work done in Pakistan on inflation and inflation forecast in mostly based on annually time series data. There are few studies which used quarterly and monthly data to understand the relationship of inflation and inflation forecast. In this thesis we forecast inflation by Philips curve, New Philips curve and incomplete competition models. None of study used these models to forecast inflation in case of Pakistan.

2.11 Research Gap

Number of studies reviewed about the inflation and inflation forecast uncertainty and mostly studies used traditional methods to estimate the inflation and inflation forecast with few studies

used annual, monthly and quarterly data. Most of studies did simple ARMA and GARCH models to forecast inflation uncertainty. To the best of our knowledge, the Philips curve and In-complete Competition models are not yet applied in case of Pakistan relevant to wage and price specifications. Similarly, the study aims to that the comparison between these three models and finally choose the best model on the bases of minimum Root Mean Square Error (RMSE).

Chapter 3

Methodology

In this chapter we discuss the model specifications, diagnostics and preliminary tests and econometric techniques followed by the data sources. Furthermore, we provide the over view of the descriptive statistics of data which involves in this study.

3.1 Standard Phillips Curve

According to price and wage macroeconomic models, which determines the natural rate of price and wage equations. Price equation which is equivalent to relationship of demand and wage and according to wage equation which links the supply of wages and employment. The equation of Standard Phillips Curve Model (PCM) according to Aukrust (1977), Calmfors (1977), Nymoen (1990), Blanchard and Katz (1997) expressed below as:

$$\Delta pirce_{t} = \eta_1 \Delta \text{wages}_{t} + \eta_2 outputgap_t + \eta_3 \Delta importprices_t + \mu_t \quad (3.1)$$

$$\Delta wages_t = \gamma_1 \Delta prices_t - \gamma_2 unemployment level_t + \mu_t \quad (3.2)$$

According to equation 3.1 inflation is measured in consumer price index, wages is measured by the Gali and Gertler (1999). Inflation is dependent on three variables firstly, the unemployment rate, which is measured as total unemployment rate, secondly on output gap instead of GDP and finally on the import prices for making the model for open economy.

In above 3.2 wage equation the wage depends upon the rate of inflation (price level) and unemployment rate.

According to Friedman policymakers attempted to maintained output level above its potential level, then paid higher prices and they will adjust nominal wage demands according upward. It will effects higher inflation level without sTable low unemployment level.

The view of the Holland is due to Friedman's attitude that the rate of inflation will increase, which will lead to greater uncertainty of inflation, which further reduced economic growth and increased economic inefficiency. Fountas et al (2006) cited as the first, if the uncertainty of inflation first have negative effects on economic growth and the second high inflation increases uncertainty, an independent central bank will have a superior incentive to respond to the increasing uncertainty of inflation by a policy of monetary tightening by setting high interest rates and ultimately decreasing the rate of inflation.

There are many mechanisms like inflation is very much sensitive by oil prices. For example, crude oil prices heavily effect the petroleum products prices, from the consumer point of view which leads to increase the electricity bills, According to production point of view it leads to increase the unit cost which effects the inflation level.

3.2 New Phillips Curve Model

The New Phillips Curve Model (NPCM) by Gali and Gertler (1999) is given as

$$\Delta price_t = \delta_1 \Delta price^e{}_{t+1} + \delta_2 wagesahre_t + \delta_3 \Delta importprices_t + \mu_t \qquad (3.3)$$

According to equation 3.3 our exploratory variable is inflation and independent variables are expected inflation, wage share and import prices. According to Philips curve there is short run relationship between inflation and unemployment in long run there does not exists any relationship because inflation is determined by money growth and unemployment equals to its

natural rate. To fill this gap by rational expectation term of inflation. The expectation term Δp^{e}_{t+1} is assumed to obey rational expectations, we used lag of inflation CPI for the expected inflation. In equation 3.3 wage share is used instead of the output gap [Gali and Gertler (1999)]. Construction of wage share variable is discuss in section 4.4.

3.3 Incomplete Competition Model

The Incomplete Competition Model (ICM) Sargan (1964), Kolsrud and Nymoen (1998), Bårdsen et al. (1998) is in its modern form presented as an equilibrium error correction model is presented as

$$\Delta wages_t = \lambda_1 \Delta prices_t - \lambda_2 (wagesahre - \lambda_3 unemploumentlevel)_{t-1} + \mu_t \qquad (3.4)$$

$$\Delta prices_t = \pi_1 \Delta wages_t + \pi_2 (importprices + \pi_3 wagesahre)_{t-1} + \pi_4 outputgap_{t-1} + \mu_t \qquad (3.5)$$

In equation 3.4 wage rate depends on the price level (CPI) and some error correction term ECM and the ECM is measured by the wage share and unemployment rate equations. And price equation is estimated by the wage rate and some ECM term which has the import prices and wage share and last one is output gap.

While the equation 3.5 inflation depends on wages and inflation error correction term and output gap. However, the objective distinction between the models is possible to highlight verifiable limitations. Differentiate between above three classes of models is that, NPCM has forward looking expectation, labor unit cost or wage share instead of formal output gap. Incomplete competition model (ICM) handle the expectations trough the error correction mechanism so that's the main difference of ICM and NPCM, while from PCM it has exclusion in error

correction mechanism which are derived from the models of Rowthorn (1977), Sargans (1980), Kolsrud and Nymoen (1998). That is, how can the PCM be modified as error correction mechanism. To see this, first that the PCM takes a stationary Unemployment rate. Thus, the internal consistency requires that the system bivariate the PCM is augmented by an equation which links with ut, for example the wage share WSt-1. Insert the equation for Ut in the wage Phillips curves which turns latter in to explicit ECM for wage equation. This is the main difference between the PCM and ICM are in the nature of the causal relationships that underlie the co-integration rather than Cointegration as such.

3.4 Differences between PCM, NPCM and ICM

In above section we mentioned equations of Standard Phillips curve, New Keynesian Phillips curve and incomplete competition models with their specifications. In following section we will analyse the different of all three models.

- New Keynesian Phillips curve is reduced form model which have forward looking expectations and wage share or real unit labor cost as a substitute of output gap which used in PCM [Gali and Gertler (1999)].

- ICM is preferred on NPCM in the treatment of expectations [Kolsrud and Nymoen (1998), Bårdsen et al. (1998)].

- ICM also deals with imperfect competition and incomplete information of product and labor market [Kolsrud and Nymoen (1998), Bårdsen et al. (1998)].

3.5 Descriptive Statistics

We have been use three measure of descriptive statistics which are mean, standard deviation and stability ratio by dividing data in sub samples. In our research work we equally divide our data in subsamples or decades, which tells about behaviour of data in different decades.

According to our study we want to measure the volatility or uncertainty so we use the standard deviation and stability ratio. Standard deviation is effected by the mean value of sample. So when we measure the volatility of subsamples according to standard deviation, higher standard deviation values shows higher level of uncertainty in that decade with higher mean value, so standard deviation is not good tool for measuring volatility of data. To overcome this problem we use the stability ratio as a volatility measure, Stability ratio not only identifies the magnitudes of the data but it also takes the difference in mean values and then estimate the volatility. So stability ratio is better tool for measuring the volatility rather than the standard deviation.

Alone the standard deviation is not best tool for measuring the volatility, while comparing different subsamples while the mean of the series is different. According to stability ratio it not only takes the mean and standard deviation, also tell about which subsample higher standard deviation relative to mean for all variables. So, stability ratio better recognizes which series has higher volatility and which has lower in data set.

In conclusion, according to standard deviation and stability are easy to estimate and provides valuable information for the analyst to understand the basic behaviour of the overall series and in between the different subsamples.

3.6 Unit Root

Dickey Fuller test was developed by American statisticians David Dickey and Wayne Fuller in 1979. It is valuable and important to check whether the series is stationary or not with the help of this test. If the series is not stationary then our regression is spurious. It is simple approach to check unit root, but most economic and financial time series have complicated and dynamic structure which cannot accurately captured by DF test. So there come Augmented Dickey Fuller ADF test come for complicated and dynamic structure. The primary difference between the DF and ADF is utilized for a larger and more complicated data of time series models, ADF test used negative numbers and more negative numbers is stronger the rejection of the hypothesis that is there is unit root. For our complicated and dynamic analysis we use ADF test.

Hypothesis

H_o = series is not stationary

H_a=series is stationary.

There are various cases to test the equation:

1. When there is no trend in the series

When the series have no trend and potentially slow turning around to zero then the equation used is given below.

$$\Delta z_t = \sigma z_{t-1} + \varsigma_1 \Delta z_{t-1} + \varsigma_2 \Delta z_{t-2} + \ldots\ldots\ldots\ldots + + \varsigma_p \Delta z_{t-p} + \alpha_t \qquad (3.6)$$

In equation 3.6 number of augmented lags is examined by the reducing the Schwartz Bayesian information criterion or Akaike information criterion.

$H_0 : \sigma = 0$ Series is not stationary

$H_a : \sigma < 0$ Series is stationary

2. When there is intercept in series

The equation for the series without trend and potentially turning around non-zero values is given below.

$$\Delta z_t = \alpha_o + \sigma z_{t-1} + \varsigma_1 \Delta z_{t-1} + \varsigma_2 \Delta z_{t-2} + \ldots\ldots\ldots\ldots + + \varsigma_p \Delta z_{t-p} + \alpha_t \quad (3.7)$$

In equation 3.7 there is intercept and no time trend. Number of augmented lags is examined by the reducing the Schwartz Bayesian information criterion or Akaike information criterion.

$H_0 : \sigma = 0$ Series is not stationary

$H_a : \sigma < 0$ Series is stationary

3. When the series has time trend and intercept

When the series has trend and intercept. Then the following equation will be used.

$$\Delta z_t = \alpha_o + \gamma_t \sigma z_{t-1} + \varsigma_1 \Delta z_{t-1} + \varsigma_2 \Delta z_{t-2} + \ldots\ldots\ldots\ldots + + \varsigma_p \Delta z_{t-p} + \alpha_t \quad (3.8)$$

In equation 3.8 trend and intercept both are there. Again, the number of augmented lags is examined by the reducing the Schwartz Bayesian information criterion or Akaike information criterion.

$H_0 : \sigma = 0$ Series is not stationary

$H_a : \sigma < 0$ Series is stationary

Here we have many unit root test like Phillip's and pierre perron developed PP unit root test which similar to ADF test. The key difference between the PP test and ADF test is PP test ignore the serial correlation and ADF uses a parametric auto regression to approximate the structure of error. So we used ADF test for our study to overcome these issues.

3.7 Generalized Method of Moments Estimation (GMM)

GMM was developed by Lars Peter Hansen (1982) as the generalization of the method of moments (MM) which was initially introduced by Pearson (1894). However, GMM is the general estimation principle and its estimators are derived from MM. There are some motivations that why we use GMM.

There are many estimators which are considered as a special case of GMM. Maximum likelihood estimators (MLE) have the smaller variance, consistent and asymptotic estimator. GMM based on some minimal assumptions. The GMM estimation is often possible when a probability analysis is extremely difficult. We require the sub model specification.

There required some movement condition for GMM which is given below.

$$g(\theta_0) = E[f(\omega_t, z_t, \theta_o)] = 0 \qquad (3.9)$$

Where, θ is a K × 1 vector of parameters, ω_t contains model variables and z_t contains instruments.

If expectations are known then we might solve the above system of equation. Then there is unique solution,

$$E[f(\omega_t, z_t, \theta_o)] = 0 \quad (3.10)$$

If and only if $\theta = \theta_o$

Identification is basic part for the Econometric analysis, if the above condition is fulfilled then the given system is identified, so there will be two ideas.

I. Identification

The model constructed so that θ_o is unique.

II. Empirical identification

The data is informative enough to determine the θ_o.

Specific form of the GMM model is

$$f(\omega_t, z_t, \theta) = u(\omega_t, \theta).z_t \quad (3.11)$$

In the equation 3.11 the instruments are multiplied by the error term of the equation.

Then the movement condition become

$$g(\theta_0) = E[u(\omega_t, \theta_o).z_t] = 0 \quad (3.12)$$

In the equation 3.12, it is identified that the instruments are un-correlated with the error term, then the function $u(\omega_t, \theta_o)$ may be linear and not linear in θ.

Firstly, there is required at least as many equations, As we have parameters in equation. Then the order condition for identification of equation is R≥K.

- R = K is called exact identification and the estimator is denoted the MM and denoted by $\hat{\theta}_{MM.}$
- R > K is called over identification then the estimator is denoted by the GMM estimator, which is denoted by $\hat{\theta}_{GMM.}$

Consistency is a statistical property of an estimator that has a sufficient number of observations and the estimator will converge in probability to the true value of parameter. If the moment conditions are correct $g(\theta_o) = 0$ then GMM is consistent. Similarly, asymptotic distribution is important property which allows to construct confidence bands for the estimator and to conduct different tests. Furthermore, the variance of $\hat{\theta}_{GMM}$ depends on the weight matrix and the efficient GMM estimator has the smallest variance. J-test or the Hansen test for over identifying restrictions, in linear models it is often referred to as the Sargan test, and is normally used. E_t is not a test of the validity of model or the underlying economic theory instead E_t considers whether the R−K moments are in line with the K identifying moments.

3.8 Full information Maximum Likelihood

The full-information maximum likelihood (FIML) based on system of equations. Which have normally distributed errors and has efficient between all estimators. FIML treats all equations and estimators simultaneously.

3.9 Forecasting

In this section we discuss the concepts of economic forecasting of different economists, importance of forecasting, evaluation and methods of economic forecast. Economic forecasting involves predicting economic condition about the future economy. According to Carnot, Koen and Tissot (2005) economic forecasting has three important concepts. In first step a view on the future of economic evolution, including quantitative estimates Key macroeconomic variables across different forecast horizons, such as GDP, inflation or unemployment and estimates for specific sectors of the economy. 2nd an underlying analytical "story", which gives an account of the assumptions underlying the forecasts, also studies the risks if the assumptions fail. 3rd and most important is that economic forecast is very much important because it can effects the behaviour of individual, firm and governments. For example government used economic forecast to adjust the monetary and fiscal policy for countries beneficial.

Forecast has different numbers of methods. According to Carnot, Koen and Tissot (2005) economics forecast has four different methods. 1st subjective forecast which totally depends on the guessing or expert opinion. This kind of forecast has lack of reliability when they commonly used. 2nd indicator based approach which is frequently applied in business cycle approach. 3rd and 4th economics forecast on the times series and structural model. While time series models are mostly based on statistical properties rather than causal relationship between economic variables informed by economic theory. Structural models could be explained the economic theory.

There are number of methods to forecast like single number forecast, rang of number forecast and entire distribution forecast. Single number forecast is also called point forecast. The point

forecasts are different from the achievements, it is clear that a good Point forecast should be closer to the outcome. The differences between the results and forecasts are called forecasting errors. These forecasting errors, which are out of sample Prediction errors, is different from the model errors that are derived from the sample forecasts.

To evaluating the forecast we have to know the difference between ex-post forecast and ex-ant forecast. While in ex-post forecast which are made when we know about the realizations and ex-ant forecast which are made when we do not know the real out comes. Evaluation for ex-post forecast help from previous mistakes so from then we can perfume better ex-ant forecast. I focused on the evaluation of ex-post point forecast which required close to real outcomes.so it required that forecast errors have smaller variance. Mean squared error (MSE) and root means square error (RMSE) are commonly used measure of accuracy. To evaluate two or more forecasts, we not only need a forecast is more accurate than competing forecasts, but also incorporates all relevant information in competing forecasts. That is forecast encompassing, see Chong and Hendry (1986).

3.10 Root Mean Square Error

Root mean square error (RMSE) is one of the important statistical tool which used to test the forecast accuracy between the different models. It used the forecasted values and the actual values of inflation to compare the goodness of forecast between the numbers of models. It is calculated as:

$$\text{RMSE} = \sqrt{\frac{\sum_{i=1}^{n} (\hat{y} - y_i)^2}{n}} \qquad (3.13)$$

According to equation 3.13, where estimated value for y and n is the number of observation in the forecast period. After estimating the RMSE for different models, the values of RMSE are compared of models and with the minimum value of RMSE, is considered as the best model for forecasting.

3.11 Mean Absolute Percentage Error (MAPE)

The mean absolute percentage error is also known as mean absolute percentage deviation (MAPD). It is measured of forecast accuracy of different models. It mostly used to express the accuracy as a percentage and it expressed by:

$$MAPE = \frac{100}{n}\sum_{t=1}^{n}\left|\frac{A_t - F_t}{A_t}\right|$$

Where A_t is actual values and F_t is forecasted values. Difference between A_t and F_t is divided by the actual values of series. The absolute values is summed for every forecasted pint in time and divided by the number of fitted points, multiply by 100 which makes it in percentage error.

After estimating the MAPE for different models, the values of MAPE are compared of models and with the minimum value of MAPE, is considered as the best model for forecasting.

Chapter 4

Data and Description

In this section the detail of data which is used for estimation is described. Similarly the source of data as well as time spam of data is mentioned. Furthermore the relationship between variables is stated in this segment.

To estimate the inflation based models (PCM, NPCM, ICM), which were presented in previous section, the data of following variables is used: Inflation CPI, output gap, unemployment rate, wages, taxes and import prices.

We used annual time series data from 1981 to 2015. Data is collected from Pakistan Economics Survey, Pakistan Bureau of Statistics, Pakistan Labor force survey, International financial statistics (IFS) and World Development indicators (WDI).

4.1 Inflation CPI

Inflation CPI is measured by taking the changes for each commodity in predetermined basket of goods and services and then averaging them. In the fiscal year of 2016 Inflation is averaged at 2.79% as compared the last year is 4.81%. food group inflation in fiscal year of 2016 is 2.1% which lower than the last year which is 3.6% and non-food inflation in fiscal year 2016 at 2.07 percentage points as against 1.34 percentage points percent and 3.56 percentage points, respectively, in the comparable period of last year. Both the food and non-food increase at lower space as compared to the last year and etc.

Inflation has increasing trend with respect to time. In 1981 inflation rate was almost to 13 percent, in 1990 inflation rate increases to 14 percent. After 2000 inflation rate increase rapidly so in 2015 inflation rate are almost 88 percent.

Okrun (1971) purposed the causative relationship between inflation and inflation forecast uncertainty where importance given to government's policy over the expectations of public about inflation uncertainty. He suggested that increase in inflation uncertainty results highly increased in inflation level. Cukierman and Meltzer (1986) gave a model in which policy makers wants to maximize their objective function. According to him the public is faced with a reasoning problem in which they try to distinguish between changes in monetary policy objectives and errors in monetary control. They also consider that expectations are rational, but the information is incomplete. His model led to Cukierman and Meltzer effect, indicating that the average inflation rate will increase the increasing uncertainty of inflation, as policymakers are motivated to create inflation surprises. The effect is now known as Cukierman and Meltzer effect. Holland (1995), on the contrary, that the inflation uncertainty increased inflation actually lowers the inflation rate and a negative relationship between the two, unlike the positive, which is proposed by Cukierman and Meltzer associates.

4.2 Unemployment Rate

The unemployment rate is measured by dividing the number of unemployed person by all persons in percent. When the economy is in recession has high unemployment rate.

According to Phillip's curve "there exists trade-off relationship between inflation and unemployment level". So there exists negative link between inflation and unemployment level.

Further Able and Bernanke (2005) reconsidered Phillips hypothesis and said that there is no systematic association among inflation and unemployment in case of United States. Later Friedman (1968) clarified the rationale behind the disappointment of the previously mentioned relationship. Distinguish among nominal and real wages must leads to channel of anticipated and unanticipated inflation rate. The association was returned to by Friedman refuting it to be among the aggregate inflation and unemployment, rather than the association exists among the cyclical unemployment and unanticipated inflation (Friedman, 1968).

4.3 Output Gap

Output gap is measured by difference between actual and potential level. Potential level discussed by many economists by different ways. According to Okun's (1962) the potential level of output of economy is capable to producing in absence of external shocks. While according to other, potential output level is absence of nominal rigidities. Then the potential level of output is defined as the output which can be produced by some external shocks, and interventions.

The difference among the actual level of output and the possible potential level of output shows the economic situation of the country. If the output gap is positive, which means that the actual amount of output is greater than the potential level of output, so the economy is in the state of the boom, which increases the rate of inflation. If the output gap is negative, which means that the actual level of the output power is below possible production level, which indicates a slowdown in economic activity, and this phase is associated with low inflation. The positive output gap shows that too many goods are produced in the economy and a greater number of services are generated in the economy and this condition is unsTable, requiring oversizing and additional

work in a high rate of inflation leads to long term at least. And in the opposite state of the negative output gap is the low level of inflation and led to a high unemployment rate. Thus, this is the objective of the monetary authorities to stabilize the level of actual output gap, so that the difference between the actual and the potential level of the output are minimized, making the production gap a crucial and important role for the implementation of monetary policy.

The change in interest rates effects the output gap, which leads to stabilize inflation as well as production (Taylor (1993)). So the data for output gap is not available directly, it estimate by the Quadratic trend method. Wage inflation is effected by output gap [Phillips (1958)]. According to Cockerell and Russell (1995) and De Brouwer and O'Regan (1997) wage growth is sensitively effects the output gap and economy's growth. Further they explains that price and wage inflation is sensitive from output gap, monetary policy factors are also mainly determined by output and output gap. Potential level of output is not given, also not easy to observe and not easy to measure because the model for economy is unknown.

Friedman (1977) discussed in his Nobel lecture on the negative effects of inflation and inflation uncertainty. Developing the additional channel said Friedman that rise in inflation will lead to an unpredictable in prices stabilizing response by the monetary authority, which leads to the uncertainty of inflation in future. His idea was that this increase in uncertainty will complicate the process of stabilization of the relative policy that interferes with the allocation of economic resources efficiently and accurately. Contrary to the view of Friedman Sarte and Dostey (2000) stated in different angle in which they argue that an increase in inflation uncertainty may actually have a small but positive effect on the rate of growth of output. They have used the classic linear growth model, where they have introduced into the model via Cash in advance money. Their results show (with its model) that more inflation rate has negative impact on economy output

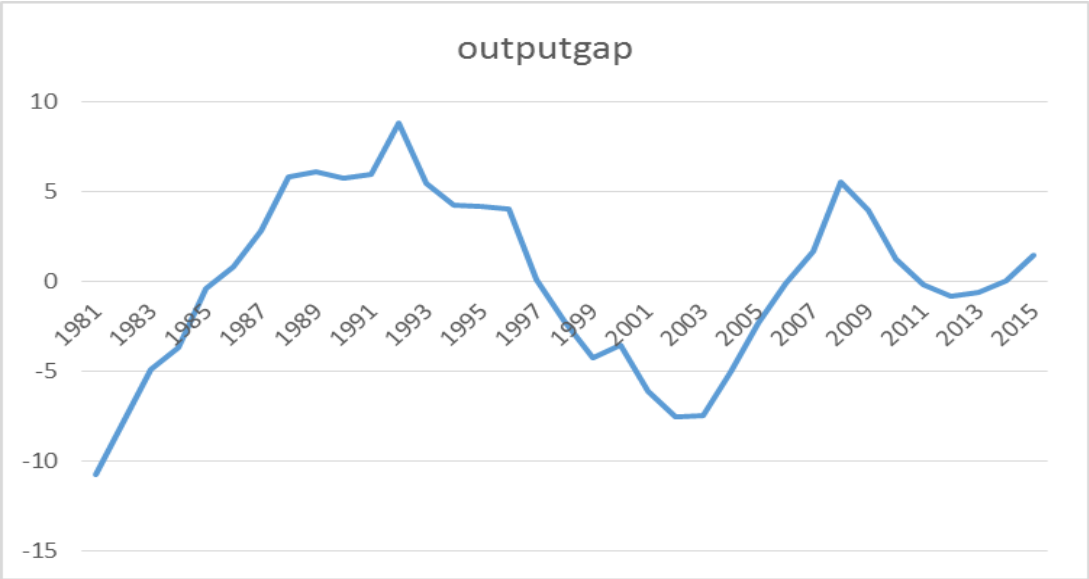
growth, but an rise in inflation uncertainty affects positive to output growth through precautionary saving motives. They also argue that more resources will be invested than the uncertainty of inflation has led to increased doubts about investment decisions, which reduces the demand for real money balances. As more resource investment, which in turn will increase the investment expenditure of economy, which is an important part of the growth and thus contributes positively to the output growth. The effects of economic growth on inflation uncertainty, the Phillip curve hypothesis suggests that an increase in the output will lead to an increase in the rate of inflation, while an increase in the rate Inflation will increase the uncertainty of inflation.

4.3.1 Quadratic Trend Method

Quadratic trend method is estimated by regressed GDP on time trend and square of time trend with constant term included, which can be expressed in equation 3.6.

$$Y_t = \omega_o + \omega_1 t + \omega_2 t^2 + \mu_t \qquad (3.6)$$

Figure 4.1 Output Gap



According to figure 4.1 show the economic condition, while from 1981 to 1985 economy is in recession and after 1985 economy moves toward the boom condition. And at year 1993 Pakistan has at boom condition. Then its moves toward recession, in 1997 its economic condition is breakeven point neither on boom or neither on recession. And at year 2003 it again comes to recession point, then at year 2009 it becomes to its boom condition economic condition.

4.4 Wage share

According to Gali and Gettler (1999) including the real unit labour cost instead of output measure. It is calculated from the minimizing the effect of inflation and average productivity of labor from the wages and get the real unit labour cost and used instead from the output gap. Formula is given below.

$$ws = w - p - pr \qquad (3.7)$$

In the equation 3.7 w is wages, p is consumer price index and pr is average productivity of labor. While average productivity of labor is measured by ratio of gross domestic product and employed labor force.

$$\text{Average Productivity of Labor} = \frac{\text{Gross domestic Product}}{\text{Employed Labor force}}$$

4.4.1 Labor Income Share

Labor income share is described by Gali and Gertler (1999). They argued that real marginal cost (MC) is the ratio of the real wage W and marginal product of labor.

$$MC = \frac{w}{\partial y / \partial l}$$

For formal derivation of labor income share we start with Cobb-Douglas production function

$$Y = AK^{\alpha} L^{1-\alpha}$$

In the above equation K is capital and L is labor input, then we get the equation for marginal cost MC as follow

$$MC = \frac{W_t / P_t}{\partial Y_t / \partial N_t}$$

In above MC equation, the ratio in between the wage rate and marginal product of labor is called marginal cost of labor.

4.4.2 Measurement of Marginal Cost

For getting MC the data of variables including wage rate and marginal product of labor share was collected in form of "non-former business labor income share" from Pakistan Statistics of Bureau and Pakistan Economic survey for the years 1981 to 2015.

First of all we took data of hour of working of non-labor which is "distribution of employed: hours worked" and "percentage distribution of employed persons 10 years and over by employment status, number of hours worked during reference week and sex".

The data of employment in agriculture sector was given in groups regarding the working hours such as labour's work in agriculture sector per week less than 4 hours (hrs.), 2^{nd} group is greater than 3 hrs and less than 9 hrs., 3^{rd} group greater than 8 hrs and less than 14 hrs, 4^{th} group greater than 13hrs and less than 24 hrs, 5^{th} group greater than 23hrs and less than 34 hrs, 6^{th} group greater than 33 hrs and less than 41 hrs, 7^{th} group greater than 40 hrs and less than 48 hrs, 8^{th} group is greater than 47 hrs and less than 55 hrs and final group is greater than 54 hrs and less than 56 hrs.

On the bases of above mentioned groups we find the weights of each group and sum all of them at the end. Finally it is equal to workers work hours per week in agriculture sector in Pakistan. After describing the data for "hours per week of workers in agriculture sector in Pakistan" in following section we have the average working hours of labor, then we estimate the wage rate.

4.4.3 Wage per Day

In this section we will describe the construction of data for wage per day. For this purpose the data has taken from the Pakistan Economics survey for "daily wages of construction works in different cities" (1981-2015).

The data is taken for daily wages of "carpenter, mason and labor unskilled" of construction workers in 6 major cities of Pakistan including Islamabad, Karachi, Lahore, Peshawar and Quetta.

In context of above information, for a single year, we took the average of the data of carpenter for all 6 cities which gave us a single number for this variable in specific year. Similarly, we made the variable for mason and labor unskilled by taking averages. After that, we made two major categories from these three variables first, skilled labor and second, unskilled labor. In skilled group carpenter and mason were included and in other group there were labor unskilled.

Moreover, the wage share was assigned by multiplying 70% to skilled labor and 30% to unskilled labor and sum them. With the help of all this process we get the wages of workers. If we divide the wage by the 8 working hrs, it will give us the wage per day.

In the next step we find the annual income by multiplying the number of workers who work per day with wage per day. Up till now we have shown the process by which we constructed the non-agriculture income. Similarly, we multiplied the non-agriculture employment to their annual income and get non-agriculture GDP. Finally, we divide the non-agriculture income to non-agriculture GDP which is equal to Labor share.

4.5 Import Price

There are two indexes which monitor the price of good and services in the country. The import and export prices are indexes by compiling to prices of good purchased in the economy. In import prices index compile the prices of those goods which produced out of country (imports) while the prices index of those goods which purchased out of country is called export price. Here we use the import price index[3].

There are two indexes, import and export prices indexes. Import price index is compiled by the prices of those commodities which are purchased in country but these commodities are produced out of that country. According to Lescaroux and Mignon (2008) there are many mechanisms like inflation and countries economic condition is very much sensitive by oil prices. For example, crude oil prices heavily effect the petroleum products prices, from the consumer point of view which leads to increase the electricity bills, According to production point of view it leads to increase the unit cost which effects the inflation level. While in case of Pakistan energy prices plays crucial role to effects inflation. According to Malik, A. (2016) if there increase in import prices which leads to increase in inflation rate.

4.6 Taxes

We used two types of taxes first is direct taxes and second is indirect taxes.

1) Direct tax are contribution of the federal and provincial taxes (given by the Pakistan bureau of statistics). Which has small amount of share in the income the Pakistan.

[3] Import prices are taken from International financial statistics (IFS).

2) The Indirect taxes are comprised of excise duty, sales tax, tax on I.T, surcharge on petroleum, natural gas and other taxes which are stamp duties, motor vehicle taxes, foreign travel taxes and others. These taxes play a vital role in country's GDP like Pakistan[4].

According to Steven Davis and Magnus Henrekson (2005) taxes directly influenced the activity of labor directly through the channels of supply and demand for labor, and indirectly through the responses of government spending to the tax revenues available. Higher tax rate on labor income and consumption expenditures mean less work in the legal area market, more time in the household, a large underground economy and a share of lower domestic production and employment in industries that heavily rely on labor in low wage and low- Cost leave .

[4]Given by the Pakistan bureau of statistics

Chapter 5

Results and Discussion

Introduction

In this chapter we conclude the estimation results and forecasting for different classes of inflation which are Phillip's Curve, New Keynesian Phillips Curve and Incomplete Competition Model. We used Full Information Maximum Likelihood (FIML) for Standard Phillips curve and Incomplete Competition Model, Generalized Method of Movement (GMM) for New Keynesian Phillips curve. First of all results for Description Statistics are presented in section 5.1. Results of unit root will show in section 5.2. The result for Incomplete Competition Model will be presenting in section 5.3. The result for Standard Phillips curve model will be shown in section 5.4. The result of New Keynesian Phillips curve model shown in section 5.5. Finally the result of forecasting will show in section 5.6.

5.1 Descriptive Statistics

5.1.1 Univariate Analysis

For descriptive analysis, the complete sample period for all variables has been divided into 7 equal sub samples in Table 5.1. The average inflation rate from the period of 1981 to 2015 is 65.58 with standard deviation of 53.83 and the stability ratio (coefficient of variation) is almost 82%. Standard deviation and stability ratio are the measure of volatility. The value of the SD and SR is greater than of complete period from the sub samples period of inflation. Similarly, for

Import prices, direct taxes, indirect taxes, unemployment rate, average productivity of labor, working hours per week, wage rate and labor income share the average of whole sample period (1981 to 2015) are 58.74,215904.451, 443776.028, 5.17, 144353.655,45.53, 266.86 and 34.49 with the SD of 26.41, 282131, 495160, 1.62, 2662.5,1.10,231.27 and 23.22. The SR (coefficient of variation) are 45%, 131%, 112%, 31%, 18%, 2%, 87% and 67% for Import prices, Direct taxes, indirect taxes, unemployment rate, average productivity of labor, working hours per week, wage rate and labor income share. So the SD and SR shows the highly volatility in complete sample period of all above variables as compared to the sub samples in Table 5.1 for Import prices, Direct taxes, indirect taxes, unemployment rate, average productivity of labor, working hours per week, wage rate and labor income share. Therefore it can be said that according to SD and SR for all variables in Table 5.1 is most volatile as compared to sub sample periods.

Furthermore there are 5 sub sample groups which shows the SD and SR of all variables in each decade. There are different values for SD and SR in each sub group, higher value of SD and SR shows higher volatility in that subgroup. According to SD then the three sample 2011 to 2015, 2006 to 2010 and 1986 to 1990 for import prices have higher SD which means that these samples are more volatile as compared to other samples, and the subsample of 1991 to 1995 has lowest SD which shows that sample is less volatile. But we discussed in methodology chapter that alone SD is not best volatility measure so we use SR as a measure of volatility as compared to SD. So according to SR sample 2006 to 2010 has higher volatility and the subsample 1991 to 1995 has lowest stability ratio i.e. this subsample is least volatile.

Similarly, if we used SD as the measure of volatility then among the subsamples of direct taxes of 1986 to 1990, 2001 to 2005 and 2011 to 2015 have highest standard deviations but the

problem with this measurement that these subsamples have highest means values. So it's better to stability ratio instead of SD. According to SR in the subsample of 1991 to 1995 has greater volatility and in subsample of 1981 to 1985 low volatility. While in indirect taxes according to stability ratio in the subsample of 1986 to 1990 the value of SR is more which means in this subsample volatility level is greater as compared to subsample of 1996 to 2000 which has less volatility level. In the subsample of 1986 to 1990 according to SR has more volatility, while in the subsample of 2001 to 2005 the SR value is minimum which shows less volatility in that subsample.

In the subsamples of unemployment level according to SR, in subsample 1986 to 1990 shows the higher level of volatility and in subsample of 2001 to 2005 shows less volatile. Similarly, in subsamples of 1981 to 1985 for average productivity of labor, 1996 to 2000 for working hour per week, 2006 to 2010 for wage rate and labor income share have been highest volatility level according to SR. which shows higher volatility in these subsample of these variables. And in subsamples of 1991 to 1995 and 2006 to 2010 for average productivity of labor, 2006 to 2010 for working hours per week, 1981 to 1985 for wage rate and labor income share have lowest volatility level.

Table 5.1 Descriptive Statistics

Variables	year	MEAN	SD	SR
Inflation	1981-2015	65.585	53.833	0.820
	1981-1985	15.265	1.606	0.105
	1986-1990	13.407	0.936	0.069
	1991-1995	32.006	5.171	0.161
	1996-2000	51.484	5.561	0.108
	2001-2005	65.220	5.114	0.078
	2006-2010	100.573	20.796	0.206

	2011-2015	174.258	20.712	0.118
Import prices	1981-2015	58.743	26.418	0.449
	1981-1985	40.274	2.678	0.066
	1986-1990	37.716	3.748	0.099
	1991-1995	43.822	1.607	0.036
	1996-2000	46.258	2.447	0.052
	2001-2005	51.178	5.720	0.111
	2006-2010	83.666	14.421	0.172
	2011-2015	108.299	17.097	0.157
Direct Taxes	1981-2015	215904.451	282131	1.306
	1981-1985	9519.556	609.442	0.064
	1986-1990	13168.6	2700.96	0.205
	1991-1995	39220	16065.2	0.409
	1996-2000	98693	14661.5	0.148
	2001-2005	159355.6	24191.6	0.151
	2006-2010	387706	114100	0.294
	2011-2015	803668.4	170161	0.211
Indirect taxes	1981-2015	443776.028	495160	1.115
	1981-1985	46173.393	5080.62	0.110
	1986-1990	77615.2	23413.9	0.301
	1991-1995	148508	32412.7	0.218
	1996-2000	257567.6	28704.9	0.111
	2001-2005	390011	65658.4	0.168
	2006-2010	701076	153983	0.219
	2011-2015	1485481	305389	0.205
Unemployment rate	1981-2015	5.172	1.624	0.314
	1981-1985	3.648	0.194	0.053
	1986-1990	2.788	0.699	0.250
	1991-1995	4.920	0.668	0.135
	1996-2000	5.985	0.685	0.114
	2001-2005	7.802	0.313	0.040
	2006-2010	5.436	0.436	0.080
	2011-2015	5.627	0.886	0.157
Average Productivity of Labor	1981-2015	144353.655	26662.5	0.184
	1981-1985	103059.54	8661.05	0.084
	1986-1990	118702.363	4433.88	0.037
	1991-1995	139477.861	4309.05	0.030
	1996-2000	143915.56	5154.97	0.035
	2001-2005	153851.368	6723.74	0.043

	2006-2010	168051.705	5162.17	0.030
	2011-2015	183417.191	11168.3	0.060
Working hours per week	1981-2015	45.531	1.101	0.024
	1981-1985	46.398	0.561	0.012
	1986-1990	45.885	0.685	0.014
	1991-1995	46.721	0.354	0.007
	1996-2000	45.731	0.852	0.018
	2001-2005	45.757	0.540	0.011
	2006-2010	44.345	0.180	0.004
	2011-2015	43.877	0.438	0.009
Wage rate	1981-2015	266.86	231.271	0.866
	1981-1985	59.479	3.572	0.060
	1986-1990	79.165	9.724	0.122
	1991-1995	125.30	18.767	0.149
	1996-2000	190.08	19.414	0.102
	2001-2005	239.81	35.164	0.146
	2006-2010	452.42	82.091	0.181
	2011-2015	721.76	113.947	0.157
Labor Share	1981-2015	34.494	23.221	0.673
	1981-1985	12.869	0.538	0.041
	1986-1990	13.407	0.936	0.069
	1991-1995	18.955	2.311	0.121
	1996-2000	28.521	2.490	0.087
	2001-2005	34.495	3.813	0.110
	2006-2010	54.697	7.584	0.138
	2011-2015	78.510	8.951	0.114

5.2 Unit Root Test

In our analysis we use annual time series data, as we know that time series data have some trend and data is not stationary which leads to spurious results. So before estimating the equation's test for stationarity of all variables. We use Augmented Dickey Fuller test which shows the variables used in analysis is stationary. The result of Augmented Dickey fuller test is given in Table 5.2.

Table 5.2 Unit root

	Coefficient	Order of Integration
Inflation	-2.901 (0.055)	I(0)
Working Hours per week	-7.644 (0.000)	I(0)
Import Prices	-5.776 (0.000)	I(0)
Average productivity of labor	-4.700 (0.003)	I(0)
Direct taxes	-4.310 (0.008)	I(0)
Indirect taxes	-6.569 (0.000)	I(0)
Unemployment rate	-8.651 (0.000)	I(0)
Wage rate	-3.677 (0.038)	I(0)
Output Gap	-2.704 (0.084)	I(0)

* T-stats and in parenthesis probability are given.

As discussed in literature determinants of inflation, different methodologies and inflation theories. In this section we use different methodologies like incomplete competition (ICM), Standard Phillip's curve model (PCM) and New Keynesian Phillips curve model (NPCM) with described data, differentiate between these models and forecast inflation, also choose the best model who forecast inflation and reduce inflation uncertainty.

In this section used simple model for wage and price. We used wage price system for an open economy which based on theories on imperfect competition in goods and labor markets. Model is adopted from Kolsrued and Nymeon (1996). Variables used are nominal wages W, Inflation

CPI P, Labor productivity PR, Import price index PI, Unemployment rate U, direct and indirect taxes and the deviation from the output gap from its trends.

5.3 Incomplete Competition Model

According to Bardsen et al. (1998), we estimate the model with its steady state condition is given:

$$w = \underset{(29.7)}{0.98}\, p + 0.39\, \underset{(2.97)}{0.39}\, pr - \underset{(-4.70)}{0.12}\, u - 1.33 \qquad (5.1)$$

$$p_t = \underset{(9.12)}{0.25}(w - pr + t1) + 0.13\, \underset{(3.29)}{0.13}\, pb + \underset{3.50}{0.18}\, t3 - 0.03 \qquad (5.2)$$

The model based on two equations one is wage equation and second one is price equation In the parenthesis t- stats value is given and according to it all variables are significantly effects. According to 5.1 equation, wages are based on inflation, average productivity of labor and unemployment rate. Wages are estimated by Gali and Getler (1999)[5].

In the equation 5.2 inflation depends on average wage growth[6], import prices and indirect taxes.

While estimating above wage system we enforce the expected steady state condition on a sub-system for Wage and inflation which based on additional lags of Average productivity, Unemployment rate, direct taxes and indirect taxes. We add output gap and also working hour of labor to capture the short run effects. The resulting model is given as.

[5] Wage per day, which described in chapter 3 data and methodology.

[6] According to Bardsen et al. (1998).

Table 5.3 Wage Equation for Incomplete Competition Model

Dependent variable	
Δw	
Variable	Coefficient
Δp	1.039***
	(4.80)
Δpb_{t-2}	-0.126
	(-1.17)
$\Delta t1_{t-2}$	-0.128*
	(-1.78)
Δh	-0.914**
	(-2.10)
ECM	-0.009**
	(-1.73)
Heteroscedasticity F(1,22)	0.567 [0.459]
Normality test: Chi^2(2)	2.613 [0.270]
over-identifying restrictions	[0.000]**

Note: T-stats value are written in parenthesis. ***, ** and * show 1%, 5% and 10% level of significance respectively.

According to the Table 5.3 wage growth depends on inflation, import prices and taxes. And the above model captures short run as well as long run effects of wage determinants over wage growth. All variables statistically significant effects wage growth.

Results of Table 5.3 indicated that inflation growth has positive and significant effect over wage growth in short run. Which means if inflation goes increase then there will be increase in wage growth. According to "wage push inflation" if there increase in the price level of goods so purchasing power moves to decrease, workers ultimately require increase in wages to compensate for the cost of living. Wage growth has negatively and significant effect by taxes, if there 1% increase in tax rate then wage growth decreases by 12%. Taxes influence the activity of labor directly through the channels of supply and demand for labor, and indirectly through the

responses of government spending to the tax revenues available. Higher tax rate on labor income and consumption expenditures mean less work in the legal area market, more time in the household, a large underground economy and a share of lower domestic production and employment in industries that heavily rely on labor in low wage and low- Cost leave [Steven Davis and Magnus Henrekson (2005)] .

Finally the error correction[7] term has significant with negative sign effect over wage growth rate, as expected from theory. Coefficient of ECM term is speed of adjustment which tells about the speed of model converge to its equilibrium stage, which is almost 1%, which shows that model will converge to its equilibrium with 1% annually. At the end of Table the diagnostics, there is no Heteroscedasticity, residuals are normally distributed and also fulfil the over identified restriction's condition.

Table 5.4 Price equation for Incomplete Competition Model

Dependent variable	
Δp	
Variable	Coefficient
$\Delta w_t + \Delta t1_{t-1}$	0.214***
	(4.90)
gap_{t-1}	-0.252
	(-0.873)
Δpb_{t-2}	-0.002
	(-0.032)
$\Delta t3_{t-2}$	0.037
	(0.687)
ECM	-0.421***
	(-2.75)
Heteroscedasticity F(1,22)	6.536 [0.018]*
Normality test: Chi^2(2)	4.420 [0.109]
over-identifying restrictions	[0.000]**

Note: T-stats value are written in parenthesis. ***, **

[7] Error correction term consists of $w_{t-1} - 0.98\,p_{t-1} - 0.39\,pr_{t-1} + 0.12u_{t-1}$ which is derived from equation 4.1 according to Bardsen et al. (1998).

and * show 1%, 5% and 10% level of significance respectively.

According to Table 5.4 inflation growth has significant influenced by real wage growth and output gap, which is expected by the theoretical model. Real wage effects positively inflation growth which shows that if there is change in 1% in wage which effects inflation by 21%. There is strongly evidence that rise in the level of wages causes inflation, if wages increase which tends to both of combination of demand pull inflation and cost push inflation. According to demand pull inflation, arise aggregate demand of economy which overtakes aggregate supply, it contains inflation rising as well as gross domestic product and falls unemployment level as the economy moves along Phillip's curve. This describes that too much money spent on few goods and demand for those goods increased which caused inflation [Barth, J. R. and Bennett, J. T. (1975)]. While according to cost push inflation, increased in prices of factor of production leads to decrease in supply of those goods, while demand of these goods remains unchanged. Prices of commodities moves to increase which caused rise in the price level.

The second and important significant factor is ECM[8] of inflation growth. Coefficient of ECM is -0.42. It has negative sign which shows the model move toward convergence with the speed of 42%. Which also represents there exists Cointegration between inflation and its determinants.

So overall conclusion of this model is that there exists the relationship between inflation, inflation uncertainty and unemployment, also holds the Phillip's curve hypothesis which is there exists trade-off relationship between inflation and unemployment level and also holds the

[8] Inflation ECM is derived from equation 4.2, error correction term is equal to $p_{t-1}0.22(w_{t-1-}pr_{t-1}+t1_{t-1})-0.13pb_{t-1}-0.18t3_{t-1}$ according to Bardsen et al. (1998).

hypothesis of Friedman, which is there is positive relationship between inflation and inflation uncertainty. At the end of Table 5.4 the diagnostics, there is no Heteroscedasticity, residuals are normally distributed and also fulfil the over identified restriction's condition.

5.4 Standard Philips Curve

According to price and wage macroeconomic models, PCM determines the natural rate of price and wage equations. Price equation which is equivalent to relationship of demand and wage and according to wage equation which links the supply of wages and employment. Wage equation depends on Inflation, import prices, direct and indirect taxes, unemployment rate and working hours and number of lags.

Table 5.5 Wage equation for Standard Phillips curve

Dependent variable	
Δw	
Variable	Coefficient
Δp	0.990***
	(3.88)
Δpb	0.081
	(0.836)
$\Delta t1$	0.144**
	(2.07)
$\Delta t1_{t-1}$	0.073
	(1.03)
$\Delta t1_{t-2}$	-0.243**
	(-2.31)
Δu	-0.052*
	(-1.90)
$\Delta t3$	-0.127
	(-1.62)
$\Delta t3_{t-2}$	0.076
	(1.29)
Δh	-0.527
	(-1.19)
Heteroscedasticity F(1,22)	0.113 [0.740]
Normality test: Chi^2(2)	1.892 [0.388]
over-identifying restrictions	[0.000]**

Note: T-stats value are written in parenthesis. ***, ** and

* show 1%, 5% and 10% level of significance respectively.

While estimating the PCM model, we start with the same set of information which is used in the ICM model, but her we used more lags in the dynamics.

The results in Table 5.5 clearly show that our explanatory variables are not only statistically significant but also there is a strong relationship between independent variables and dependent variable. The significance level which we have taken is 10% for all variables. Dependent variable is inflation which is positively associated with wages. Similarly, unemployment and taxes are negatively related with wages.

In Table 5.5 inflation positively effects wages which means that increase in inflation growth which leads to increase in wage growth which also discussed in model 5.3. Similarly taxes are also negative effect on wage growth by which means that if there increase in tax level which leads to decrease in wage level, which is according to theory and also discussed in above Table 5.3. Finally the unemployment has also significant and negative effect on the wage growth. Which shows trade off association between wage growth and unemployment inflation level, if there is reduction in unemployment level leads to increase in wage inflation level. According to above results if there is reduce in unemployment level by 1% level which leads to increase in inflation level by 5%, if there is low unemployment level, which means that demand for labor exceeds by its supply. In a tight labor market employers will not hesitate to offer higher wages to attract employs which results to rise in wage inflation [William Phillips (1958)].

At the end of Table 5.5 the diagnostics, there is no Heteroscedasticity, residuals are normally distributed and also fulfil the over identified restriction's condition.

While the price equation is depends on wage rate, import prices and average productivity of labor and number of lags of inflation and explanatory variables. The result for Standard Philips curve of price equation is given in Table 5.6

Table 5.6 Price equation for Standard Phillips curve

Dependent variable	
Δp	
Variable	Coefficient
Δw	-0.574 (-1.36)
Δw_{t-1}	0.496*** (2.83)
Δp_{t-1}	0.829*** (3.10)
Δpb	0.211* (1.91)
Δpr_{t-1}	0.331* (1.80)
$\Delta outputgap_{t-1}$	2.956*** (2.41)
Heteroscedasticity F(1,22)	0.084 [0.774]
Normality test: Chi^2(2)	4.642 [0.098]
over-identifying restrictions	[0.000]**

Note: T-stats value are written in parenthesis. ***, ** and * show 1%, 5% and 10% level of significance respectively.

In Table 5.6 explanatory variables wage growth, inflation uncertainty, import prices, average productivity of labor and output gap are not only statistically significant but there exists strong positive association between them and inflation growth.

According to the results there exists positive relationship between wage growth and inflation, the economic phenomena already discussed in Table 5.4. Come to second variable inflation

uncertainty, there exists positive relationship between inflation and inflation uncertainty. Which means that if there is increase in inflation uncertainty which leads to increase in inflation growth. If uncertainty of inflation increases, the monetary authorities adopt opportunistic behavior to stimulate growth production by increasing the amount of money, thereby generating higher inflation [Cukierman and Meltzer (1986),Okrun (1971)].

According to second variable wage growth has significant and positive effects inflation growth. If there is increase in wages which leads to increase in inflation level which we already discussed in Table 5.4. According to Phillip's which discussed in Table 5.5, indicated that if there decrease in unemployment level which leads to increase the demand of labour by its supply and in a tight labor market employers offers high wages to employees which leads to increase in inflation. So there is negative relationship between unemployment, and positive association between wages and inflation level.

Wage growth has negatively association with unemployment level and positive with inflation growth so it means that there exists negative affiliation exists between growth in inflation and unemployment which is according to Phillips curve hypothesis, which there is trade off relationship between inflation and rate of unemployment.

Output gap has significant and positive impact over inflation growth and inflation uncertainty, which means that if there is increase in growth which leads to increase in inflation. According to result of output gap if there is increase in growth by 1% which tends to lead in inflation growth or inflation uncertainty by 2.95%. According to Sarte and Dostey (2000) in different angle in which they argue that an increase in inflation uncertainty may actually has positive influence on the rate of growth of output. According to the classic linear growth model, where they have

introduced into the model via Cash in advance money. Their results show that higher inflation rates have a negative impact on output growth, but an increase in inflation uncertainty affects positive to output growth through precautionary saving motives. They also argued that more resources will be invested than the uncertainty of inflation has led to increased doubts about investment decisions, which reduces the demand for real money balances. As more resource investment, which in turn will increase the investment expenditure of economy, which is an important part of the growth and thus contributes positively to the output growth. An increase in the output will lead to an increase in the rate of inflation, while an increase in the rate Inflation will increase the uncertainty of inflation [William Phillips (1958)].

Similarly import price has significant and positive effect over inflation growth, which means that if there increase in import price level then there increase in inflation level. As one percent increase in import prices which leads to increase in inflation growth by21%. There are several transmission channels, like oil prices can affect economic activity and inflation. For example, the price of crude oil has shifted over the price of petroleum products and from the point of view of consumers (households, industry and government) increases the energy bills, whereas from the production phase, An increase in unit costs, Which leads to increase in inflation level [Lescaroux and Mignon (2008), Malik, A. (2016)].

While average productivity has significant and positive impact over inflation growth, increase in average productivity leads to increase in wage level due to increase in wages increase in level of inflation which we discussed in above Table 5.4.

So the overall results are according to PCM which follows the Phillips curve hypothesis which is there is trade-off between inflation and unemployment level. Okrun (1971) suggested the causal relationship between inflation and inflation forecast uncertainty.

At the end of Table 5.6 the diagnostics, there is no Heteroscedasticity, residuals are normally distributed and also fulfil the over identified restriction's condition.

5.5 New Keynesian Phillips Curve

The new Keynesian changed the Philips curve (PC), which as a result of unemployment, which maintains monetary expansion (where there is an output gap), and as a cause of inflation in full employment. According to Gali and Gertler (1999) modified the Phillips curve to Hybrid Phillips curve for US, in his new model they suggested real unit labor cost instead of output gap, because labor cost is more relevant to measure expected inflation.

While estimating the New Keynesian Phillips curve model we followed Gali and Gertler (1999) with increase in the specification with the growth rate of import prices.

Table 5.7 New Keynesian Philips curve

Dependent variable	
Δp	
Variable	Coefficient
Δp_{t+1}	0.584054***
	(7.845213)
Δws	0.077781*
	(1.726429)
Δpb	-0.071149*
	(-1.702177)
R-squared	0.307138
Durbin-Watson stat	2.249501
Adjusted R^2	0.232903
J-statistic	0.735949

Note: T-stats value are written in parenthesis.

***, ** and * show 1%, 5% and 10% level of significance respectively.

According to Table 5.7 clearly show that our explanatory variables are statistically significant. Here we used two lags of wage growth, inflation growth rate, direct taxes growth rate, indirect taxes growth rate, unemployment growth rate and working per hour growth as instrumented to estimate the NPCM by GMM.

In our analysis we used lag of inflation for expected inflation. Because we don't have future inflation value so we took the lag of inflation for expected inflation according to [Bank of England (1999)][9]. In Table 5.5 expected inflation has significant and vital impact on determination inflation. Expected inflation has positive impact in inflation, if there is 1% change in expectations of inflation uncertainty, inflation will rise by 58%. We used labor income wage share instead of output gap because it is applicable measure for inflation [Gali and Getler (1999)][10]. Meanwhile wage share has positive effect to inflation which means that if there is 1% change in wage share increase the inflation level, According to Phillips curve there is trade off relationship between inflation and unemployment. According to wage share if wages moves to increase which will reduce the unemployment level, so people purchasing power increases. Demand of that commodity increased as compared to supply which leads to increase in price which caused inflation. Import prices has also significant and negative impact on inflation growth, which shows that if there is increase in 1% of import prices then inflation decrease with 7%.

[9] Bank of England (1999)][9] investigated the empirical evidence on forward looking Phillips curve and they take the lag of inflation as a proxy of expected future inflation.

[10] Gali and Getler (1999) recommended that marginal cost rather than output gap is applicable measure of inflation. And according to that marginal cost and expected inflation are the main determinants of inflation.

Finally according to results of Table 5.7 there is positive and significant relationship between them inflation and inflation uncertainty [Okrun (1971)]. And shows trade off results between inflation and unemployment [Phillip's (1958)].

At the end of Table the diagnostics, R-square and Adjusted R-square shows the goodness of fit index of model and the values of both are good. Durbin Watson value is greater than 1.65 which also indicated that there is not any serially correlated problem between independent and dependent variables. Finally the J-stats values showed that the instruments which is used to estimate the model is valid.

5.6 Forecasting

Forecasting is the technique for making statements about future events. Econometric forecasts allow researchers to evaluate historical data trends and predict how the current economic changes will change. To estimate the performance of above models, we will compare the forecasting accuracy of above estimated models.

5.6.1 Plan for Forecasting

We used one step ahead forecasting approach, because it utilizes all available information. We divide data in to two parts: 1981 - 2012 and 2012 - 2015. Firstly, ICM and PCM models estimated from 1982 – 2012 and forecast for the year of 2013. Then we estimate the model from 1981 – 2013 and forecast for 2013. After that we estimate the model again from 1981 to 2013 and compute forecast for 2014 and this procedure will continue till 2015.

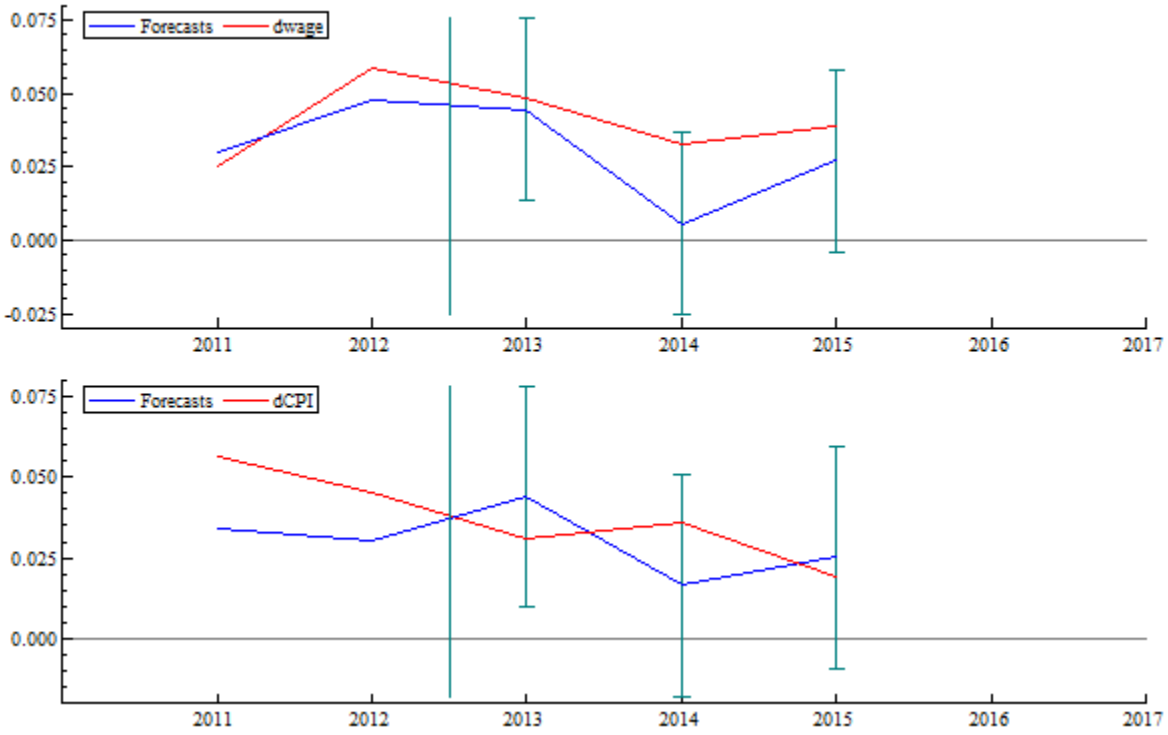
The PCM and ICM models are better models than NPCM because in inflationary process, it is too formalized and specific to perform as a good model. Furthermore, the PCM and ICM are

simultaneous equations models for wage and price, Estimation done by FIML which suggests that these models previously have the (rational) expectations explanation in term of current wage and price growth. Although be careful when expectations for period t+1 and t+2 of same variables are incorporated in the models, since the problem of identification occur [Blake (1991); Moghadam and Wren-Lewis (1994)]. Similarly, the current dated variables, namely $\Delta wage$ and $\Delta inflation$ in consumer price equation are by themselves predictor of $\Delta wage_{t+1}$ and $\Delta inflation_{t+1}$. The forecasting process is quite simple, i.e. $\Delta\Delta w_{t+1}^{e} = 0$, which shows that agents mostly resort to the rules of thumb when they face complex uncertainty (Shleifer (2000)). Elementary and basic uncertainty is a convincing feature of economic time series data as it is influenced by the unit-root and deterministic shifts. The comparison of forecasting rules demonstrate that $\Delta\Delta w_{t+1}^{e} = 0$ is the robust tool of forecasting in that the sound effects of deterministic shifts are corrected (Eitrheim et al. (1999)).

5.6.2 Incomplete Competition Model

We used recursive forecasting approach, to forecast the model for ICM. The specification for ICM is discussed in section 4. Here we forecast the ICM model of above specification by recursive forecasting approach.

Figure 5.1 Incomplete Competition Model



In figure 5.1 the above upper portion represents the forecasting according to wage equation of Incomplete competition model. On X-axis used the time spam of forecasting period, we estimate the model till 2012 and the remaining years for forecast and on Y-axis we have standard Errors. The blue line shows the forecasting series and red line represesnts the actual series. According to the grpah we have very good foreacsting because the forecated line is in between the ± 2SE [11]. in the forecasting period 2013 to 2015 both line move together in between the +2SE and -2SE. So from the above diagram the result of forecasting is very good.

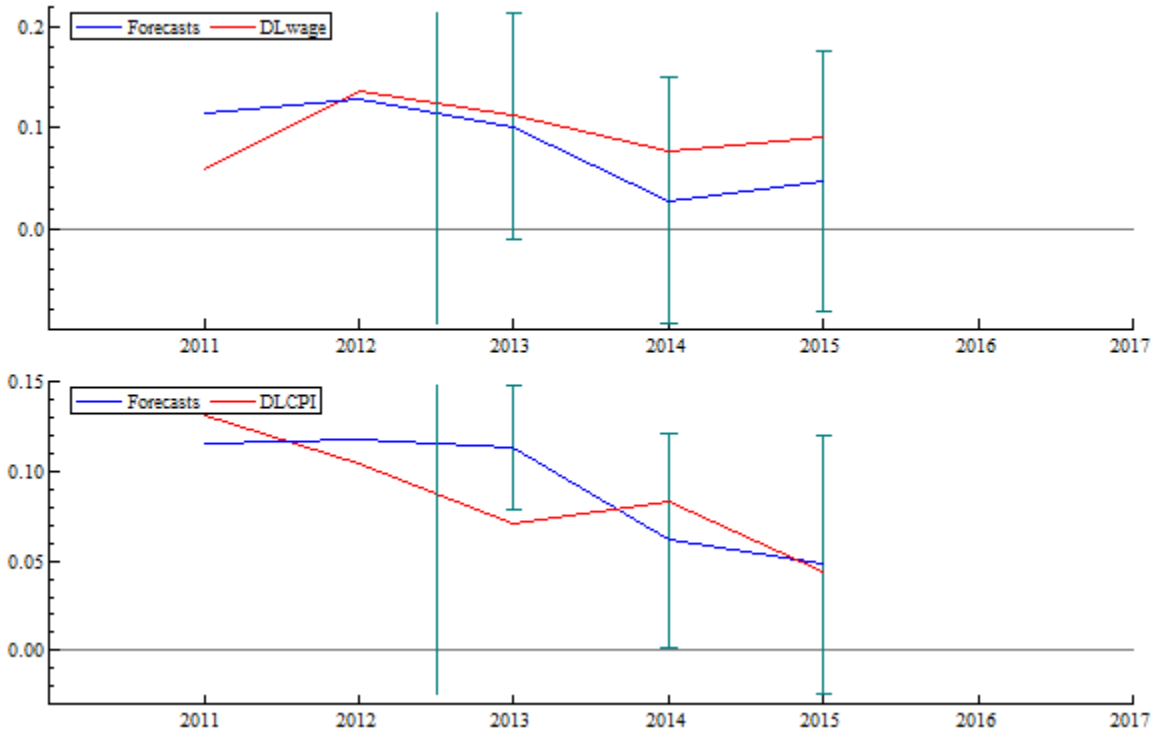
[11] Standard errors of forecasting.

While lower portion of figure 5.1 represnts the foreacsting for inflation series. And according to grpah there is good forecasting because both line lies in between the ± 2 standard errors.

5.6.3 Phillips Curve Model

We used recursive forecasting approach, to forecast the model for PCM. The model specification of PCM is discussed in section 4. Here we forecast the ICM model of above specification by recursive forecasting approach.

Figure 5.2 PCM



In figure 5.2 the above upper portion represents the forecasting according to wage equation of Standard phillips curve model. On X-axis used the time spam of forecasting period, we estimate the model till 2012 and the remaining years for forecast and on Y-axis we have standard Errors.

The blue line shows the forecasting series and red line represesnts the actual series. in the forecasting period 2013 to 2015 both line move together in between the ± 2SE. So from the above diagram the result of forecasting is very good.

While lower portion of figure 5.2 represnts the foreacsting for inflation series. According to the grpah we don't have so good foreacst because the forecated line is in between the ± 2SE because at 2013 forecasting line not lies in between SE and after that it lies in between them.

5.6.4 Measuring of Forecast Results

To evaluate relative performance of forecast. We will use Root Mean Square Error (RMSE) and mean absolute percentage error (MAPE). The value of RMSE for ICM and PCM model are given in Table 5.8.

Table 5.8 Forecasting result

Models	RMSE	MAPE
ICM	0.013990	41.681
PCM	0.037897	52.932

Table 5.8 shows that the ICM has lowest RMSE and MAPE dynamic forecasting. ICM visibly overtake the forecasting. ICM model has the minimum RMSE and MAPE value as compared to PCM.

Chapter 6

Conclusion

There is close linkage between forecasting and policy analysis. Simultaneously, econometric models also play an important role in forecasting and policy analysis. The main Objective of monetary policy makers is to 'conditional forecast of central bank', which is 1 to 2 years ahead. To accomplish this task decision makers need many different models. Moreover, the presence of non-stationarity in the data, makes unavoidable conciliations of the gains and the importance of the correct structural modelling and its costs related to the forecasting robustness. In this study, we explored the best specifications for inflation forecasting. For this purpose, in case of Pakistan, we used different classes of inflation models, which are Standard Phillips Curve (PCM), New Keynesian Phillips curve (NPCM) and Incomplete Competition Model (ICM) and used annual time series data from 1980 to 2016. So we have studied the importance of this comprise for inflation forecasts.

We considered the most important inflation models, which are Phillips curve and wage curve with their specifications. In this regard, PCM includes the output gap and unemployment rate; NPCM has the forward looking expectations and used labor income share instead of output gap, Gali and Gertler (1999); ICM identifies the importance of incomplete information of labor and product markets. However, with imperfect competition, ICM have some ECM to forecast inflation. The relevant ECM overcome the omitted variable bias.

We choose the better and more appropriate inflation model on the bases of its forecasting performance with its different specifications. We used the root mean square error (RMSE) and

mean absolute percentage error (MAPE) criteria. ICM has the lowest root means square error (RMSE) and mean absolute percentage error (MAPE). In conclusion, wage prices dynamics model (ICM) offers the finest prospect of successful inflation forecast.

Policy Recommendations

The uncertainty of future allows the researchers to depict and forecast it for reducing the risk of it. In the same way, for policy making, the forecast of Inflation is an important goal to control it. In case of Pakistan, we suggest that In-complete Competition Model (ICM) enable us to handle the incomplete information of price and labor market. ICM is well specified model as it is better in visualization forecasting and root mean square error and mean absolute percentage error (the lower root mean square and mean absolute percentage error which specifies the model at its best level) as compared to other inflation models.

While for investors the basic objective of investors to minimize the inflation uncertainty risk, and the basic motive of the firm's honors to earn profit so their main objective is to measure the real inflation in future and inflation uncertainty. So according to the results of this study ICM model specification have the better forecast with better visualization and also lower the root mean square and mean absolute percentage error in case of Pakistan.

We suggest to appoint incomplete competition model to forecast the inflation uncertainty, as this model overcome the drawbacks of other two inflation models through mechanism.

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