Exploring the Determinants of Worker's Remittances: An Application of Encompassing and LASSO Technique

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CERTIFICATE

This is to certify that this thesis entitled: **"Exploring the Determinants of Worker's Remittances: An Application of Encompassing and LASSO Technique"** submitted by Mr. Fareed Ullah is accepted in its present form by the Department of Econometrics and Statistics, Pakistan Institute of Development Economics (PIDE), Islamabad as satisfying the requirements for partial fulfillment of the degree in **Master of Philosophy in Econometrics**.

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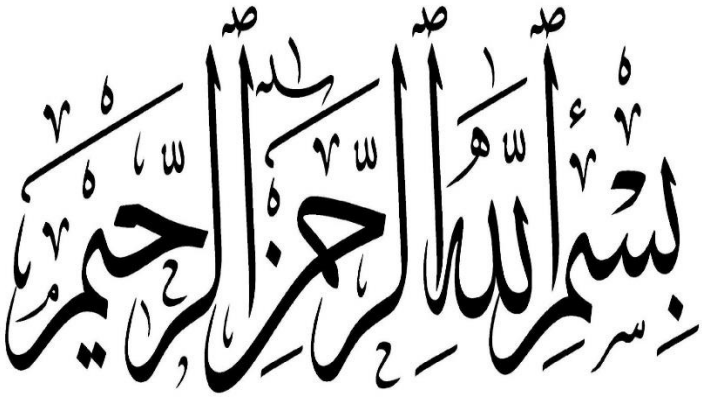
In the name of ALLAH, the most Merciful and the most Beneficent



“ALLAH NEVER CHANGE THE CONDITION OF PEOPLE UNLESS THEY STRIVE TO

CHANGE THEMSELEVE”

[QURAN 13.11]

DEDICATION

This Humble Effort is Dedicated to

"My Family for Their Love, Wishes, Support Patience, Understanding

and Guidance and All Those Who Seek Knowledge to Reach At Truth"

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LIST OF ABBREVIATION

ARDL	Autoregressive Distributive Lag
BEOE	Bureau of Emigration and Overseas Employment
BMP	Black market premium
CRRP	Corruption
DEBT	Foreign debts
DEXP	Development expenditure
DMOC	Democracy
EXR	Exchange rate
FDI	Foreign direct investment
FLIB	Financial liberalization
GDP	Gross Domestic Product
GOLD	Gold prices
GUM	General Unrestricted Model
ICNF	Internal Conflict
ICRG	International Country Risk Guide
IFS	International Financial Statistics
INF	Inflation
INT	Interest rate
irPak	Investment return of Pak
irUS	Investment return of US
LAOR	Law and order situation
LASSO	Least Absolute Shrinkage and Selection Operator
McPak	Major Agriculture Crops
PS	Political stability
REER	Real effective exchange rate
SBP	State Bank of Pakistan
sk	Job skill index
SP	Share prices
SSEN	Secondary school enrolment
TIND	Terrorism index
TO	Trade openness
UM	Unemployment
W	Wage rate
WDI	World Development Indicators
WR	Workers' Remittances
XCNF	External Conflict

ABSTRACT

This study seeks to identify the potential determinants of workers' remittances from the existing models of workers' remittances of Pakistan by using encompassing and LASSO techniques. The annual time series data are collected for the period 1975-2017. In this study we have considered the determinants of workers' remittances provided by the five models in case of Pakistan along with black market premiums(BMP) and wage rate(W) from international literature. After finding the appropriate model by encompassing and LASSO techniques, general to specific(G2S) methodology is used to find the parsimonious model which are $\mathrm{RM}_{\mathrm{Encompassing}}$ and $\mathrm{RM}_{\mathrm{LASSO}}$. Then we have chosen the final model for workers' remittances by ranking both models according to their standard errors. It has been observed that $\mathrm{RM}_{\mathrm{LASSO}}$ has the minimum standard error and has encompassed $\mathrm{RM}_{\mathrm{Encompassing}}$. Therefore, $\mathrm{RM}_{\mathrm{LASSO}}$ is considered as final model for workers' remittances in Pakistan. ARDL bound test has been applied to find the long run conintegrating relationships among the determinants of workers' remittances. The results of final model suggest that the major determinants of workers' remittances are internal and external conflicts, major agriculture crops and investment return of Pakistan and real effective exchange rate. In the long run the internal conflicts and investment return of Pakistan have negative and significant, whereas, the real effective exchange rate, external conflicts and major agricultural crops have positive and significant impact on workers' remittances of Pakistan. While in the short run internal conflicts has negative and significant whereas external conflicts has positive and significant impact on workers' remittances of Pakistan. Therefore, it is necessary to reduce the internal conflicts to enhance the workers' remittances in the country.

Key Words: Workers' remittances, Encompassing, Cox test, LASSO, Unit Root, ARDL Bound Test.

Chapter 1

INTRODUCTION

"One should start with the right model and estimate it" Asad Zaman.

In this study we are eager to choose the suitable model of workers' remittances by using LASSO and encompassing techniques because workers' remittances play a crucial role in any economy by strengthening its foreign reserves and national income. Remittances are also the key source of investment for developing country. At household level, remittances encourage to raise consumption and private investment (Shoab, 2016). According to the World, Bank; India, China, Mexico and Philippines have sustained their positon as the top most recipients of foreign remittances. Moreover, Pakistan, Bangladesh, Egypt Nigeria and Lebanon are other top recipients of foreign remittances (Alam *et al,*2017).

After independence less number of workers migrated to UK and US. The sharp rise in remittances was first observed in 1975 when more workers migrated to Middle East countries. However, transfer of remittance to Pakistan have been reduced significantly in 1983 due to oil prices hike and touched the figure of $2886 million (Alam *et al*, 2017). Again the sharp decline in remittances were observed from 1998 to 2000 when Pakistan's foreign currency account were seized due to nuclear explosion (Kamran *et al,* 2014). After 9/11 remittances have reached up to $2389 million and in 2013 Pakistan turned into the seventh developing country with $13921 million remittances. Indeed this seventh position is not constant over the time and the amount of remittances also fluctuates. Finally in 2016-17 Pakistan become the fifth developing country in receiving $19,303 million of remittances (Alam, 2017).

The stability of workers' remittances is not guaranteed. It depends on the internal and external political and economic factors. Fluctuations in the economic indicators will significantly lead to effect the inflows of remittances (Fatima, 2016). Moreover, terrorism have also forced the people to migrate to other countries to fulfil their family needs and send a huge amounts of remittances to their home country (Ullah *et al*, 2015). Page and Plaza (2006) have proposed that migrants may use unofficial channels to transfer their remittances when black market premiums[1] is high.

From the above discussion it is clear that there is not only a single determinant of remittances. Different factors such as oil prices, exchange rate, internal and external political and economic factors among others are responsible for remittances. Moreover, the investigation of the national literature make it clear that there is no consensus among the researchers over the determinants of the remittances. Therefore, it is necessary to choose the potential determinants of worker's remittances.

Leamer (1978) found that the regression model is valid only when all the relevant regressors that are the determinants of the dependent variable should be included in the model. If the relevant variables are excluded from the regression model then the model will be mis-specified and the result which are drawn from the regression model can be completely misleading.

In order to obtain the true regressors of the dependent variable, one should start with the general model which includes all the potential determents. General unrestricted model (GUM) is developed by considering all the determinants of dependent variable from the existing literature. Whenever the number of variable is greater than the number of observation (k>n) then we are

[1] Black market premium is define as, the percentage difference between the official exchange rate and black market exchange rate.

unable to estimate the GUM. To solve this problem we choose the general model either by encompassing technique or by applying Least Absolute Shrinkage and Selection Operator (LASSO) technique for feature selection. Both encompassing and LASSO have advantages over other techniques such as OLS, Ridge regression etc because encompassing and LASSO provide unique solution in case of the number of variables is greater than the number of observation. They both include the best subset of predictors in our final model instead of including all the predictors. On the other hand, different researchers have built various models in the earlier studies to examine determinants of remittances. They also concluded that if we omit any of these variables then these will cause omitted variables bias. While if we consider all the variables which are used in the earlier studies instantaneously then our model will be too large and our result will be insignificant. Therefore, the aim of this study is to find the best suitable model of workers remittances in case of Pakistan by using encompassing and LASSO methodology.

1.1 Objective of the study

The objectives of the study are

- To identify potential determinants of workers' remittances by using encompassing methodology.
- To identify potential determinants of workers' remittances by using the LASSO.

1.2 Significance of the study

The main task of the study is to find the best suitable model of remittances among different existing models by using the encompassing and Lasso methodology. It is observed from the previous literature that different models have found the impact of the determinants on workers' remittances, but it is very difficult to say that which one is the best model among the large

number of models. Thus this study will contribute only one model which may be close to the true model.

1.3 Organization of the study

This study is organized into five chapters. Chapter one focus on introduction, objective of the study and significance of the study. Chapter two provides the literature review. Chapter three explains methodology and data description. Chapter four consists on results and discussions. Finally, chapter five concentrate on conclusions and policy recommendation.

Chapter 2

LITERATURE REVIEW

Various researchers have explored the determinants of workers' remittances with various conclusions. Some researchers suggested positive whereas other have drawn a negative relationship of workers' remittances with macroeconomic determinants. So, our literature review is divided into four sections. Section 2.1 and section 2.2 review the studies that have been done on the empirical investigation of various determination of workers' remittances both at national and international level. Section 2.3 focus on the literature related to encompassing methodology and section 2.4 explains the literature relevant to LASSO technique.

2.1 Review of National Literature

The following studies are on national level which investigate the impact of various determinants on workers' remittances of Pakistan. The study are arranged from 2011 to onward.

Kock *et al.* (2011) explored the influence of five variables (namely, real effective exchange rate nominal exchange rate, investment return, job-skill index and major agricultural crops) on workers' remittances of Pakistan by using OLS and Bayesian approach. They used the time series annul data from 1997 to 2008. The researchers established that Gulf Cooperation Council (GCC) countries have an important role to rise the remittances of Pakistan. They studied that remittances of Pakistan will only be improved whenever the worker migration and economic boom in GCC countries will be increased. They also found that exchange rates and economic conditions of Pakistan have strong impact on workers' remittances.

Kamran *et al*. (2014) examined the effects of multi variables (like, exchange rate, GDP, interest rate, inflation and foreign direct investment) with the inflow of workers' remittances of Pakistan

by using OLS method. They used the annul time series data for the period 1990-2010. They established that GDP, exchange rate and FDI are seemed the main determinants of workers' remittances. They also concluded that GDP and FDI have positive and significant association with workers' remittances. On other hand interest rate and variation in the inflation are negatively related with workers' remittances of Pakistan.

Ullah *et al.* (2015) studied the long run association between terrorism and remittances in Pakistan. They found that workers' remittances of Pakistan depends on GDP, exchange rate, unemployment, inflation, trade openness and terrorism index. They used the annul time series data for the period 1995-2013. For the long and short run relationship of terrorism with workers' remittances of Pakistan, they used Johanson co-integration approach and ECM. Their analysis showed that terrorism and inflation have positive relations with remittances because they tend the people out of the country for better life.

Alam *et al.* (2017) used the Johansen co-integration method and ECM to investigate the long and short run association among the different variables in the model. They found that relationship of seven variables (namely interest rate, gross domestic product, stock market performance, gold prices, development expenditures, exchange rate and political stability) with workers' remittances in case of Pakistan economy. The researchers concluded that gross domestic product, development expenditures, gold prices, depreciation of local currency and political stability have positive relation while interest rate, unemployment rate and fluctuation in inflation are negatively related to workers' remittances.

Abbas (2017) used time series from 1972 to 2012 and examined the generalized method of moments method to study the influence of macroeconomic, financial and political factors on the workers' remittances to Pakistan. They empirically concluded that macroeconomics, political

and financial variables of Pakistan have significantly while inflation and government debt have significantly and negative influence on workers' remittances. They also found that in incident of 9/11 the dummy variable has positively and significant influence on workers' remittances in Pakistan. It was also analyzed that external conflicts, law and order and corruption have positive relationship with remittances.

From these above mentioned studies different macroeconomic determinants of remittances have observed, such as, according to Kock *et al.* (2011) the exchange rates and economic conditions of Pakistan have strong impact on workers' remittances. Kamran *et al*. (2014) have concluded that GDP and FDI have positively and significant influence on workers' remittances while interest rate and fluctuation in inflation level have negatively influence on workers' remittances in Pakistan. According to Ullah *et al.* (2017) the terrorism and inflation have positive relations with remittances because they tend the people out of the country for better life. Abbas (2017) has concluded that macroeconomics, political and financial variables of Pakistan have significant while inflation and government debt have negatively and significant influence on workers' remittances. They also found that in incident of 9/11 the dummy variable has positively and significant influence on workers' remittances in Pakistan. It was also analyzed that external conflicts, law and order and corruption have positive relationship between remittances and Alam *et al.* (2017) also concluded that GDP, development expenditures, gold prices, depreciation of local currency and political stability have positive relation while interest rate, unemployment rate and oscillation in inflation are negatively related to workers' remittances.

2.2 Review of International Literature

The following studies are on international level which investigate the impact of various determinants on workers' remittances of different countries. The study are arranged from 2005 to onward.

Aydas *et al.* (2005) collected the time series yearly data from 1960-1980 by using OLS method. They examined the influence of different macroeconomic variables (namely black market premiums, domestic inflation, real over valuation, interest rate differential, domestic growth, host-country per capita income, per capita income of Turkey) on the workers' remittances of the Turkey and found that macroeconomic variables have significant effect on workers' remittances. Their results indicated that black market premium, inflation, and military regimes have negatively and significant effect on the workers' remittances while other variables such as growth, exchange rate policies, economic and political stability have positively and significant impact on the workers' remittances. They further indicated that developing financial intermediation and avoiding exchange rate misalignments also support to rise the remittances of the Turkey.

Barua *et al.* (2007) analyzed the workers' remittances macroeconomic determinants for Bangladesh by using the GLS method. The data collected from the period 1993-2005**.** They explored that the differential of income between host and home country have positively relationship with remittances. Also studied that differential of Inflation between home and host country have negatively relationships while Real interest rate differential has positive but insignificant relationship with remittances.

Rahman (2007) examined the role of workers' remittances in the economy of the Saudi Arabia. He used ECM for the short run and collected the time series data from 1975 to 2001. He

investigated that there is a positively relationship between GDP per capita and remittances per worker from the Saudi Arabia. He further concluded that wages have significant and positive relationship with worker remittances.

Elkhider *et al.* (2008) examined the relationship of two variables such as agricultural GDP and the exchange rate with remittances. They used the co-integration between remittances and its determinants and used ECM to find the short run relationship between the variables. They collected the time series data from 1970 to 2006. They found that the exchange rate has a negative influence while agricultural GDP has a positive impact on workers' remittances. They further explored that variation in agricultural GDP and remittances are in the same direction. As agricultural GDP increased then it tend to increase the workers' remittances as well.

Nabi (2011) analyzed the impact of different macroeconomic variables (namely, GDP of Host country, domestic GDP at constant price, exchange rate, the financial sector development, Inflation) on workers' remittances in Bangladesh. He used the OLS method and collected the time series data form 1981 to 2007. He also concluded that macroeconomic variables such as economic situation of host country, economic activity of home country, financial development and exchange rate have significant impact on workers' remittances. He further found that workers' remittances have significant influences on living standard of the people, exports and imports gap, the easing of national saving-investment and to make up well foreign exchange reserves.

Sutradhar (2012) found that remittance plays important role in increasing economic growth, poverty declining and foreign exchange earnings for Bangladesh by using OLS method and used annual data for the period 1980-2011. He studied that remittances also support to increase economic development and sustain macroeconomic constancy. He further analyzed that there is

positive association between exchange rate and remittance in short run and also found that there is positive association between domestic inflation and remittances.

Johanna *et al.* (2017) investigated the impact of the Arab Spring on remittances of Tunisia and Found that Tunisian migration to the Europe have increased after Arab Spring by using OLS method. They collected the monthly data form 2000 to 2016. They concluded that the Tunisian remittances have positive relationship to the political and social changes during Arab Spring. They also found that after Arab Spring the Tunisian migrants have become quite closer to the home country. In such away their involvement, remittances and donations have increased to the home country. Results have showed that P (dummy variable) is positive and significant relationship with remittances and further studied that remittances have important association between migration and the development of Tunisia.

The important macroeconomic determinants of remittances which are found in international literature are as, according to Aydas *et al.* (2005) the macroeconomic variables have significant effect on the workers' remittances of Turkey. Their results indicated that black market premium, inflation, and military regimes have negatively and significant influence on the workers' remittances while other variables such as growth, exchange rate policies, economic and political stability have positive and significantly influence on the remittances**.** Barua *et al.* (2007) identified that differential of income have positive association with remittances between host and home country. Also studied that differential of Inflation between home and host country have negative relationships while Real interest rate differential has positive but insignificant relationship with remittances. Rahman (2007) investigated that relationship between GDP per capita and remittances per worker from the Saudi Arabia is positive. He further showed that wages have significant and positive relationship with worker remittances. Elkhider *et al*. (2008)

examined the relationship of two variables such as agricultural GDP and the exchange rate with remittances. They suggested that the exchange rate has a negative influence while agricultural GDP has a positive influence on the remittances. According to Nabi (2011) the exchange rate have significantly influence on workers' remittances. Further studied that Remittances have significantly influences on the living standard of the people, the easing of national saving-investment. Sutradhar (2012) further analyzed that there is positive association between exchange rate and remittance in short run and also found that there is positive association between domestic inflation and remittances. Johanna *et al*. (2017) also concluded the Tunisian remittances have positive relationship to the political and social changes during Arab Spring.

2.3 Literature Review on Application of Encompassing Technique

The encompassing technique is related with the capability of a model that account the features of the other models. The previous researchers such as; Mizon and Richard (1986), Hendry and Richard (1989), and Lu and Mizon (1996) concentrated on the variance and parameter encompassing. Mizon and Richard (1986) focused on the wide range of encompassing test and also found that the Cox test of the non-nested hypothesis are tests of variance encompassing. In 1990 another researcher Wooldridge developed a test of conditional mean encompassing and also compared that test with Cox and Richard tests.

The application of the encompassing technique has been found in the existing literature of Pakistan. Such as Nazir (2017) applied the encompassing technique on the three energy growth models. Those three models were proposed by Kraft (1978) and Dantama *et al* (2011). She built the third model by using the determinants of two existing models. She has tested these three models with the help of nested and non-nested encompassing by using F and Cox test. She also

found that the independent variables in the first two model defined the GDP growth very well. Finally the third model encompassed the first two modes.

Siddique (2016) explored the internal and external determinants of Islamic banking growth of Pakistan. They collected the quarterly data from the period 2004-2012. The researchers used the encompassing approach to find the parsimonious model. Firstly, they used the encompassing technique to find the GUM from the existing model. Then they used the Wald restrictions test on the GUM to find the parsimonious model. Finally, the researchers have found the Islamic banking will be in progress if there is efficient management.

2.4 Literature Review on Application of LASSO Technique

LASSO is a powerful technique which performs two main responsibilities such as; the regularization and the feature selection. This method makes a parsimonious model in the presence of large number of variables. The previous researchers i.e Epprecht *et al* (2017) Compared two approaches for the purpose of model selection for the linear regression models such as; Autometrics (automatically selection from general to specific) and LASSO(the regularization and feature selection method) and ada-LASSO (adaptive LASSO). Their result concluded that all the techniques will improve their performances as increasing the sample size and decreasing the number of relevant and candidate variables. Ferraro (2016) determined the LASSO technique, which is a statistical tool that obtain sparse solutions for regression problems. He also found that LASSO technique has so many applications, from biology to economics. But he suggested the application of social economics, especially, the investigation of poverty rate determinants. The aim of this study was to identify the explanatory variables that have higher impact on poverty of Latin American countries.

Fonti *et al* (2017) examined the use of LASSO technique to describe the feature selection task. While using different setups, they tested this technique. They mostly focused on the two types of statistical models such as; linear model and generalized linear model. They concluded that the LASSO technique have benefits to select a model that have the most relevant features.

2.5 Literature Gap

It has been observed from the previous literature that different models have used different set of determinants to describe the phenomena of worker's remittances. It has also concluded that all the models are different from each other. If different models happens on the same phenomenon then all the models are incorrect or there will be only one model that might be adjacent to the true model. Therefore, it is necessary to find the best suitable model of workers remittances in case of Pakistan.

Chapter 3

DATA AND METHODOLOGY

As the objective of this study is to choose the most suitable model of remittances among the various models. To fulfill this objective we will use encompassing approach which is proposed by Hendry and Mizon(1980) and LASSO technique was presented by Tibshirani(1996).

3.1 Model Selection by Encompassing Method

Encompassing principle is defined carefully and accurately in the several perspectives in the different era. The primary look of encompassing principle by Hendry and Mizon dates back in 1980's. Encompassing approach provides basis in constructing tests for a definite model against alternative. Encompassing approach also provides basis for model comparison, as well as integrating a large and different literature to cover nested and non-nested hypothesis tests. Different researchers have built various models in the earlier studies to examine determinants of remittances. They also concluded that if we omit any of these variables then these will cause omitted variables bias. While if we consider all the variables which are used in the earlier studies instantaneously then our model will be too large and our result will be insignificant. So we use encompassing method to choose among the various models. Now we test whether RM_i encompasses the rest of the models or not then the hypothesis are constructed as.

(1) We have different models namely, RM_1 , RM_2 ... RM_n which have been suggested by earlier researchers.

(2) First of all we estimate RM_1, RM_2 … RM_n and then we will rank all the models according to their prediction error.

let RM_i is the model which has the smallest prediction error and then we apply the below tests.

$$H_0(1): RM_i \text{ encompasses } RM_1$$

$$H_1(1): RM_i \text{ does not encompass } RM_1$$

$$H_0(2): RM_i \text{ encompasses } RM_2$$

$$H_1(2): RM_i \text{ does not encompass } RM_2$$

$$\vdots$$

$$H_0(n): RM_i \text{ encompasses } RM_n$$

$$H_1(n): RM_i \text{ does not encompass } RM_n$$

Different tests are proposed to perform the null hypothesis of encompassing. These test are based on whether the model is nested or non-nested. If the models are nested then Wald test is used for encompassing approach, otherwise, cox (1972), Ericsson (1876), JA test are used for non-nested encompassing approach. When we fail to reject H_0 then it is concluded that RM_i encompasses RM_1. Therefore, RM_1 model will be ignored because its prediction power is already presented in RM_i. On other hand if the model cannot be encompassed by RM_i then it will be considered the most general model having all the variables of RM_i and all the remaining models that have not encompassed. The general model will be further simplified by using general to specific methodology. To get specific model from GUM we use Wald coefficient restrictions on all variables. Those variables which are highly insignificant then we will drop them from the model. In this way finally we get specific model.

3.2 Model Selection by LASSO

LASSO is a machine learning technique that was developed in 1989 and presented by Robert Tibshirani in 1996. LASSO regression is a powerful technique which performs two main responsibilities such as; the regularization and the feature selection. This technique is used when there are more independent variables and high multicollinearity in the model. It is an alternative method to the least squares estimate. Moreover, in this model when the variables are insignificant or do not have relationship with the response variable then the lasso makes their coefficient approximately equal to zero and finally drop them from the model. In this way the overfitting is also reduced.

LASSO is a linear regression that uses shrinkage. Shrinkage means the data values are shrunk towards a central point, such as mean. The LASSO technique encourages simple, sparse models. For example a models which has a few parameters. The main objective of the LASSO is to minimize the prediction error. Whenever there is low accuracy and more than enough irrelevant information in the linear model then we use LASSO. This method applies a shrinking (regularization) process where it penalizes the coefficients of the regression variables shrinking some of them to zero. During features selection process those variables which have still a non-zero coefficient. After the shrinking process they are selected as a part of the model. It is a linear model that estimates sparse coefficients.

3.2.1 Feature Selection

The main purpose of feature selection process is to omit those variables which are redundant, to make the model easier to interpret and to reduce the overfitting. The feature selection is very important task because here the number of variables are very high and sometime the number of

variables are greater than the number of observation. In this case it is not easy to say that which one of the variable is relevant and which one is irrelevant. Therefore the feature selection process has a great importance (Fonti, 2017).

3.2.2 Methodology

A commonly used procedure to find a linear relationship among variables is the linear regression model which involve the minimization of RSS.

$$\boldsymbol{RSS = \sum_{j=1}^{n}(y_i - ß_0 - \sum_{j=1}^{p} ß_j x_{0ij})^2} \qquad \textbf{… (3.1)}$$

But this linear regression model has the problem of variability in the least square fit as the number of variable exceeds the number of observation. The solution is suggested in form of ridge regression. The ridge regression has advantage over OLS because as the penalty λ increases the variance decreases substantially at the expenses of very small increase in bias. Secondly the OLS does not provide unique solution in case of the number of variables is greater than the number of observation. While in this case the ridge regression works well which is given in the bellow equation.

$$\boldsymbol{\sum_{i=1}^{n}(y_i - ß_0 - \sum_{j=1}^{p} ß_j x_{0ij})^2 + \lambda \sum_{j=1}^{p} ß^2_j} \qquad \textbf{… (3.2)}$$

Despite having a lot of advantages the ridge procedure is not free of problem. The problem with Ridge regression is that it tell us to include all the predictors in our final model instead of best subset which leads to shrink all the coefficient toward zero but not exactly equal to zero. Secondly,

for selecting a good value of penalty λ, the ridge regression produces a different set of coefficient for each of λ. To get rid of this problem, a new procedure that is *LASSO which* was introduced by

Robert Tibshirani that is given below.

$$\sum_{i=1}^{n}(y_i - ß_0 - \sum_{j=1}^{p} ß_j x_{0ij})^2 + \quad \lambda \ \sum_{j=1}^{p} |ß_j| \qquad \text{... (3.3)}$$

$$\text{RSS} + \underbrace{\lambda}_{\text{Tuning parameter}} \underbrace{\sum_{j=1}^{p} |ß_j|}_{Penalty} \qquad \text{... (3.4)}$$

We have seen in the above equation (3.2) and (3.3) that Ridge and LASSO regression have same construction but the only difference is that the $ß^2_j$ term in the ridge regression penalty equation (3.2) has been replaced by $|ß_j|$ in the LASSO penalty equation (3.3). In the LASSO equation (3.3) where RSS is residual sum of squares, λ is tuning parameter and $\sum_{j=1}^{p} |ß_j|$ is sum of absolute value of coefficients is the LASSO penalty.

3.2.3 Choosing the Value of the Tuning Parameter(λ)

The tuning parameter(λ) controls the strength of the penalty. The parameter coefficient (ß) correlates with the tuning parameter value. Whenever λ=0 then the penalty term has no effect and we will get the same coefficients as simple linear regression. When $\lambda = \infty$ then all the coefficients are zero. When λ is in between the two extremes ($0 < \lambda < \infty$) then we are balancing the two ideas. Such as; fitting a linear model of Y on X and shrinking the coefficients. The range of tuning parameter is between zero to infinity and it is a crucial value for the identification of the true model. Whenever an intercept is included in the model, then it is left unchanged and in the equation (3.8) the shrinkage penalty is applied to $ß_1, \ldots, ß_p$, but not to the intercept $ß_0$. Moreover, LASSO has a major advantage over ridge regression i.e, it produces simpler and more interpretable models which involve only a subset of in predictors variables. It is a regularization methods that creates parsimonious model in the presence of large number of features. In this way the overfitting is reduced James *et al* (2013).

3.3 Estimation of Specific Model

When there are more than one non stationary time series, then there is the possibility of co-integration among them. ARDL co-integration by Pesran *et al*(2001) is commonly used for the identification of co-integration among the variables and it's details are given bellow.

3.3.1 ARDL Approach

Whenever the variables are integrated of different order then we use Autoregressive Distributed Lag (ARDL). For example, some variables are integrated of I(0) and some are I(1). In this study ARDL approach will be used to study the co-integration relationship between Workers' remittances and its determinants because we are expecting both I(0) and I(1) regressors. This approach capture both short run and long run relationship. It tells us that dependent variable must be stationary at livel or stationary at first difference and other explanatory variables can be either stationary at levels or first difference but no variable in the model should be stationary at I(2).

3.3.1.1 ARDL Model Specification

We have constructed a general model by using y_t as a dependent variable and $x_{1t}, x_{2t}, \dots, x_{nt}$ as independent variables. We also assume that $y_t \sim \mathrm{I}(1)$ and independent variables are either I(1) or I(0). The mathematical representation of the ARDL model is given below.

$$\Delta \boldsymbol{y_t} = \alpha + \sum_{i=1}^{n} ß_{1i}\, \Delta \boldsymbol{y_{t-i}} + \sum_{i=0}^{n} ß_{2i}\, \Delta \boldsymbol{x_{1t-i}} + \sum_{i=0}^{n} ß_{3i}\, \Delta \boldsymbol{x_{2t-i}} + \sum_{i=0}^{n} ß_{4i}\, \Delta \boldsymbol{x_{3t-i}} + \dots + \sum_{i=0}^{n} ß_{ni}\, \Delta \boldsymbol{x_{nt-i}} + \delta_1 \boldsymbol{y_{t-1}} + \delta_2 \boldsymbol{x_{1t-1}} + \delta_3 \boldsymbol{x_{2t-1}} + \delta_4 \boldsymbol{x_{3t-1}} + \delta_5 \boldsymbol{x_{4t-1}} + \dots + \delta_n \boldsymbol{x_{nt-1}} + \varepsilon_t \quad \textbf{... (3.5)}$$

3.3.2 Long run Relationship

For the existence of long run cointegration, we use Bound testing approach. The following null hypothesis is tested against alternative hypothesis. The null hypothesis is that the coefficients of the lagged variables are equal to zero. It means there exists no long run relationship among the variables. Whereas the alternative hypothesis is that at least one of these coefficients is not equal to zero.

The null hypothesis for bound testing is

H_0: $\delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_n = 0$ (no long run relationship exist)

And the alternative hypothesis is

H_0: $\delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq \delta_n \neq 0$ (long run relationship exist)

F-statistic is use to identify the existence of long run relationship among the variables. The computed F-statistic value is compared with the critical values provided by (Pesran *et al*,2001). If the computed F-statistic value is greater than the upper bound I(1) critical value then the null hypothesis will be rejected. It indicates that there exists a long run relationship. If the computed F- statistic value lies below the lower bound I(0) critical value then the null hypothesis will be accepted. It shows that there is no long run relationship exist and if it occurs between the I(0) and I(1) critical value then the result will be inclusive.

3.3.3 Error Correction Mechanism (ECM)

ECM captures the speed of adjustment or it capture convergence in long run after any short run shock or drift. For convergence ECM coefficient must be negative and significant.

$$\Delta \boldsymbol{y_t} = \alpha + \sum_{i=1}^{n} ß_{1i}\, \Delta \boldsymbol{y_{t-i}} + \sum_{i=0}^{n} ß_{2i}\, \Delta \boldsymbol{x_{1t-i}} + \sum_{i=0}^{n} ß_{3i}\, \Delta \boldsymbol{x_{2t-i}} +$$

$$\sum_{i=0}^{n} ß_{4i}\, \Delta \boldsymbol{x_{3t-i}} + \ldots + \sum_{i=0}^{n} ß_{ni}\, \Delta \boldsymbol{x_{nt-i}} - \boldsymbol{\omega}\varepsilon_t + \boldsymbol{v_t} \qquad \textbf{... (3.6)}$$

In the above equation (3.6) **ω** (Omega) the speed of adjustment which should be negative and significant for convergence toward the long run equilibrium.

3.4 Diagnostic Test

During model selection procedure different tests will be used to ensure that the residuals are free from the problem of heteroscedasticity, non-normality and autocorrelation problem. For identifying such kind of problems we use White heteroscedasticity (ARCH) LM test (F-stat.), Jarque Berra test (1980) ($\chi 2$) of normality and Breusch-Godfrey Serial Correlation LM test (1978). Moreover, we detect the stability of the parameters of estimated dynamic ECM with the help of CUSUM and CUSUMSQ which were proposed by Brown, Durbin and Evans in 1975.

3.5 Data Description and Sources

This research is based on the annual time series data over the period of 1975-2017 for Pakistan. Different sources are used for data collection. The detailed description of all variables with data sources is available in the following Table 3.1.

Table 3.1 Data Description

S. No	Variables	Symbol	Definition/ Construction	Source of Data
1	**Workers' Remittances**	WR	The transfer of foreign money by migrated workers to Pakistan.	SBP
2	**Interest rate**	INT	Call money rate.	SBP
3	**Gold prices**	GOLD	Gold prices is define the price of gold in which the gold is traded on gold market.	SBP
4	**Development expenditure**	DEXP	It is the type of expenditure which helps economic and social development of the country. For example the expenditure on education, health etc.	SBP
5	**Major agriculture crops**	McPak	Major agriculture crops are wheat, rice, cotton, sugarcane, maize etc.	SBP
6	**Inflation**	INF	Inflation is the increase in price of goods and services over time in general level. Inflation rate is measured by. CPI_t- CPI_{t-1}/ CPI_t * 100	SBP
7	**Foreign direct investment**	FDI	FDI is the type of investment in which the people or organization of one country invested in company or property of other countries.	SBP
8	**Trade openness**	TO	Trade openness is defined as, the ratio of trade to GDP.	SBP
9	**Exchange rate/Nominal exchange rate**	EXR	Value of the rupees per unit of US dollar	IFS
10	**Stock market performance**	SP	Share prices	IFS

11	**Investment return of Pak**	irPak	$0.8INT_{Pk}+0.2dLn(SP_{Pk})$ Where, INT_{Pk} is interest rate and SP_{Pk} is share prices of Pakistan.	IFS
12	**Investment return of US**	irUS	$0.8INT_{US}+0.2dLn(SP_{US})$ Where, INT_{US} is interest rate and SP_{US} is share prices of US.	IFS
13	**Real Domestic Product**	GDP	It is define as, the total value of final goods and services which are produced inside the boundary of the country in a given period.	WDI
14	**Unemployment**	UM	Unemployment is defined as, the people who want to work but do not have a job.	WDI
15	**Foreign debts**	DEBT	Foreign debt It is a money that one country borrowed from outside country or organization. It is also known as external debt.	WDI
16	**Real effective exchange rate**	REER	It is define as, the nominal effective exchange rate which is divided by a price deflator.	WDI
17	**Secondary school enrolment**	SSEN	Secondary school enrolment is defined as the number of student which are enrolled in secondary school.	WDI
18	**Financial liberalization**	FLIB	The data on **f**inancial liberalization is taken from Shabir (2013). She used the following formula for the construction of financial liberalization. FLIB $= w_1 INR + w_2 CRD + w_3 RSRV + w_4 BNK + w_5 PRD + w_6 SRC + w_7 PRCOM$ Where, FLIB is **f**inancial liberalization**,** INR is interest rate regulation, CRD is credit	Shabir(2013).

			controls, RSRV is reserve requirements, BNK is banking ownership, PRD is prudential regulation measures, SRC is securities market development and PRCOM is pro-competitive measures. The data from 2014 to 2017 on financial liberalization is generated by extrapolation method.	
19	**Job skill index**	sk	The Job skill index is constructed with the help of weighted index of the different skill categories. The formula of Job skill index is given below Kock *et al* (2011) SK=(1/25)*(7*HS+6*HQ+5*S+4*SS+3*U)/(HS+HQ+S+SS+U). Where HS is Highly skilled, HQ is Highly qualified, S is Skilled, SS is Semi-skilled and U is Unskilled.	Bureau of Emigration & Overseas Employment
20	**Wage rate**	W	The amount of wage that is paid to the worker per unit of time.	Bhatti(2018)
21	**Democracy**	DMOC	Democracy is the type of government in which people elect their representatives through elections.	ICRG
22	**Internal Conflict**	ICNF	Internal conflict is define as, the political violence inside the country and its actual influence on the governance.	ICRG
23	**External Conflict**	XCNF	External conflict is define as, the problem such as; diplomatic pressures, trade restrictions etc to the mandatory government from the foreign action to violent external pressure.	ICRG
24	**Law and order situation**	LAOR	Law and order situation is define as the condition when people follow the rule and regulation. There is no violence or threats and the police control all the crime etc.	ICRG

25	**Corruption**	CRRP	The illegal actions by powerful people such as bureaucrats, govt., police etc.	ICRG
26	**Terrorism index**	TIND	*It* is the use of violence and threats for the purpose of achieving political and ideological objectives.	ICRG
27	**Political stability**	PS	Whenever the representative of the govt. change without any threats or violence it is known as political stability.	ICRG
28	**Black Market Premium**	BMP	See detail below	ICRG

28. Black Market Premium(BMP)

Black market premium is define as, the percentage difference between the black market exchange rate and official exchange rate. It is calculated by using the formula.

$$\text{BMP} = (\frac{\text{Parallel exchange rate}}{\text{Official exchange rate}} \text{-1})*100$$

The data of parallel exchange rate are collected from "http://www.carmenreinhart.com". However, this data is available only for the period 1948-2003. The remaining data from 2004 to 2015 is generated by forecasting univariate model of parallel exchange rate and the use of black market exchange rate rating information for Pakistan provided https://knoema.com/EFFI2017/economic-freedom-by-fraser-institute.

According to Box and Jenkins (1970) methodology the suitable model for parallel exchange rate is ARMA (0,1,0).

$$\mathbf{Dlnpex}_t = \mathbf{0.053} \qquad \textbf{... (3.7)}$$

Where, $\text{Dlnpex}_t = \text{lnpex}_t - \text{lnpex}_{t-1}$ therefore, the above equation (3.7) can be written as

$$\mathbf{lnpex_t = 0.053 + lnpex_{t-1}} \quad \textbf{… (3.8)}$$

Where, lnpex_t is the log of parallel exchange rate.

Diagnostic tests

Auto LM lag1 = 0.024	Hetero ARCH lag13.33	Normality= 1.35
P-value= 0.88	P-value=0.07	JB= 0.51
Auto LM lag2=2.17	Hetero ARCH lag=3.47	
P-value=0.34	P-value=0.18	

The forecasted values for parallel exchange rate over the period 2003 to 2017 are provided in Table 3.2.

Table 3.2 Forecasted Values for Parallel Exchange Rate

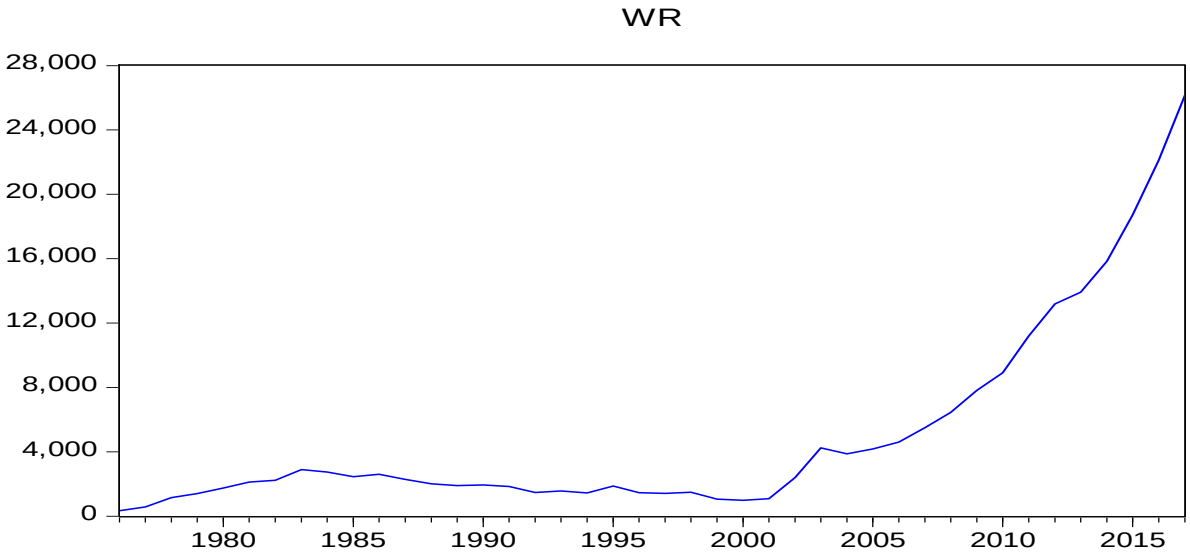
Year	**Forecasted Parallel Exchange Rate** (1)	**Black Market Exchange Rating** (2)	**Nominal Exchange Rate** (3)	**Difference between (3) and (1)**	**Final Forecasted Parallel Exchange Rate**
2003	61.26	8.32	57.22	-4.04	61.26
2004	64.62	8.93	59.12	-5.50	64.62
2005	68.17	8.93	59.83	-8.34	68.17
2006	71.91	9.05	60.92	-10.99	71.91
2007	75.86	9.21	61.22	-14.64	75.86
2008	80.02	9.25	79.10	-0.92	80.02
2009	84.42	10	84.26	-0.16	84.42
2010	89.05	10	85.71	-3.34	89.05
2011	93.94	10	89.97	-3.97	93.94
2012	99.10	10	97.14	-1.96	99.10
2013	104.54	10	105.68	1.14	104.54
2014	110.28	10	100.46	-9.82	102.12
2015	116.33	10	104.87	-11.46	106.53
2016	122.72	10	104.81	-17.91	106.47
2017	129.46	10	108.20	-21.26	109.86

It is cleared from the Table 3.2 that the difference between nominal and forecasted parallel exchange rate is increasing over the time. However, the ranking suggest that both of these should be closed to each other. Thus we may relay on the forecast of parallel exchange rate upto the period 2013. Beyond 2014, to avoid this contradiction we forecate the parallel exchange rate by adding average difference between nominal and forecasted parallel exchange rate having ranking 10 that is -1.65 to the nominal exchange rate series. The final forecasted values are reported in the last column.

3.6 Graphical Analysis

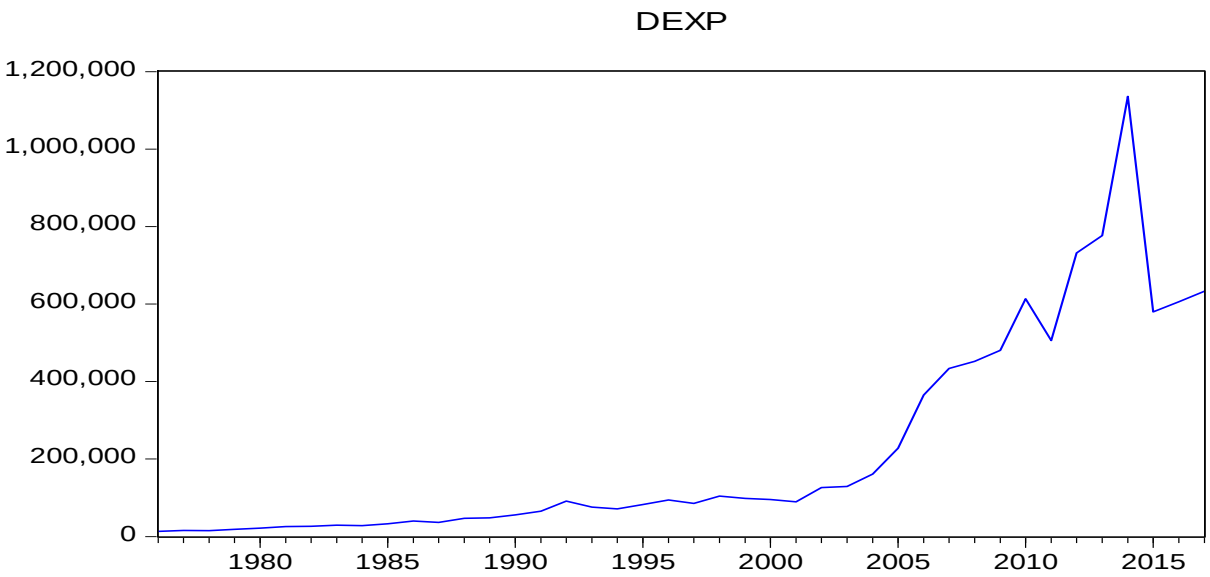
The variables which are used in the study are plotted below.

Figure 3.1 Workers Remittances in Pakistan



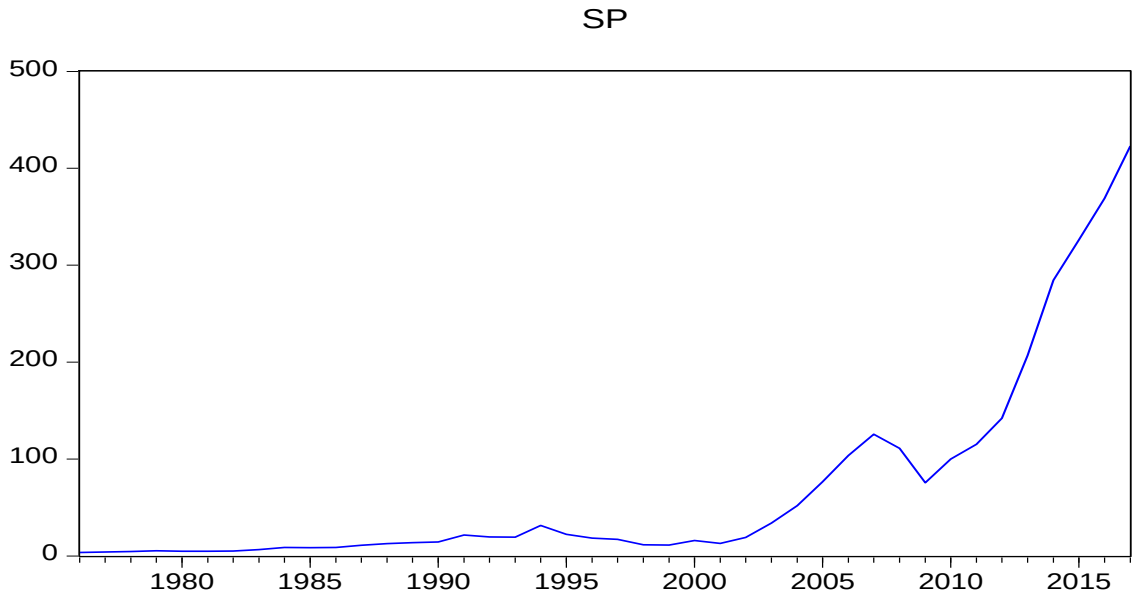
The graph of worker's remittances (WR) in case of Pakistan is presented in Figure 3.1. The data is taken over the period of 1975-2017. The years is along x-axis and WR is shown along y-axis. The worker remittances were lowest in 2000 which were $983 million and highest in 2017 which were $26153 million.

Figure 3.2 Development Expenditure in Pak



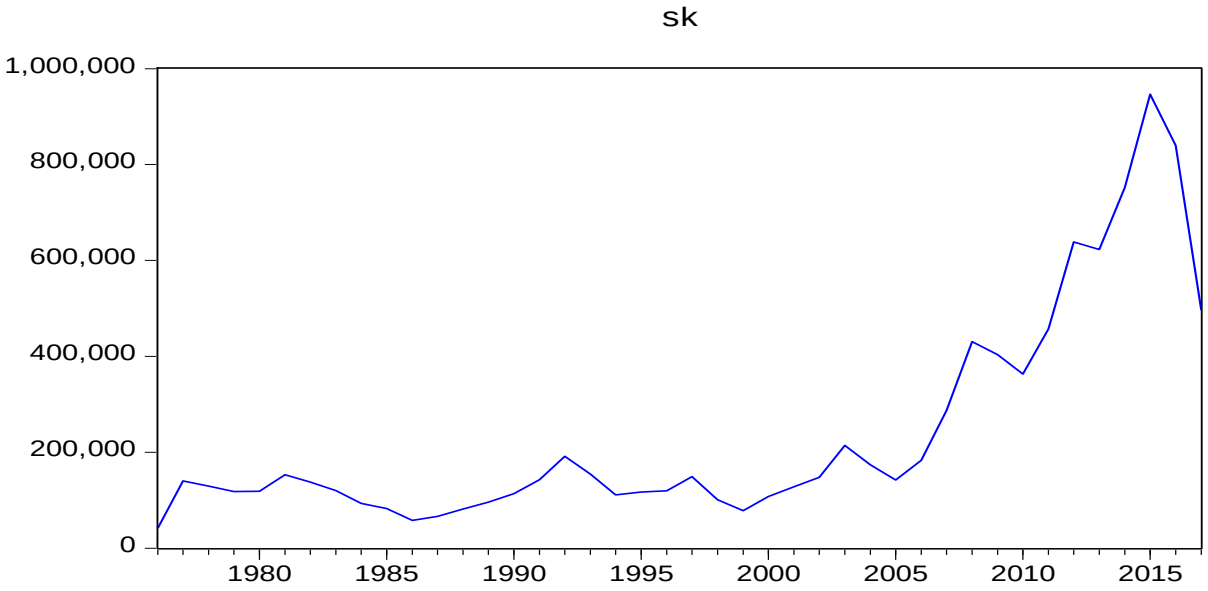
The plot of Development expenditure (DEXP) is displayed in Figure 3.2. The time period from 1975 to 2017 is taken along x-axis and DEXP of the country was shown along vertical axis respectively. During the year 1976, DEXP was lowest which was 13404 million rupees and highest in 2014 which was 1135918 million rupees.

Figure 3.3 Share prices in Pakistan



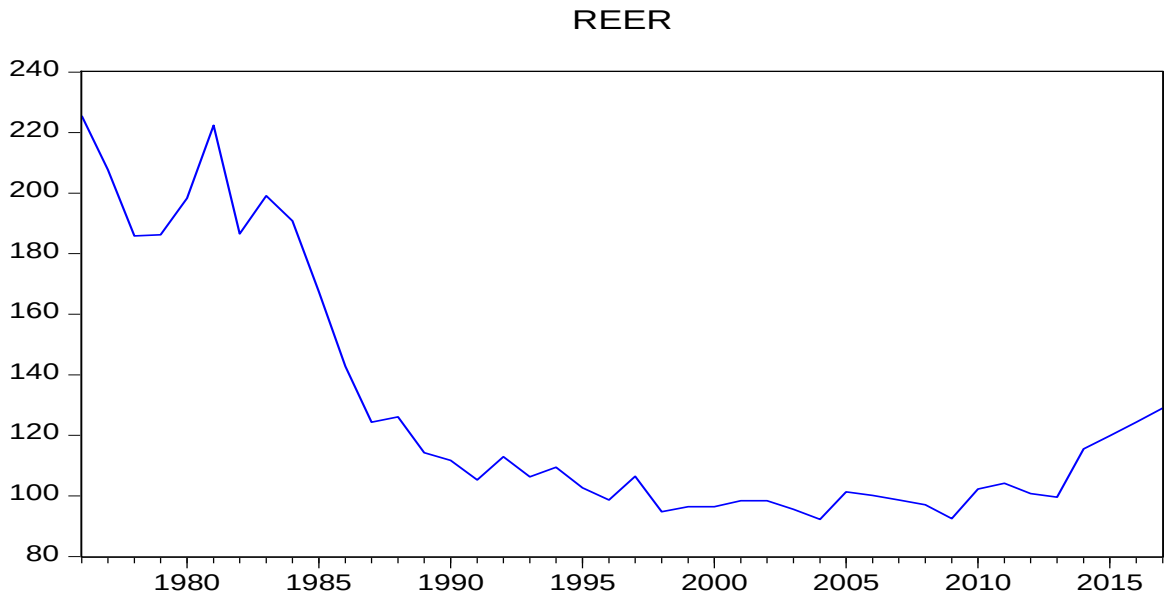
The graph display the Share prices (SP) in Pakistan can be seen in Figure 3.3. The time period is taken from 1976 to 2017 along x- axis and SP is shown along vertical axis. The index value of share prices were lowest in 1976 which were 3 and highest in 2014 which were 423.

Figure 3.4 Job skill index in Pakistan



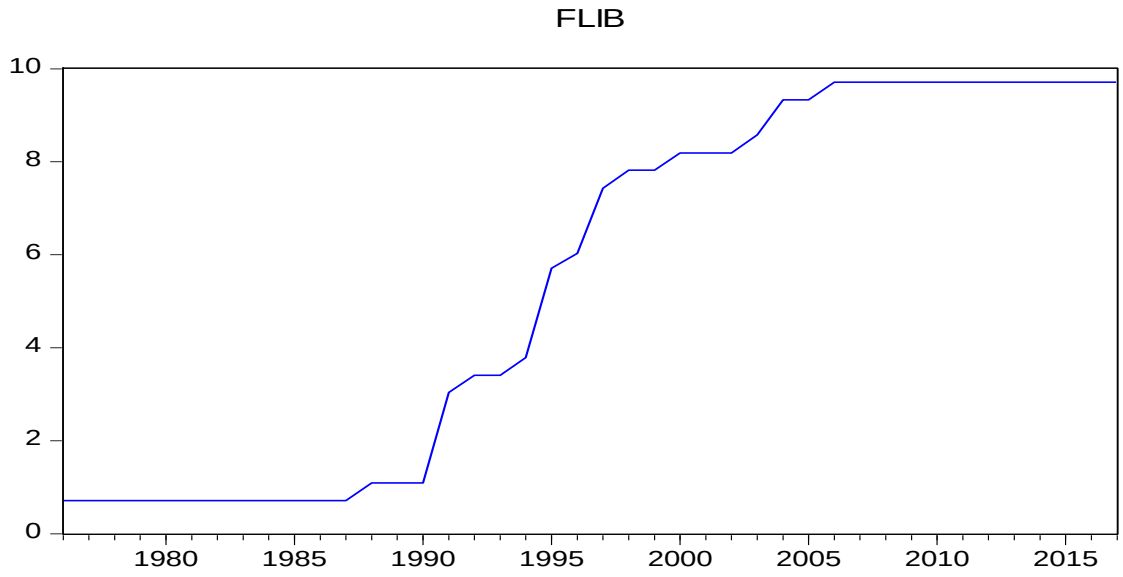
The graph display the Job skill index(sk) which can be seen in Figure 3.4. The time period is taken from 1975 to 2017 along x- axis and the Job skill index of the country is shown along vertical axis. During the year 1976, it was lowest which was 41690 million and highest in 2015 which was 946571 million.

Figure 3.5 Real effective exchange rate in Pakistan



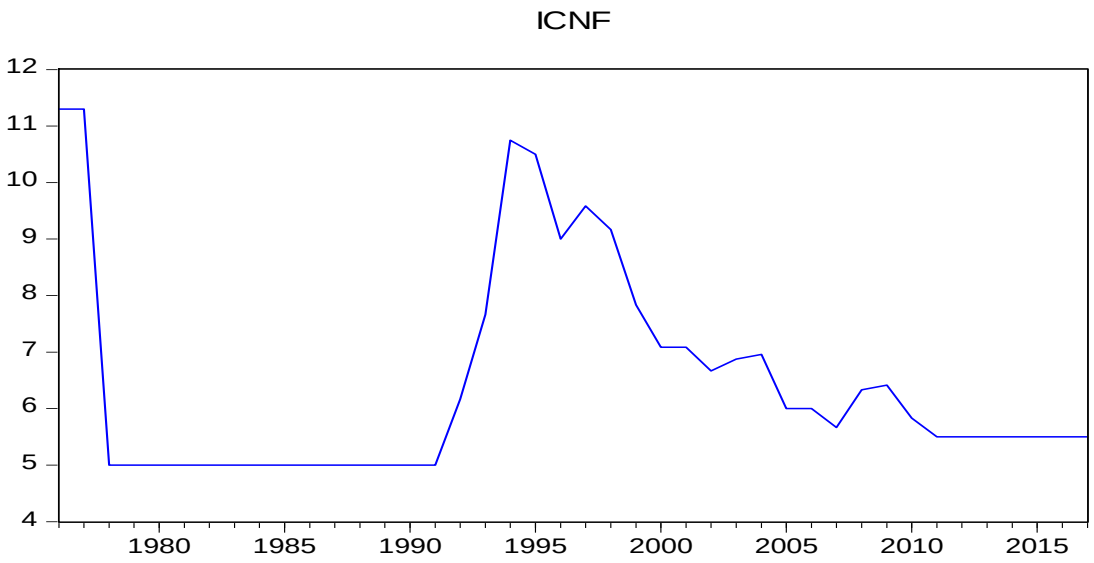
The plot of Real effective exchange rate(REER) in case of Pakistan is displayed in Figure 3.5. The time period from 1975 to 2017 is taken along x-axis and REER of the country was shown along vertical axis respectively. It was lowest in 2004 which was 92% and highest in 1976 which was 225%.

Figure 3.6 Financial Liberalization in Pakistan



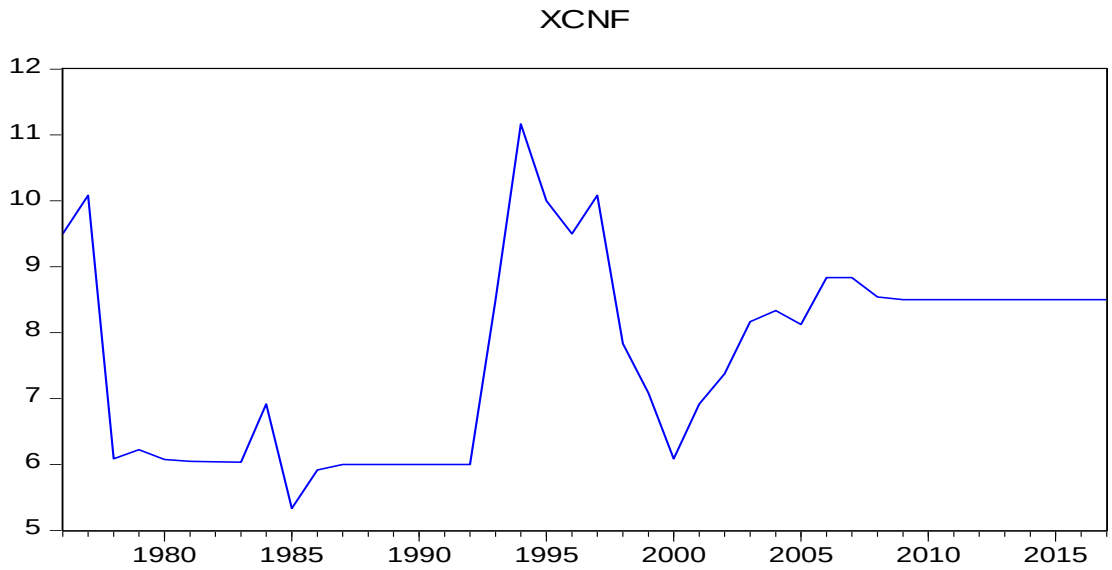
The plot of Financial Liberalization (FLIB) in case of Pakistan is given in Figure 3.6. The data is taken from 1975 to 2017 along x-axis and FLIB of the country was shown along vertical axis respectively. It was lowest in 1976 which was 0.7% and highest in 2017 which was 9.7%.

Figure 3.7 Internal Conflict in Pakistan



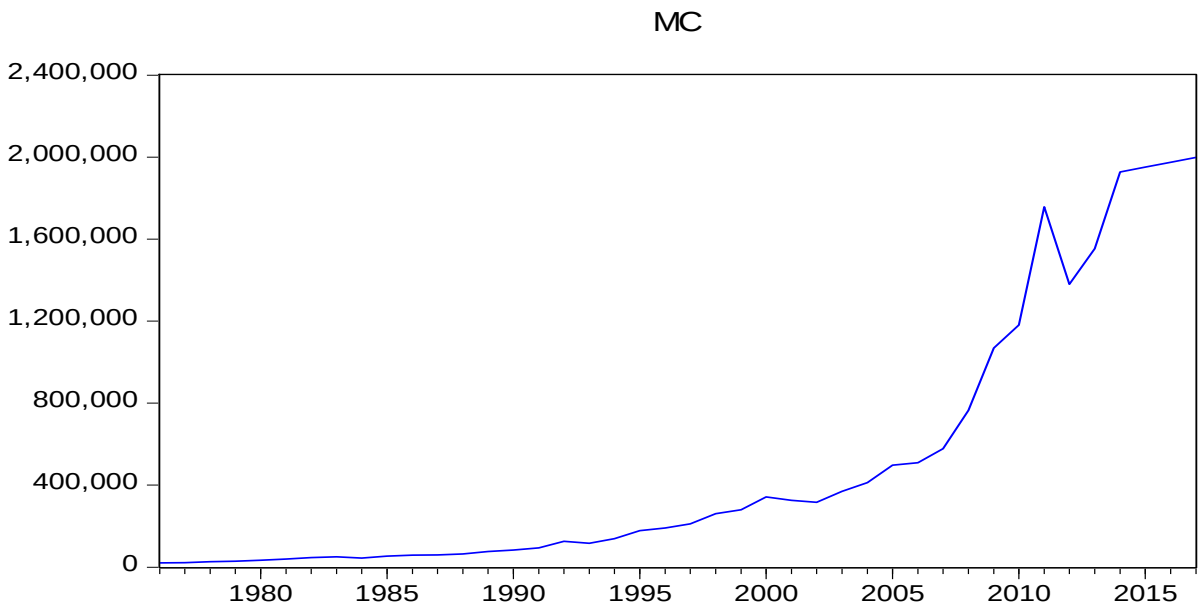
The graph of Internal Conflict (ICNF) in Pakistan is shown in Figure 3.7. The data is used from 1975 to 2017. The years is along x-axis and ICNF is given along y-axis. During the year 1978, ICNF was lowest which was 5% and highest in 1994 which was 10%.

Figure 3.8 External conflict in Pakistan



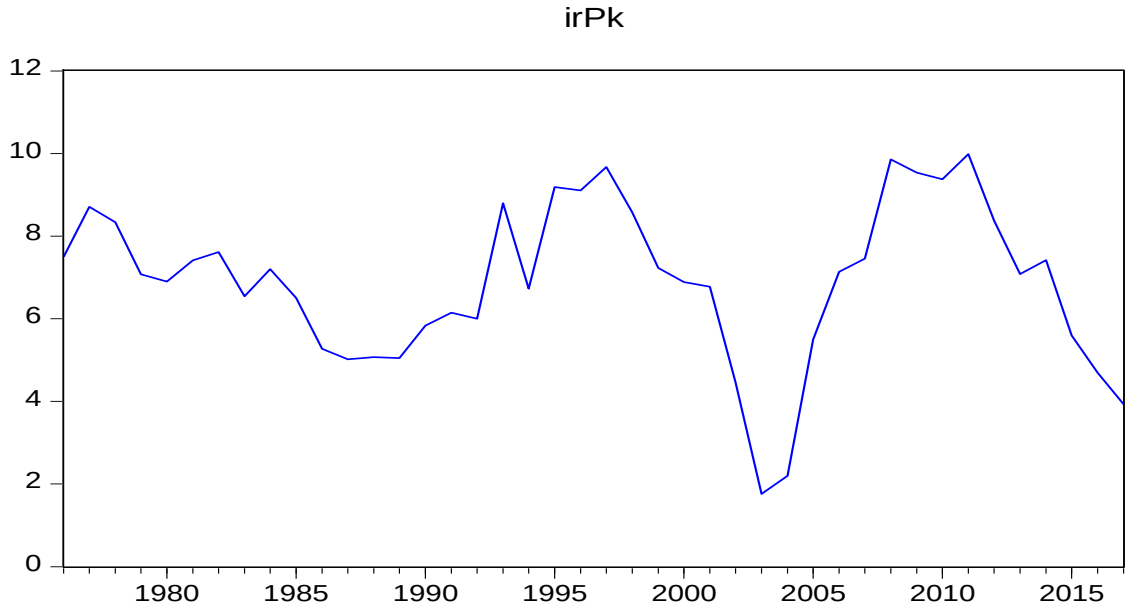
The graph of External conflict (XCNF) to Pakistan is presented in figure 3.8. The period is taken from 1975 to 2017. The years is along x-axis and XCNF is shown along y-axis. XCNF was lowest in 1985 which was 5% and highest in 1994 which was 11%.

Figure 3.9 Major agriculture Crops in Pakistan



The plot of Major agriculture crops(MC) is given in Figure 3.9. The data is taken from 1975 to 2017 along x-axis and MC of the country was shown along vertical axis respectively. MC was lowest in 1976 which was 20572 million rupees and highest in 2017 which was 1998691 million rupees.

Figure 3.10 Investment Return in Pakistan



The plot of Investment Return of Pakistan (irPak) is shown in Figure 3.10. The data is taken from 1975 to 2017 along x-axis and irPak of the country was shown along vertical axis respectively. During the year 2003, the irPak was lowest which was 1% and highest in 2011 which was 11%.

Chapter 4

RESULTS AND DISCUSSIONS

In this study our aim is to identify the potential determinants of workers' remittances by using encompassing and LASSO techniques. Different researchers have built various models in the earlier studies to examine potential determinants of workers' remittances in Pakistan which shows different concepts of workers' remittances. These existing models impose a priory zero restriction on each other. In such a way, one regression model has excluded a relevant variable of the other regression model which create bias and therefore, all the regression models are not valid, because of misspecification. In this chapter we have followed five existing models of workers' remittances by different researchers at national level namely, RM_1, RM_2 ... RM_5. We have applied encompassing and LASSO method to estimate the general model. The general model has extended by adding two variables such as; black market premiums(BMP) and wage rate(w). In this chapter we will find the best suitable model of workers' remittances among the different existing models by using the encompassing and LASSO technique.

4.1 Specifying Model by Using Encompassing Technique

Using encompassing approach, we estimate all the existing models i.e RM_1, RM_2 ... RM_5 to find the general model. First we check the standard error of all the estimated models, then rank all the estimated models according to their standard error and finally we will see that which model has minimum standard error. All possible workers' remittances models (RM_1, RM_2 ... RM_5) which are discussed in the literature review are given as below.

RM_1: Suggested by Kock *et al.* (2011): They studied the determinants of workers' remittances in Pakistan by using OLS and Bayesian approach. In this paper they collected the annual time series

data for the period of 1997-2008. Workers' remittances depends on job-skill index, real effective exchange rate, investment return, nominal exchange rate, and major agricultural crops. The researchers found that Gulf Cooperation Council (GCC) countries plays an important role to rise the remittances of Pakistan.

$$\mathbf{RM_1: WR = f\ (sk, REER, irPak, irUS, McPak, EXR)} \quad \ldots \quad \mathbf{(4.1)}$$

Now we run the regression on the same model on the annual time series data for the period of 1976-2017 and then we get the below results which are provided in the Table 4.1.

Table 4.1 Regression results of RM_1

Dependent variable LWR

	Coefficient	Standard Error	t-value	t-prob
Constant	-8.290	1.945	-4.26	0.000
Lsk	0.324	0.186	1.74	0.091
LREER	-0.104	0.466	-0.223	0.825
irPak	-0.100	0.029	-3.44	0.001
irUS	0.026	0.037	0.704	0.486
McPak	1.796	0.386	4.66	0.000
LEXR	-2.393	0.690	-3.47	0.001
Std. Error	RSS	R^2	F(6,35)	
0.351	4.319	0.896	50.47[0.000]**	

RM_2 :suggested by Kamran *et al* (2014): They analyzed the effects of multi variables (like, GDP, exchange rate, interest rate, inflation and FDI) on the movement of workers' remittances in Pakistan by using OLS method. The yearly time series data are collected from 1990 to 2010. They found that GDP, exchange rate and FDI are seemed the main determinants of workers'

remittances. They also concluded that GDP and FDI have positive and significant while interest rate and variation in inflation have negative influence on workers' remittances in Pakistan.

$$\mathbf{RM_2: WR = f\ (GDP, EXR, INT, INF, FDI)} \quad \ldots \quad \mathbf{(4.2)}$$

The regression results of above model on the annual time series data for the period 1976-2017 are provided in Table 4.2.

Table 4.2 Regression results of RM_2

Dependent variable LWR

	Coefficient	Standard Error	t-value	t-prob
Constant	-5.662	2.024	-2.80	0.008
LGDP	6.175	1.123	5.50	0.000
LEXR	-2.005	0.720	-2.79	0.009
INT	0.038	0.049	0.773	0.445
INF	-0.001	0.036	-0.028	0.978
LFDI	-0.467	0.156	-2.99	0.005
Std.Error	RSS	R^2	F(5,36)	
0.532	10.179	0.756	22.29[0.000]**	

RM_3: suggested by Ullah *et al* (2015): They studied the long run association between terrorism and remittances in Pakistan. In this paper the yearly time series data are collected from 1995 to 2013. For identifying the long and short run association between terrorism and remittances in Pakistan they used Johanson co-integration approach and ECM. They found that workers' remittances of Pakistan depends on GDP, exchange rate, unemployment, inflation, trade openness and terrorism index.

$$\mathbf{RM_3}: \mathbf{WR} = \mathbf{f}(\mathbf{GDP}, \mathbf{EXR}, \mathbf{UM}, \mathbf{INF}, \mathbf{TO}, \mathbf{TIND}) \quad \ldots \quad \mathbf{(4.3)}$$

The regression results of above model on the annual time series data for the period 1976-2017 are provided in Table 4.3.

Table 4.3 Regression results of RM_3

Dependent variable LWR

	Coefficient	Standard Error	t-value	t-prob
Constant	6.334	3.832	1.65	0.108
LGDP	5.162	1.005	5.13	0.000
LEXR	-2.492	0.734	-3.39	0.002
UM	-0.095	0.090	-1.06	0.297
INF	0.018	0.030	0.583	0.564
LTO	-2.799	1.011	-2.77	0.009
LTIND	-0.028	0.110	-0.256	0.799

Std.Error	RSS	R^2	F(6,35)
0.523	9.591	0.770	19.52 [0.000]**

RM_4: suggested by Alam *et al.* (2017): They used the Johansen co-integration method and ECM to identify the long and short run association among the variables in the model. They found the relationship of seven variables namely, GDP, interest rate, exchange rate, gold prices, development expenditures, stock market performance and political stability with workers' remittances in case of Pakistan. In this paper they collected the yearly time series data from 1975 to 2016. They concluded that GDP, development expenditures, gold prices, and political stability are positive while interest, unemployment and inflation rate are negatively related to workers' remittances.

$$\mathbf{RM_4: WR = f\ (GDP, INT, EXR, GOLD, DEXP, SP, PS)} \quad \ldots \quad \mathbf{(4.4)}$$

The regression results of above model on the annual time series data for the period 1976-2017 are provided in Table 4.4.

Table 4.4 Regression results of RM_4

Dependent variable LWR

	Coefficient	Standard Error	t-value	t-prob
Constant	-6.129	3.109	-1.97	0.057
LGDP	3.214	1.342	2.40	0.022
INT	-0.059	0.029	-2.05	0.048
LEXR	-2.831	0.738	-3.84	0.001
LGOLD	1.053	0.289	3.65	0.001
LDEXP	0.208	0.360	0.576	0.569
LSP	-0.079	0.236	-0.336	0.739
LPS	0.259	0.218	1.19	0.244
Std.Error	RSS	R^2	F(7,34)	
0.359	4.382	0.895	41.35 [0.000]**	

RM_5: suggested by Abbas(2017): He collected time series data from 1972 to 2012 and examined the generalized method of moments method to study the influence of macroeconomic, financial and political factors on remittances to Pakistan. They analyzed the effects of multi variables such as, real domestic product, inflation rate, secondary school enrollment, Job skill index, real effective exchange rate, dummy variable, financial liberalization index, democracy, internal conflicts, external conflict, law and order situation, corruption, government stability and foreign debts on workers' remittances of Pakistan. They empirically concluded that macroeconomics,

political and financial variables of Pakistan have significantly while inflation and government debt have negative and significantly influence on workers' remittances. It was also analyzed that external conflicts, law and order and corruption have positive relationship with remittances.

$$\mathbf{RM_5: WR = f\ (GDP, INT, INF, SSEN, sk, REER, FLIB, DMOC, ICNF, XCNF, LAOR, CRRP, PS, DEBT)\ \ldots\ (4.5)}$$

The regression results of above model on the annual time series data for the period 1976-2017 are provided in Table 4.5.

Table 4.5 Regression results of RM_5

Dependent variable LWR

	Coefficient	Standard Error	t-value	t-prob
Constant	-12.131	3.051	-3.98	0.001
LGDP	2.524	0.422	5.99	0.000
INT	-0.019	0.021	-0.899	0.377
INF	0.025	0.015	1.64	0.113
LSSEN	0.213	1.003	0.213	0.833
Lsk	0.308	0.114	2.70	0.012
LREER	0.740	0.333	2.23	0.035
LFLIB	-0.641	0.155	-4.14	0.000
DMOC	0.190	0.068	2.81	0.009
ICNF	-0.186	0.071	-2.63	0.014
XCNF	0.115	0.085	1.37	0.184
LAOR	-0.213	0.143	-1.49	0.148
CRRP	-0.214	0.146	-1.47	0.153
LPS	0.635	0.202	3.14	0.004
LDEBT	0.406	0.340	1.19	0.243

Std.Error	RSS	R^2	F(15,26)
0.183	0.872	0.979	81.13 [0.000]**

The standard errors of all the above estimated models are given in the below Table 4.6. Here we want to see that which of the estimated model has minimum standard error.

Table 4.6 Standard. Errors of all Existing Models

Model	**Std.Error**
RM_1	0.351
RM_2	0.532
RM_3	0.523
RM_4	0.359
RM_5	0.183

It has observed from the above Table 4.6, that RM_5 has the minimum standard error i.e 0.183 as compared to the all other estimated models. So, the RM_5 is our best model in all the existing models. While using encompassing approach we must check whether RM_5 encompasses all the other existing models or not. When RM_5 encompasses all the other existing models, than it means that the prediction power of all existing models which are encompassed by RM_5, is already presented in RM_5. So, we ignore all those existing models which are encompassed by RM_5. On the other hand, if the RM_5 does not encompass a model, then we cannot ignore that model. Therefore, all those existing models which do not encompass by RM_5 will be put aside. Then we will take union of independent variables of RM_5 and all the other existing models which are not encompassed by RM_5. Finally, in this way we get a generalized unrestricted model.

Now we have to test whether RM_5 encompasses RM_i or not where $i \neq 5$. By using Cox test the result are reported in Table 4.7

Table 4.7 Encompassing Results

RM_5 encompasses RM_i	**Cox test (P-values)**
RM_5 encompasses RM_1	-1.705[0.088]
RM_5 encompasses RM_2	0.381[0.703]
RM_5 encompasses RM_3	1.097[0.273]
RM_5 encompasses RM_4	-0.106[0.915]

The results of the above Table 4.7 indicates that p-value of all the tests is greater than 0.05. Therefore, we are fail to reject H_0 in all the cases. So, RM_5 encompasses all the existing models and we consider RM_5 as our general model.

$$\mathbf{LWR = f(LGDP, INF, INT, LSSEN, Lsk, LREER, LFLIB, ICNF, XCNF, LAOR, CRRP, LPS, LDEBT)} \quad \mathbf{\dots (4.6)}$$

4.1.1 General to Specific Model

In the encompassing approach we have observed that RM_5 has the minimum standard error and encompasses the rest of the existing models. Therefore, we consider the RM_5 as our best model. Finally, we make our general model with the help of RM_5 and include two variables i.e black market premiums (BMP) and wage rate (W) from the international literature. Now we check the significance of all variables in the general model. In the general model there may be such independent variables which may have insignificant impact on the dependent variable. We omit all those independent variables which have insignificant impact on the dependent variable.

$$\mathbf{LWR = f(LGDP, INF, INT, LSSEN, Lsk, LREER, LFLIB, DMOC, ICNF, XCNF, LAOR, CRRP, LPS, LDEBT, BMP, LW)} \quad \mathbf{\dots (4.7)}$$

Table 4.8 Steps of General to Specific Model

Variable	Step:1	Step:2	Step:3	Step:4	Step:5	Step:6	Step:7	Step:8
	t-value	t-value	t-value	t-value	t-value	t-value	t-value	t-value
LWR_1	0.818 (0.440)	2.35 (0.043)	2.62 (0.024)	3.17 (0.008)	2.78 (0.014)	3.92 (0.001)	4.43 (0.000)	5.86 (0.000)
Constant	-1.18 (0.275)	-1.34 (0.214)	-1.55 (0.150)	-1.42 (0.180)	-2.28 (0.038)	-1.85 (0.082)	-1.58 (0.130)	-2.98 (0.007)
LGDP	-0.265 (0.799)	-0.518 (0.617)	-0.707 (0.495)	-1.53 (0.149)	**-0.338 (0.740)**	—	—	—
LGDP_1	0.620 **(0.555)**	0.783 (0.454)	0.984 (0.346)	1.71 (0.111)	**0.645 (0.528)**	—	—	—
INT	-1.23 (0.257)	-0.736 (0.480)	0.749 (0.469)	**-1.40 (0.186)**	—	—	—	—
INT_1	0.571 (0.586)	-0.091 (0.929)	-0.304 (0.767)	**-0.326 (0.749)**	—	—	—	—
INF	0.932 (0.382)	**0.366 (0.723)**	—	—	—	—	—	—
INF_1	0.149 (0.886)	**0.022 (0.983)**	—	—	—	—	—	—
LSSEN	-0.737 (0.485)	-0.307 (0.766)	-0.415 (0.686)	-0.330 (0.746)	-1.35 (0.195)	-1.29 (0.215)	-1.56 (0.134)	-1.53 (0.142)
LSSEN_1	0.291 (0.779)	0.869 (0.407)	0.923 (0.376)	1.17 (0.265)	1.58 (0.135)	1.84 (0.084)	2.08 (0.051)	2.76 (0.012)
Lsk	0.603 (0.566)	0.781 (0.455)	**0.866 (0.376)**	—	—	—	—	—
Lsk_1	0.759 (0.473)	0.170 (0.869)	**0.230 (0.823)**	—	—	—	—	—
LREER	-0.085 (0.934)	0.054 (0.958)	0.075 (0.942)	0.252 (0.805)	-0.248 (0.807)	-0.743 (0.468)	-0.555 (0.586)	-0.160 (0.874)
LREER_1	2.79	2.46	2.90	3.05	3.33	3.12	3.13	3.35

	(0.027)	(0.036)	(0.015)	(0.009)	(0.005)	(0.006)	(0.006)	(0.003)
LFLIB	0.569 (0.587)	1.30 (0.225)	1.47 (0.169)	1.52 (0.153)	1.95 (0.070)	2.19 (0.043)	2.15 (0.044)	3.17 (0.005)
LFLIB_1	-1.20 (0.270)	-0.510 (0.622)	-0.654 (0.526)	-0.789 (0.444)	-0.878 (0.393)	-0.843 (0.411)	-1.08 (0.292)	-0.967 (0.345)
DMOC	1.13 (0.295)	0.751 (0.472)	0.987 (0.345)	1.10 (0.292)	1.37 (0.190)	1.16 (0.262)	1.11 (0.280)	1.02 (0.321)
DMOC_1	-0.129 (0.901)	-1.64 (0.136)	-1.99 (0.072)	-1.84 (0.089)	-1.85 (0.085)	-2.11 (0.050)	-1.98 (0.063)	-2.05 (0.053)
ICNF	-1.26 (0.250)	-1.12 (0.291)	-1.17 (0.268)	-1.27 (0.228)	-1.87 (0.081)	-1.89 (0.076)	-2.67 (0.015)	-3.61 (0.002)
ICNF_1	-0.492 (0.638)	-0.670 (0.520)	-0.985 (0.346)	-0.959 (0.355)	-1.80 (0.092)	-1.46 (0.163)	-1.74 (0.098)	-1.78 (0.090)
XCNF	0.576 (0.583)	0.756 (0.469)	0.756 (0.466)	0.630 (0.540)	1.76 (0.099)	2.25 (0.038)	2.28 (0.034)	3.37 (0.003)
XCNF_1	0.888 (0.404)	1.20 (0.261)	1.95 (0.077)	2.30 (0.039)	1.97 (0.068)	1.50 (0.152)	1.58 (0.131)	1.41 (0.172)
LAOR	-0.781 (0.460)	-0.936 (0.374)	-0.948 (0.363)	-1.33 (0.205)	-1.80 (0.092)	-2.21 (0.041)	-2.10 (0.049)	-2.37 (0.028)
LAOR_1	-0.139 (0.894)	0.824 (0.431)	0.819 (0.430)	0.488 (0.633)	1.64 (0.121)	2.00 (0.061)	1.90 (0.073)	2.57 (0.018)
CRRP	-0.497 (0.634)	-0.741 (0.478)	-0.961 (0.357)	-1.27 (0.227)	-1.76 (0.099)	-1.36 (0.193)	-2.37 (0.029)	-2.53 (0.020)
CRRP_1	0.371 (0.722)	1.60 (0.143)	1.94 (0.079)	1.86 (0.086)	1.63 (0.125)	1.41 (0.176)	1.40 (0.177)	2.30 (0.032)
LPS	**-0.118 (0.909)**	—	—	—	—	—	—	—
LPS_1	**1.59 (0.157)**	—	—	—	—	—	—	—
LDEBT	-0.989	-1.01	-1.08	-1.16	-0.529	**-0.516**	—	—

	(0.356)	(0.341)	(0.302)	(0.266)	(0.605)	**(0.612)**		
LDEBT_1	0.819 (0.440)	0.955 (0.364)	1.08 (0.304)	0.738 (0.474)	1.36 (0.195)	**1.18** **(0.253)**	__	__
LW	-0.560 (0.593)	-1.17 (0.274)	-1.32 (0.212)	-1.32 (0.210)	-0.732 (0.475)	-0.800 (0.435)	**-0.695** **(0.496)**	__
LW_1	0.650 (0.536)	0.952 (0.366)	1.11 (0.289)	1.31 (0.214)	0.671 (0.512)	0.919 (0.371)	**0.928** **(0.365)**	__
BMP	-0.336 (0.747)	0.344 (0.739)	0.447 (0.663)	0.377 (0.713)	0.626 (0.541)	0.568 (0.578)	0.387 (0.703)	0.074 (0.942)
BMP_1	-1.25 (0.251)	-1.02 (0.336)	-1.15 (0.276)	-1.50 (0.157)	-2.21 (0.043)	-2.25 (0.039)	-3.38 (0.003)	-4.66 (0.000)

Value in round bracket represents the P-value

In general to specific methodology we exclude the variables on the basis of joint restrictions. First we choose the highly insignificant level or lagged level variable on the basis of t- value and p-value then impose joint restrictions via F- test. With null hypothesis both level and lagged level variables are insignificant against alternative at least one of these is significant. If we fail to reject the null hypothesis then we retain the variable in the model otherwise drop it from the model. The result of insignificant variables are given in the following Table 4.9.

Table 4.9 Insignificant Variables

Step	Variable	Lag	F-test	Remarks
Step 1	LPS	LPS_1	1.263[0.340]	Excluded
Step 2	INF	INF_1	0.074[0.929]	Excluded
Step 3	Lsk	Lsk_1	0.549[0.593]	Excluded
Step 4	INT	INT_1	1.527[0.254]	Excluded
Step 5	LGDP	LGDP_1	1.197[0.330]	Excluded
Step 6	LDEBT	LDEBT_1	0.809[0.462]	Excluded
Step 7	LW	LW_1	0.650[0.533]	Excluded

After the exclusion of insignificant variables the final specific model under encompassing is given in the following equation (4.8).

$$\mathbf{LWR = \alpha + \beta_1 LSSEN + \beta_2 LREER + \beta_3 LFLIB + \beta_4 DMOC + \beta_5 ICNF + \beta_6 XCNF + \beta_7 LAOR + \beta_8 CRRP + \beta_9 BMP + \varepsilon_t} \quad \ldots \quad \mathbf{(4.8)}$$

4.2 Specifying Model by Using LASSO Technique

In this section our objective is to use the LASSO technique to find the best suitable model of workers' remittances in Pakistan. LASSO regression is a powerful method which performs two main responsibilities such as; the regularization and the feature selection. We use this technique when there is more independent variables and high multicollinearity in the model. In this model when the variables are insignificant or do not have relationship with the response variable then the lasso makes their coefficient approximately equal to zero and finally drop them from the model. The objective of the LASSO is to minimize the prediction error. Moreover, the main purpose of feature selection process is to omit those variables which are redundant, to make the model easier to interpret and to reduce the overfitting. The feature selection is very important

task because here the number of variables are very high and sometime the number of variables are greater than the number of observation. In this case it is not easy to say that which one of the variable is relevant and which one is irrelevant. Therefore the feature selection process has a great importance.

In this study our aim is to identify the potential determinants of workers' remittances by using LASSO method. We have considered the determinants of workers' remittances provided by the five models(namely, RM_1, RM_2 ... RM_5) in case of Pakistan along with black market premiums(BMP) and wage rate(W) from international literatures and to check whether these all determinants have significant or insignificant impact on workers' remittances of Pakistan.

4.2.1 Computations

To perform the computation of the model we have used R. The glmnet package is used for the LASSO computation. To use coordinate descent method we fit the command of glmnet. To choose the non-zero coefficients and best lambda(λ) by cross-validation, we use the following codes.

```
out=glmnet(x,y,alpha=1,lambda=grid)
lasso.coef=predict(out,type="coefficients",s=bestlam)[1:28,]
lasso.coef
bestlam.
```

4.2.2 The Value of Tuning Parameter(λ)

The tuning parameter(λ) controls the strength of the penalty. The parameter coefficient (ß) correlates with the λ value. As increasing the value of λ, the more coefficients are set to be equal to zero and in this situation only few variables are selected for our model. The range of tuning

parameter is between zero to infinity and it is a crucial value for the identification of the true model. Moreover, LASSO is a feature selection process which helps us to make a general model. In our case we choose the value of λ and select the non-zero coefficients with the help of cross validation (Cross validation is often used to choose the value of λ for the LASSO estimator). In such away we get the general model which is shown in the following Table 4.10. In the general model the lambda(λ) value is equal to 0.014 and fourteen non-zero coefficients have been selected.

Table 4.10 Non-zero coefficients & values (λ=0.014)

Variable	**Coefficient**	**Variable**	**Coefficient**
INF	0.001	DMOC	0.073
LDEXP	0.067	ICNF	-0.200
LSP	0.265	XCNF	0.046
LSSEN	1.285	LAOR	0.071
Lsk	0.154	CRRP	-0.083
LREER	0.432	LMcPak	0.155
LFLIB	-0.061	irPak	-0.030

4.2.3 General to Specific Model

In the general model we check the significance of all variables and there may be such independent variables which may have insignificant impact on the dependent variable. We omit all those independent variables which have insignificant impact on the dependent variable. In case of LASSO the general model of workers' remittances is given in the following equation (4.9)

$$\mathbf{LnWR = f(INF, LDEXP, LSP, LSSEN, Lsk, LREER, LFLIB, DMOC, ICNF, XCNF, LAOR, CRRP, LMcPak, irPak)} \quad \mathbf{\ldots\ (4.9)}$$

Table 4.11 Steps of General to Specific Model

Variable	Step:1	Step:2	Step:3	Step:4	Step:5	Step:6
	t-value	t-value	t-value	t-value	t-value	t-value
LWR_1	-1.29 (0.224)	-0.469 (0.647)	0.149 (0.884)	0.268 (0.792)	0.303 (0.765)	0.555 (0.585)
Constant	-2.35 (0.038)	-1.73 (0.107)	-2.27 (0.039)	-2.51 (0.023)	-2.71 (0.014)	-4.03 (0.001)
INF	0.694 (0.502)	0.747 (0.469)	**0.478** **(0.640)**	—	—	—
INF_1	-1.57 (0.146)	-0.482 (0.638)	**-0.062** **(0.951)**	—	—	—
LDEXP	2.61 (0.024)	1.94 (0.074)	2.06 (0.057)	2.24 (0.039)	2.25 (0.037)	2.21 (0.038)
LDEXP_1	1.04 (0.321)	1.05 (0.313)	0.673 (0.511)	0.591 (0.563)	0.321 (0.752)	0.375 (0.711)
LSP	-2.59 (0.025)	-1.67 (0.119)	-1.89 (0.079)	-2.24 (0.039)	-2.26 (0.036)	-2.40 (0.026)
LSP_1	1.54 (0.151)	0.804 (0.436)	0.654 (0.523)	0.799 (0.435)	0.548 (0.590)	0.810 (0.427)
LSSEN	-1.14 (0.280)	-0.501 (0.625)	-0.183 (0.857)	-0.306 (0.763)	**-0.083** **(0.935)**	—
LSSEN_1	0.316 (0.758)	0.266 (0.795)	0.765 (0.456)	0.891 (0.385)	**0.735** **(0.472)**	—
Lsk	-1.66 (0.125)	-1.10 (0.292)	-0.828 (0.420)	-0.777 (0.448)	-0.633 (0.535)	-0.598 (0.556)
Lsk_1	1.47 (0.169)	1.84 (0.089)	1.75 (0.101)	1.84 (0.083)	2.13 (0.047)	2.31 (0.031)
LREER	-0.252 (0.806)	-0.735 (0.475)	-0.418 (0.682)	-0.412 (0.685)	-0.305 (0.764)	-0.130 (0.898)
LREER_1	2.60	2.01	1.81	1.89	2.01	1.99

	(0.025)	(0.065)	(0.090)	(0.077)	(0.059)	(0.060)
LFLIB	-0.693 (0.503)	-0.089 (0.931)	0.043 (0.966)	0.134 (0.895)	0.117 (0.908)	-0.056 (0.956)
LFLIB_1	-2.22 (0.048)	-2.00 (0.067)	-2.40 (0.030)	-2.66 (0.017)	-2.55 (0.020)	-2.61 (0.016)
DMOC	0.532 (0.605)	**1.02** **(0.327)**	—	—	—	—
DMOC_1	1.30 (0.219)	**0.233** **(0.820)**	—	—	—	—
ICNF	-3.08 (0.011)	-1.98 (0.070)	-2.38 (0.031)	-2.51 (0.022)	-4.05 (0.001)	-4.19 (0.001)
ICNF_1	-1.66 (0.126)	-1.17 (0.263)	-1.22 (0.242)	-1.65 (0.117)	-2.06 (0.054)	-2.14 (0.044)
XCNF	2.62 (0.024)	1.26 (0.229)	2.28 (0.038)	2.70 (0.015)	4.06 (0.001)	4.14 (0.004)
XCNF_1	2.15 (0.054)	1.35 (0.200)	1.83 (0.087)	2.19 (0.043)	2.33 (0.031)	2.47 (0.022)
LAOR	**-0.270** **(0.792)**	—	—	—	—	—
LAOR_1	**-1.58** **(0.142)**	—	—	—	—	—
CRRP	-0.930 (0.372)	-1.05 (0.313)	-0.559 (0.584)	**-0.817** **(0.425)**	—	—
CRRP_1	-0.648 (0.530)	-0.610 (0.552)	-0.289 (0.777)	**-0.127** **(0.900)**	—	—
LMcPak	2.37 (0.037)	1.17 (0.263)	1.24 (0.235)	1.50 (0.151)	1.86 (0.079)	1.90 (0.072)
LMcPak_1	1.09 (0.298)	0.567 (0.581)	0.587 (0.566)	0.584 (0.567)	0.368 (0.717)	0.504 (0.620)
irPak	-3.02	-2.10	-2.49	-3.07	-3.04	-3.22

	(0.015)	(0.055)	(0.025)	(0.007)	(0.007)	(0.004)
irPak_1	-0.205 (0.841)	-0.315 (0.758)	-0.616 (0.547)	-0.796 (0.437)	-1.13 (0.273)	-1.20 (0.243)

Values in round bracket represents the P-value

In general to specific methodology we exclude the variables on the basis of joint restrictions. First we choose the highly insignificant level or lagged level variable on the basis of t- value and p-value then impose joint restrictions via F- test. With null hypothesis both level and lagged level variables are insignificant against alternative at least one of these is significant. If we fail to reject the null hypothesis then we retain the variable in the model otherwise drop it from the model. The result of insignificant variables are given in the following Table 4.12.

Table 4.12 Insignificant Variables

Step	**Variable**	**Lag**	**F-test**	**Remarks**
Step 1	LAOR	LAOR_1	2.602 [0.119]	Excluded
Step 2	DMOC	DMOC_1	0.610 [0.558]	Excluded
Step 3	INF	INF_1	0.119 [0.889]	Excluded
Step 4	CRRP	CRRP_1	0.541 [0.592]	Excluded
Step 5	LSSEN	LSSEN_1	0.285 [0.755]	Excluded

After the exclusion of insignificant variables the final specific model of LASSO is given in the following equation (4.10).

$$\mathbf{LWR} = \boldsymbol{\alpha} + \boldsymbol{\beta_1}\mathbf{LDEXP} + \boldsymbol{\beta_2}\mathbf{LSP} + \boldsymbol{\beta_3}\mathbf{Lsk} + \boldsymbol{\beta_4}\mathbf{LREER} + \boldsymbol{\beta_5}\mathbf{LFLIB} + \boldsymbol{\beta_6}\mathbf{ICNF} + \boldsymbol{\beta_7}\mathbf{XCNF} + \boldsymbol{\beta_8}\mathbf{LMcPak} + \boldsymbol{\beta_9}\mathbf{irPak} + \boldsymbol{\varepsilon_t} \quad \ldots \quad \mathbf{(4.10)}$$

4.3 Final Model for Workers' Remittances

Now we choose the final model for workers' remittances from the above selected specific models from encompassing($RM_{Encompassing}$) and LASSO (RM_{LASSO}) in equation (4.8) and (4.10). First rank the models according to their minimum standard error provided in the Table 4.13.

Table 4.13 Standard. Errors of Models

Model	**standard Error**
$RM_{Encompassing}$	0.323
RM_{LASSO}	0.214

It has been observed from the above Table 4.13, that RM_{LASSO} has the minimum standard Error i.e 0.214 as compared to the $RM_{Encompassing}$. So, the RM_{LASSO} is our best model in the above two models. While using encompassing approach we must check whether RM_{LASSO} encompasses the $RM_{Encompassing}$ or not. When RM_{LASSO} encompasses $RM_{Encompassing}$, than it means that the prediction power of $RM_{Encompassing}$ which are encompassed by RM_{LASSO}, is already presented in RM_{LASSO}. So, we ignore $RM_{Encompassing}$. By using COX test the result are reported in Table 4.14.

Table 4.14 Encompassing Results

Models	**Test statistic (Cox)**	**Values**
RM_{LASSO} encompasses $RM_{Encompassing}$	Cox	-1.716 [0.086]

The results of the above Table 4.14 indicates that p-value of the COX test is greater than 0.05. Therefore, we are fail to reject H_0. So, RM_{LASSO} encompasses $RM_{Encompassing}$ and we consider RM_{LASSO} as our final model for workers' remittances in Pakistan which is given in the equation (4.10).

4.3.1 Unit Root Test (Stationary Test)

To estimate any regression model, it is necessary to describe the order of integration of variables. The series will be non-stationary if it has unit root problem. Whenever we continue and estimate those variables which have problems of unit root then it produces meaningless or spurious regression. Therefore, in this study we use Augments Dickey Fuller(ADF) test to check the stationary properties of the data. ADF procedure was established by Dickey and Fuller in 1981 to test for non-stationarity.

Table 4.15 Unit Root Test

Variables	**At level**				**At first Difference**				**Conclusion**
	t_{cal}	t_{tab}	Drift	Trend	t_{cal}	t_{tab}	Drift	Trend	
LWR	-1.22	-3.52	Yes	Yes	-3.91	-1.95	No	No	1(1)
LDEXP	-2.39	-3.52	Yes	Yes	-6.24	-1.95	No	No	1(1)
LSP	-3.11	-3.53	Yes	Yes	-4.24	-1.95	No	No	1(1)
Lsk	-2.70	-3.53	Yes	Yes	-4.63	-1.95	No	No	1(1)
LREER	-0.54	-3.52	Yes	Yes	-6.10	-1.95	No	No	1(1)
LFLIB	-0.78	-3.52	Yes	Yes	-5.42	-1.95	No	No	1(1)
ICNF	-3.72	-2.94	Yes	No	___	___	___	___	1(0)
XCNF	-4.26	-3.52	Yes	Yes	___	___	___	___	1(0)
LMcPak	-2.76	-3.52	Yes	Yes	-7.62	-2.94	Yes	No	1(1)
IrPak	-2.00	-3.52	Yes	Yes	-5.85	-1.95	No	No	1(1)

After checking the order of integration of variables in the Table 4.15. It is confirmed that variables are stationary at different level. Some are stationary at level and others are at first difference.

4.3.2 ARDL Bounds Test

ARDL Bounds test is use when the time series data is integrated of different order or integrated of I(0) and I(1). We use this procedure to study the co-integration relationship between workers' remittances and its determinants in case of Pakistan. In our study in equation (4.10) some variables are integrated of I(0) such as internal conflicts and external conflicts and some are integrated I(1) such as workers' remittances, development expenditures, share prices, job skill index, real effective exchange rate, financial liberalization index, major agricultural crops and investment return of Pakistan. For this reason we use ARDL Bounds testing procedure. It should also be noted from the final step of general to specific methodology provided in Table 4.11. The appropriate lag selection of ARDL for RM_{LASSO} is ARDL(1,0,0,1,1,1,1,1,0,1).

Table 4.16 ARDL Bound Test Results

Test Statistic	**Value**	**K**
F-statistic	4.240	9
Critical Values		
Significance level	Lover Bound value	Upper Bound value
10%	1.88	2.99
5%	2.14	3.3
2.5%	2.37	3.6
1%	2.65	3.97

At 5% level of significance the calculated value is 4.240 which is greater the tabulated value of upper bound I(1) i.e., 3.3 value. So, we reject H_0 and it indicates that there exists a long run relationship.

In case of cointegration it is preferable to estimate the ECM of ARDL model, which is reported in Table 4.17.

Table 4.17 ARDL Model

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(Lsk)	0.046	0.131	0.352	0.728
D(LREER)	-0.114	0.417	-0.273	0.787
D(FLIB)	-0.030	0.076	-0.395	0.696
D(ICNF)	-0.144	0.044	-3.301	0.003
D(XCNF)	0.122	0.048	2.532	0.018
D(irPak)	-0.040	0.024	-1.685	0.105
C	-5.198	2.083	-2.496	0.020
LDEXP(-1)	0.098	0.197	0.498	0.623
LSP(-1)	-0.129	0.123	-1.046	0.306
Lsk(-1)	0.142	0.119	1.197	0.243
LREER(-1)	0.676	0.293	2.309	0.030
FLIB(-1)	-0.056	0.038	-1.472	0.154
ICNF(-1)	-0.277	0.072	-3.845	0.001
XCNF(-1)	0.328	0.089	3.693	0.001
LMcPak(-1)	0.439	0.186	2.360	0.027
irPaK(-1)	-0.058	0.022	-2.653	0.014
LWR(-1)	-0.724	0.167	-4.325	0.000

Adjusted R^2	S.E. of regression	F-statistic	Prob(F-statistic)
0.567	0.152	4.269	0.001

The above Table 4.17 shows that in the long run the internal conflicts and investment return of Pakistan have negative and significant impact on worker's remittances. The similar results have been reported by Helbling *et al*. (2005). The results are encouraging, as they show that the internal conflicts is an important determinant of workers' remittances and it has negative and significant impact on workers' remittances. Whenever there is high uncertainty and political risk(such as political violence) inside the home country then people will not be attracted more to their home country and feel their money insecure in their home country. On the other hand if there is low uncertainty and political risk inside the home country then people will be attracted more to their home country and feel their money to be secure in their home country. The results also shows that the investment returns in the host country and in Pakistan plays a strong role in explaining remittances. The real effective exchange rate, external conflicts and major agricultural crops have positive and significant impact on workers' remittances of Pakistan. Parallel findings are found in the studies of Bouhga-Hagbe (2006) and Akkoyunlu *et al.* (2013) for real effective exchange rate and external conflicts. The exchange rate has positive impact on worker remittances'. With high disposable income, high networth individuals look for an opportunity when the rupee falls so that they can cash in on the pricing difference and remit more money back home. Exchange rate (depreciation) is a strong incentive for workers' remittances to home state. The literature also shows that there is positive impact of devaluation of home currency on the remittances as the devaluation of home currency makes goods and services, and thus increases remittances flow. External conflicts show positively significant impact on remittances. The workers do not feel their money secure in foreign countries, when there is high incidents of external conflicts. Therefore, people sent more remittances to home country. Major agriculture crops has positive impact on workers remittances' foreign resident of Pakistan national. In short

run internal conflicts has negative and significant whereas external conflicts has positive and significant impact on workers' remittances of Pakistan.

ECM also provides the speed of adjustment or it capture convergence in long run after any short run shock or disequilibrium. For convergence ECM coefficient must be negative and significant.

In the above Table 4.17 the ECM_{-1} coefficient is negative and highly significant. So we can say that there is convergence towards long run equilibrium after short run shock. The coefficient of ECM_{-1} is equal to -0.724 and p-value is highly significant. It means that 72% adjustment will be occurred in one period.

4.3.3 Diagnostic Test

The residuals of the above final model has satisfied the diagnostic tests of Breusch Pagon and Godfrey(1981) LM test of no serial correlation($\chi^2_{(1)} = 2.159,\ \mathrm{p-value} = 0.142$), Engle's (1982) ARCH test of no ARCH effect ($\chi^2_{(1)}$ =2.867, $\mathrm{p-value}$ =0.090) and Jarque-Bera normality ($\chi^2_{(1)} = 0.061,\ \mathrm{p-value} = 0.970$) at 5% level of significance.

4.3.4 Stability Test

Now we use cumulative sum (CUSUM) and cumulative sum of square (CUSUMSQ) tests to check the stability of the parameters of workers' remittances. The null hypothesis is that the parameters are stable. So, we do not reject the null hypothesis because the plot of CUSUM and CUSUM square lies inside the critical bounds at 5% level of significance. Their results are given in the following Figure 4.1 and Figure 4.2.

Figure 4.1 CUSUM

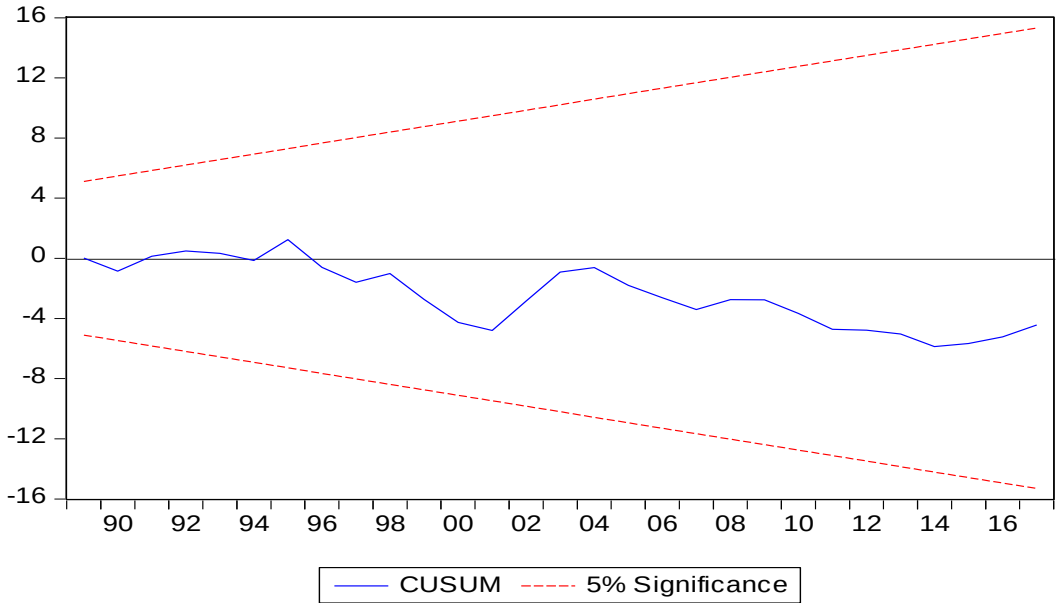
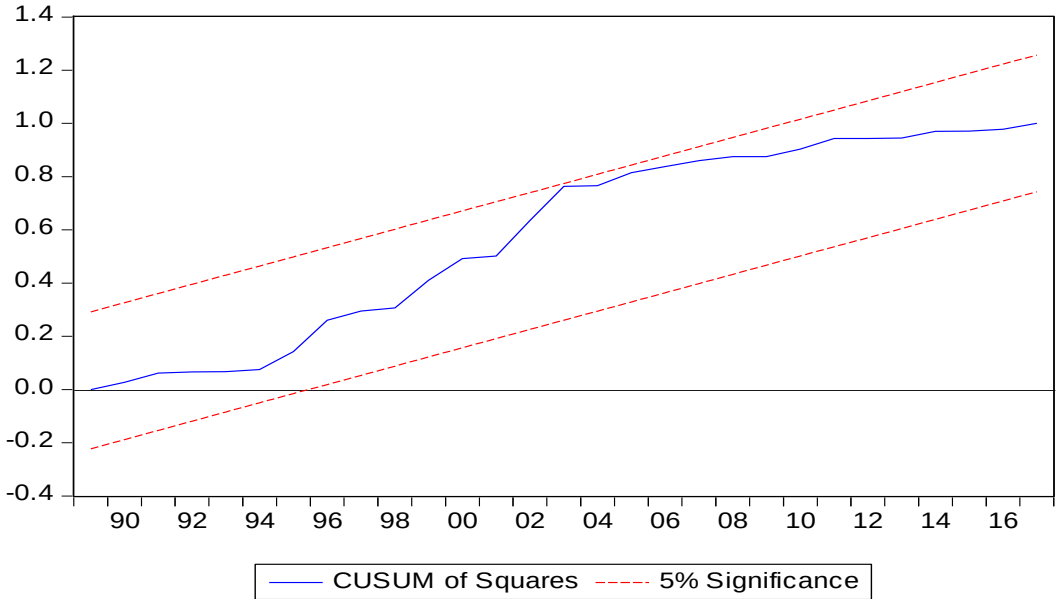


Figure 4.2 CUSUMSQ



Chapter 5

CONCLUSION AND POLICY RECOMMENDATION

5.1 Conclusion

The main objective behind this study was to find the true determinants of workers remittances' for Pakistan from the five existing model of workers' remittances of national literature along with black market premiums(BMP) and wage rate(W) from international literatures by using encompassing and LASSO techniques. In the both techniques we used the general to specific (G2S) methodology to find the parsimonious model these are $RM_{Encompassing}$ and RM_{LASSO}. Then we have chosen the final model for workers' remittances by ranking both parsimonious models according to their standard errors. It has been observed that RM_{LASSO} has the minimum standard error and has encompassed the $RM_{Encompassing}$. Therefore, RM_{LASSO} is considered as final model for workers' remittances in Pakistan. ARDL bound test has been applied to find the long run conintegrating relationships among the determinants of workers' remittances. The results of LASSO suggest that the major determinants of workers' remittances are internal and external conflicts, major agriculture crops and investment return of Pakistan and real effective exchange rate. In the long run the internal conflicts and investment return of Pakistan have negative and significant, whereas, the real effective exchange rate, external conflicts and major agricultural crops have positive and significant impact on workers' remittances of Pakistan. While in the short run internal conflicts has negative and significant whereas external conflicts has positive and significant impact on workers' remittances of Pakistan.

5.2 Policy Recommendation

On the basis of results following poly is recommend for improving workers remittances' in Pakistan. Internal conflicts is an important determinant of workers' remittances and it has negative and significant impact on workers' remittances. Whenever there is high uncertainty and political risk(such as political violence) inside the home country then people will not be attracted more to their home country and feel their money insecure in their home country. On the other hand if there is low uncertainty and political risk inside the home country then people will be attracted more to their home country and feel their money to be secure in their home country. Therefore, the government of Pakistan must reduce high uncertainty and political risk inside the country then in this way the foreign resident Pakistan national will be attracted more to their home country and they feel their money secure in their home country.

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