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Exploring the Determinants of Workers' Remittances in Pakistan through the Application of LASSO Technique

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Abstract

Remittances are a significant source of foreign income in Pakistan. In order to stabilize the flow of remittances in Pakistan, significant determinants of workers' remittances should be identified. Therefore, in this paper, the Least Absolute Shrinkage and Selection Operator (LASSO) technique was adopted to identify the potential determinants that affect the flow of workers' remittances to Pakistan. Additionally, the Auto Regressive Distributed Lag (ARDL) bound test was applied to explore the long-run and short-run effects of potential determinants on workers' remittances. The results of this study suggest that in the long-run, internal conflicts and investment returns negatively affect the flow of workers' remittances to Pakistan, whereas, real effective exchange rate (REER), external conflicts, and the production of major crops positively affect the flow of workers' remittances.

Keywords: ARDL bound test, LASSO, workers' remittances

JEL: C4, E0, J6.

Introduction

Currently, job migration is on the rise due to the globalization of the labour market. As a result, foreign remittances have become a significant source of income, especially in developing countries. Remittances also play an important role in enhancing consumption, private investment, education, and health expenditure at the micro-level and in strengthening foreign reserves and national income at the macro-level in developing countries (Shoab, 2016). By examining the history of remittances inflow in Pakistan, it has been observed that there was a sharp rise in the flow of remittances after the independence in 1975 when more workers migrated to Middle East

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countries. However, the flow of remittances to Pakistan was reduced significantly in 1983 due to an oil price hike, which touched the figure of $2886 million (Alam et al., 2017). Again, a sharp decline in the flow of remittances was observed from 1998 till 2000 because Pakistan's foreign currency account was seized due to a nuclear explosion (Kamran et al., 2014). After 9/11, remittance inflow reached up to $2389 million. Additionally, in 2013, Pakistan turned into the seventh remittance-receiving country with $13921 million remittances. It should be noted that this position was not constant since the flow of remittances fluctuated over time. In 2016-17, Pakistan became the fifth developing country after receiving $19,303 million through remittances. (Alam et al., 2017). On a macro level, remittances comprise roughly 7% of the volume of our economy. Additionally, remittances serve as a cushion that stabilizes the exchange rate and maintains a decent level of international reserves when there is a rise in exports and trade deficit in the country. Therefore, it is necessary to find the potential determinants of remittances.

In his study, Leamer (1978) suggested that the regression model is valid when all the relevant regressors of the dependent variable are included in the model. If the relevant variables are excluded from the regression model, then the model will be misspecified. Thus, the results that are drawn from the regression model will be completely misleading. To obtain the true regressors of the dependent variable, the general unrestricted model (GUM) should be utilized since it includes all the potential determinants.

Key macroeconomic determinants of remittances that are found in international literature are black market premiums, domestic inflation, interest rate differential, domestic growth, and host and home country per capita income (Aydas et al., 2005). Page and Plaza (2006) have proposed that migrants should use unofficial channels to transfer their remittances when black market premiums are high. Barua (2007) identified that the difference of income between home and host country encourages the workers to work in the host country and send the remittances to the home country. Similarly, the inflation differential and real interest rate differential discourages individuals to send remittances to their home country. Rahman (2007) investigated that higher wages in the host country have a significant and positive relationship with worker remittances. According to Nabi

(2007), financial development increases an expatriate's trust in home country. They readily transfer money to their home country, which not only improves the living standard of the people involved but it also facilitates national investment.

A review of previous studies in this field revealed that researchers have partially explored how different factors influence worker remittances. For example, Sun et al. (2011) explored the influence of five variables on workers' remittances, namely, the real effective exchange rate (REER), nominal exchange rate, investment return, job-skill index, and domestic production of major crops. They found that the stable exchange rate and economic conditions of Pakistan have a strong impact on the flow of workers' remittances. Likewise, Kamran et al. (2014) examined the effect of the exchange rate, gross domestic product (GDP), interest rate, inflation, and foreign direct investment (FDI) on the inflow of workers' remittances. They proposed that the gross domestic product (GDP), exchange rate, and foreign direct investment (FDI) seem to be the main determinants of workers' remittances. They also found that the gross domestic product (GDP) and the foreign direct investment (FDI) are positively related to workers' remittances, while interest rate and variation in inflation are negatively related to workers' remittances. Ullah et al. (2015) studied the long-run association between terrorism and remittances in their paper. They conclude that terrorism in the home country forces people to migrate to other countries. In order to fulfil their family needs, they transfer huge amounts of remittances to their home country. They found that the flow of workers' remittances in Pakistan depends on the gross domestic product (GDP), exchange rate, unemployment, inflation, trade openness, and terrorism index. Their analysis showed that terrorism and inflation have a positive connection with remittance. Alam et al. (2017) extended the list of factors affecting workers' remittances to seven variables: interest rate, gross domestic product (GDP), stock market performance, gold prices, development expenditures, exchange rate, and political stability. The researchers concluded that the gross domestic product (GDP), development expenditures, gold prices, depreciation of the local currency, and political stability are positively related to workers' remittances, while interest rate, unemployment rate, and fluctuation in inflation are negatively related to workers' remittances. In their study, Abbas et al. (2017) examined the

influence of macroeconomic, financial, and political factors on the workers' remittances of Pakistan. They empirically concluded that the macroeconomics, political, and financial variables of Pakistan have a significantly positive effect on workers' remittances, while inflation and government debt have a negative influence on workers' remittances. Moreover, external conflicts, law and order, and corruption have a positive connection with remittances.

Through a review of existing literature, it is concluded that different models have used different sets of determinants to describe the phenomena of worker's remittances. It has also been concluded that all models are different from each other based on different set of determinants. If different models analyze the same phenomenon, then all the models might be incorrect, or there might only be one model whose results are close to that of the true model. Therefore, it is necessary to find the best model that can be used to explore determinants of workers' remittances in Pakistan. While constructing the general model, there is a possibility that the number of variables is greater than the number of observations (k>n). In that case, we will be unable to estimate the guide to the expression of uncertainty in measurement (GUM). To solve this problem, we construct the general model by applying Least Absolute Shrinkage and Selection Operator (LASSO) technique by Tibshirani (1996) for feature selection. LASSO technique has advantages over other techniques such as ordinary least squares (OLS) and ridge regression because it provides a unique solution in case the number of variables is greater than the number of observations. LASSO provides the best subset of predictors by considering all potential features. Thus, this study aims to find a suitable model that could be used to find out potential determinants of workers' remittances in Pakistan by using LASSO as a methodology.

Following the introduction, the rest of the paper is organized as such; section 2 presents the methodology and data description, section 3 includes results and discussion, and the last section will conclude this study.

Methodology

To fulfil the objective of the study, we will use the LASSO technique that was developed by Tibshirani (1996). LASSO regression is a powerful

technique that performs two main responsibilities, namely regularization and feature selection. This technique is used when there is high degree of multicollinearity among the larger set if independent variables. It is an alternative method to the least squares estimate. Moreover, in this model, when the variables are insignificant or do not have a relationship with the response variable, then the LASSO makes their coefficient approximately equal to zero and finally drops 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 that have a few parameters.

LASSO Methodology

A commonly used procedure to find the linear relationship among variables is the linear regression model which involves the minimization of the residual sum of squares (RSS).

$$RSS = \sum_{j=1}^{n}(y_i - ß_0 - \sum_{j=1}^{p} ß_j x_{0ij})^2 \tag{1}$$

However, this linear regression model has a problem of variability in the least square fit since the number of a variable exceeds the number of observations. The solution is suggested in the form of ridge regression. The ridge regression has an advantage over OLS because as the penalty λ increases the variance decreases substantially at the expense of a very small increase in bias. Secondly, the ordinary least squares (OLS) method does not provide a unique solution in case the number of variables is greater than the number of observations. In this case, the ridge regression works well. It is given in the equation below:

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

Despite having a lot of advantages, the ridge procedure is not free of problems. The problem with ridge regression is that it tells us to include all the predictors in our final model rather than just the best subset. This shrinks all the coefficients 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 coefficients for each of λ. To get rid of this problem, Tibshirani introduced the *LASSO* equation in 1996. This equation is given below:

$$\sum_{i=1}^{n}(y_i - ß_0 - \sum_{j=1}^{p} ß_j x_{0ij})^2 + \ \ \lambda \ \sum_{j=1}^{p} |ß_j| \qquad (3)$$

$$\text{RSS} + \underbrace{\lambda}_{\text{Tuning parameter}} \underbrace{\sum_{j=1}^{p} |ß_j|}_{Penalty} \qquad (4)$$

We have seen in the above equation (2) and (3) that ridge and LASSO regression have the same construction. The only difference between the two equations is that the $ß^2{}_j$ term in the ridge regression penalty equation (2) has been replaced by $|ß_j|$ in the LASSO penalty equation (3). In the LASSO equation (3), RSS is the residual sum of squares, λ is the tuning parameter, and $\sum_{j=1}^{p} |ß_j|$ is the sum of the absolute value of coefficients in the LASSO penalty.

The tuning parameter (λ) controls the strength of the penalty. The parameter coefficient (ß) correlates with the tuning parameter value. Whenever $\lambda=0$, then the penalty term has no effect. 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, namely fitting a linear model of Y on X and shrinking the coefficients. The range of the tuning parameter is between zero to infinity and is a crucial value for the identification of the true model. Whenever an intercept is included in the model, then it is left unchanged. In the equation (3), 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. It produces simpler and more interpretable models that involve only a subset of predictors' variables. It is a regularization method that creates a parsimonious model in the presence of a large number of features. In this way, the overfitting is reduced (James et al., 2013).

Estimation of Specific Model

After attaining the desired model through LASSO regression, the long-run and short-run impact of independent variables on the remittances are examined by the Auto Regressive Distributed Lag (ARDL) co-integration method, which was introduced by Pesran et al. (2001). This method is used because we are expecting both I(0) and I(1) regressors. The econometric representation of the ARDL model is given below:

$$\Delta y_t = \alpha + \sum_{i=1}^{n} \text{ß}_{1i} \Delta y_{t-i} + \sum_{i=0}^{n} \text{ß}_{2i} \Delta x_{1t-i} + \sum_{i=0}^{n} \text{ß}_{3i} \Delta x_{2t-i} +$$
$$\sum_{i=0}^{n} \text{ß}_{4i} \Delta x_{3t-i} + \ldots + \sum_{i=0}^{n} \text{ß}_{ni} \Delta x_{nt-i} + \delta_1 y_{t-1} + \delta_2 x_{1t-1} + \delta_3 x_{2t-1}$$
$$+\delta_4 x_{3t-1} + \delta_5 x_{4t-1} + \ldots + \delta_n x_{nt-1} + \varepsilon_t \qquad (5)$$

y_t is a dependent variable and $x_{1t}, x_{2t}, \ldots, x_{nt}$ are independent variables. It is also assumed that $y_t \sim I(1)$ and independent variables are either I(1) or I(0). ARDL cointegration method is not applicable in the presence of I(2) variable. The ordinary least square (OLS) method is used to estimate the ARDL model specified in equation (5). Additionally, the existence of long-run cointegration is examined by the bound testing approach with the following hypothesis:

The null hypothesis for bound testing is

$H_0: \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \ldots = \delta_n = 0$ \qquad (no long-run relationship exists)

And the alternative hypothesis is

$H_0: \delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq \cdots \neq \delta_n \neq 0$ \qquad (long-run relationship exists)

F-statistic is used to identify the existence of a long-run relationship among the variables. The computed F-statistic value is compared with the critical values provided by (Pesran et al., 2001).

During the model selection procedure, different tests are used to ensure that the residuals do not have the problem of heteroscedasticity, non-normality, and autocorrelation problem. For identifying such kinds of problems, we use the White heteroscedasticity (ARCH) LM test (F-stat.), Jarque and Berra (1980) test ($\chi 2$) of normality. and Breusch-Godfrey Serial Correlation LM test (1978). Moreover, we detect the stability of the parameters of the estimated dynamic error correction model (ECM) with the help of cumulative sum (CUSUM) and cumulative sum of square (CUSUMSQ), both of which were proposed by Brown, Durbin, and Evans in 1975.

Data Description

This research was based on the annual time series data of Pakistan from 1975 to 2017. Different sources are used for data collection. From the

existing literature, we found 28 candidates that send remittances to their families in Pakistan. A detailed description of all variables is available in Table 1.

Table 1

Data Description

S.No	Variables	Symbol	Definition/ Construction	Source of Data
1	Workers' Remittances	WR	The transfer of foreign money by expatriates to Pakistan.	SBP
2	Interest rate	INT	Call money rate.	SBP
3	Gold prices	GOLD	*Gold prices define the price of gold on which the gold is traded in the gold market.*	SBP
4	Development expenditure	DEXP	It is the type of expenditure that helps the economic and social development of a country. For example, the expenditure on education, health, etc.	SBP
5	Major agriculture crops	McPak	Major agriculture crops are the production of wheat, rice, cotton, sugarcane, maize, etc.	SBP
6	Inflation	INF	Inflation is the increase in the price of goods and services over time at a general level. The inflation rate is measured by the following equation: $CPI_t - CPI_{t-1}/ CPI_t * 100$	SBP
7	Foreign direct investment	FDI	FDI is the type of investment in which the people or organization of one country invest in the 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	$0.8INT_{Pk}+0.2dLn(SP_{Pk})$ In this equation, INT_{Pk} is the interest rate and SP_{Pk} is the share prices of Pakistan.	IFS
12	Investment return of US	irUS	$0.8INT_{US}+0.2dLn(SP_{US})$ In this equation, INT_{US} is the interest rate and SP_{US} is the share prices in the US.	IFS

S.No	Variables	Symbol	Definition/ Construction	Source of Data
13	Real Domestic Product	GDP	It is defined as the total value of final goods and services that are produced inside the boundary of a 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 is the money that one's country borrowed from an outside country or organization. It is also known as external debt.	WDI
16	Real effective exchange rate	REER	It is defined as the nominal effective exchange rate. It is divided by a price deflator.	WDI
17	Secondary school enrolment	SSEN	Secondary school enrolment is defined as the number of students who are enrolled in secondary school.	WDI
18	Financial liberalization	FLIB	The data on financial liberalization is taken from Shabir (2013). She used the following formula for the construction of financial liberalization: $$FLIB = w_1 INR + w_2 CRD + w_3 RSRV + w_4 BNK + w_5 PRD + w_6 SRC + w_7 PRCOM$$ FLIB is the financial liberalization, INR is the interest rate regulation, CRD is the credit controls, RSRV is reserve requirements, BNK is the banking ownership, PRD is the prudential regulation measures, SRC is the securities market development, and PRCOM is the pro-competitive measures. The data from 2014 to 2017 on financial liberalization is generated by the extrapolation method.	Shabir ([2013]).
19	Job skill index	sk	The job skill index is constructed with the help of a weighted index of the different skill categories. The formula of job skill index is given below [Sun *et al.* (2011)]:$SK=(1/25)*(7*HS+6*HQ+5*S+4*SS+3*U)/(HS+HQ+S+SS+U)$. HS is stands for 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

S.No	Variables	Symbol	Definition/ Construction	Source of Data
22	Internal Conflict	ICNF	Internal conflict is defined as the political violence inside the country and its actual influence on the governance.	ICRG
23	External Conflict	XCNF	External conflict is defined as the problems that one's country faces with foreign countries such as diplomatic pressures, trade restrictions, etc to violent external pressure.	ICRG
24	Law and order situation	LAOR	Law and order situation is defined as the condition when people follow the rules and regulations. There is no violence or threats, and the police control all the crimes.	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 to achieve political and ideological objectives.	ICRG
27	Political stability	PS	It is used to measure the threats and violence from one democratic regime to another democratic regime.	ICRG
28	Black Market Premium	BMP	$BMP = (\frac{\text{Parallel exchange rate}}{\text{Official exchange rate}} - 1) * 100$	The data of parallel exchange rate are collected from "http://www.carmenreinhart.com

Results and Discussions

The existing models impose a priory zero restriction on each other. One regression model has excluded a relevant variable of the other regression model which creates bias in the estimated parameters. Therefore, all aforementioned regression models are not valid due to misspecification. Therefore, we have considered all possible determinants of workers' remittances. By using the LASSO technique[1], fourteen predictors of workers' remittances have been selected. They are presented in Table 2.

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[1] In R software *glmnet* package is used for LASSO computation.

Table 2

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

Based on the selected determinants of worker remittances through LASSO, we have constructed the ARDL model with the maximum lag length of one, which is chosen by Akaike information criteria. In general, we exclude the variables based on joint restrictions. First, we choose the highly insignificant level or lagged level variable based on t- value, then we impose joint restrictions via F- test on the different lags of each variable. With the null hypothesis, both level and lagged level variables are insignificant when compared with the alternative hypothesis, in which at least one is significant. If we fail to reject the null hypothesis, then we retain the variable in the model, otherwise, we drop it from the model. The result of insignificant variables is given in Table 3.

Table 3

Insignificant Variables

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

After the exclusion of insignificant variables, the final specific model that is used to find out the determinants of workers remittances are reported in equation (6) as follows:

$$LWR = \alpha + \beta_1 LDEXP + \beta_2 LSP + \beta_3 Lsk + \beta_4 LREER + \beta_5 LFLIB + \beta_6 ICNF + \beta_7 XCNF + \beta_8 LMcPak + \beta_9 irPak + \varepsilon_t \qquad (6)^2$$

ARDL (1,0,0,1,1,1,1,1,0,1) is our specific model and indicating the appropriate lag length of each variable. Bound test results are reported in Table 4. Accordingly, at a 5% level of significance, the calculated value is 4.240. It is greater than the tabulated value of upper bound I (1) which is 3.3. Therefore, we reject the null hypothesis of no cointegration among the variables In the case of cointegration, it is preferable to estimate the error correction model (ECM) of the ARDL model, which is reported in Table 5. It shows that in the long-run, the internal conflicts and investment return of Pakistan have a negative and significant impact on the flow of workers' remittances. Similar results have been reported by Helbling and Cardarelli (2005).

The results of this study are promising since they show that internal conflicts are an important determinant of workers' remittances. These conflicts have a negative and significant impact on the flow of workers' remittances. Whenever there is high uncertainty and political risk (such as political violence) inside the home country, then people will not trust their home country and will feel that their money is insecure in their home country. On the other hand, if there is low uncertainty and political risk inside the home country, then people will trust their home country and will feel that their money is secure in their home country.

The results of this study also show that the investment returns in the host country and Pakistan play a strong role in exploring the determinants of workers' remittances. It was found that the real effective exchange rate (REER), external conflicts, and success major crops have a positive and significant impact on the flow of workers' remittances to Pakistan. Parallel findings for the real effective exchange rate (REER) and external conflicts

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[2]Augments Dickey Fuller's (1981) unit root test confirmed that LWR, LDEXP, LSP, Lsk, LREER, and LFLIB are I(1) and the rest of the variables in the model are I(0), hence none of the variables is integrated of order two.

are found in the studies of (Bouhga-Hagbe, 2006; Akkoyunlu et al., 2016). The exchange rate has a positive impact on the flow of worker remittances. With high disposable income, high-net-worth individuals (HNWI) look for opportunities during which 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 remittance inflow to the home state. Prior literature also shows that the devaluation of the home currency has a positive impact on remittance inflow since the devaluation of home currency makes domestic goods and services cheaper, which increases remittance flow. External conflicts have a positive and significant impact on remittance inflow. Workers do not feel that their money is secure in foreign countries when there are high incidents of external conflicts. Therefore, people send more remittances to their home country when there are low incidents of external conflict. Additionally, major crops also have a positive impact on workers' remittances. In the short run, internal conflicts have a negative and significant impact on the flow of workers' remittances, while external conflicts have a positive and significant impact on the flow of workers' remittances to Pakistan.

After any short-run shock or disequilibrium, the error correction model (ECM) also provides the speed of adjustment or capture convergence in the long-run. In Table 5, the coefficient of LWR (-1) is also the error correction term. It is negative and highly significant. It shows that 72% adjustment happens in one year.

Table 4

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

Table 5

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

Diagnostic Test

The residuals of the final model have satisfied the diagnostic tests of Breusch et al. ([1981](#)) LM test shows that there is no serial correlation ($\chi^2_{(1)} = 2.159$, $p-value = 0.142$), Engle's (1982) ARCH test shows that there is no ARCH effect ($\chi^2_{(1)} = 2.867$, $p-value = 0.090$), and Jarque-Bera normality ($\chi^2_{(1)} = 0.061$, $p-value = 0.970$) shows that level of significance is 5%.

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. Thus, we do not reject the null hypothesis because the plot of the cumulative sum (CUSUM) and the cumulative sum of square (CUSUMSQ) lies inside the critical bounds at a 5% significance level. Their results are given in the following Figure 1 and Figure 2.
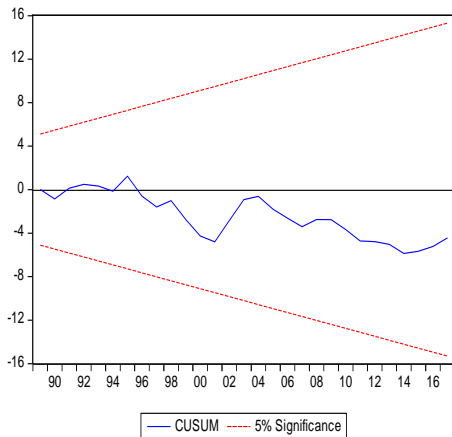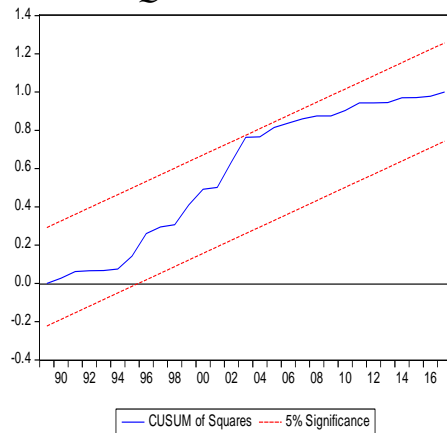
Figure 1

CUSUM

Figure 2

CUSUMSQ

Conclusion and Policy Recommendation

The main objective of this study was to find the true determinants of workers' remittances to Pakistan from the existing literature through the application of LASSO technique. The results of this paper suggest that the major determinants of workers' remittances are internal and external conflicts, success of major agriculture crops, investment returns in Pakistan, and the real effective exchange rate (REER). It was also found that in the long-run, internal conflicts and investment returns have a negative and significant effect on workers' remittances, whereas real effective exchange rate (REER), external conflicts, and success of major crops have a positive and significant impact on the flow of workers' remittances to Pakistan. Additionally, in the short-run, internal conflicts have a negative and

significant effect on workers' remittances, whereas external conflicts have a positive and significant impact on the flow of workers' remittances.

Based on the results, it was found that internal conflicts are an important determinant of workers' remittances. Whenever there is high uncertainty and considerable political risk (such as political violence) inside the home country, then its expatriates fear for the security of the money invested in their home country. As a result, they send just a fraction of their total income to their families to meet the basic requirements of life, such as consumption, medication, and education. They also avoid investing in their home countries. Therefore, it is suggested that the government of Pakistan should reduce internal conflicts. Once there is a reduction in internal conflicts, then expatriates will trust the home country and will feel that their money is safe and secure in Pakistan. Thus, reduction in internal conflicts will improve remittance inflow to Pakistan.

References

Abbas, F., Masood, A., & Sakhawat, A. (2017). What determine remittances to Pakistan? The role of macroeconomic, political and financial factors. *Journal of Policy Modeling*, *39*(3), 519−531. https://doi.org/10.1016/j.jpolmod.2017.03.006

Akkoyunlu, K., & Öktem, K. (2016). Existential insecurity and the making of a weak authoritarian regime in Turkey. *Southeast European and Black Sea Studies*, *16*(4), 505−527. https://doi.org/10.1080/14683857.2016.1253225

Alam, S., Wasim, S. S., & Ahmad, B. (2017). Macroeconomic determinants of workers' remittances: Pakistan, a case in point. *Global Management Journal for Academic & Corporate Studies*, *7*(1), 85−102.

Aydas, O. T., Metin-Ozcan, K., & Neyapti, B. (2005). Determinants of workers' remittances: the case of Turkey. *Emerging Markets Finance and Trade*, *41*(3), 53−69. https://doi.org/10.1080/1540496X.2005.11052609

Barua, S. (2007). Determinants of workers' remittances in Bangladesh: An empirical study. *Policy Analysis Unit (PAU), Bangladesh Bank* (Working Paper No. 713). Policy Analysis Unit.

Bhatti, A. (2018). "*Model specification and Inflation Forecast Uncertainty in case of Pakistan*". [Unpublished Thesis]. Department of Econometrics and Statistics, PIDE, Islamabad, Pakistan.

Bouhga-Hagbe, J. (2006). *Altruism and workers' remittances: Evidence from selected countries in the Middle East and Central Asia* (WP/06/130). International Monetary Fund.

Breusch, T. S., & Godfrey, L. G. (1981). A review of recent work on testing for autocorrelation in dynamic simultaneous models. *Macroeconomic Analysis, Essays in Macroeconomics and Economics*, *1*, 63−100.

Dickey, D. A., & Fuller, W. A. (1981). Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica: Journal of the Econometric Society*, *49*(4), 1057−1072. https://doi.org/10.2307/1912517

Helbling, T., Batini, N. and Cardarelli, R. (2005) Globalization and external imbalances. IMF World Economic Outlook International Monetary Fund, Washington, DC.

International Monetary Fund. (2004). *World Economic Outlook, April 2005: Globalization and External Balances*. International Monetary Fund. https://doi.org/10.5089/9781589064294.081

James, G., Witten, D., Hastie, T., & Tibshirani, R. (2013). *An introduction to statistical learning* (Vol. 112, p. 18). Springer. https://link.springer.com/book/10.1007%2F978-1-4614-7138-7

Jarque, C. M., & Bera, A. K. (1980). Efficient tests for normality, homoscedasticity and serial independence of regression residuals. *Economics Letters*, *6*(3), 255-259. https://doi.org/10.1016/0165-1765(80)90024-5

Kamran, A., Alam, S., Ghias, K. A., & Ali, S. N. (2014). Economic determinants of workers' remittances in Pakistan. In *Proceedings of the Seventh International Conference on Management Science and Engineering Management* (pp. 415-424). Springer. https://link.springer.com/chapter/10.1007/978-3-642-40078-0_36

Leamer, E. E. (1978). Regression selection strategies and revealed priors. *Journal of the American Statistical Association*, *73*(363), 580-587.

Nabi, M. G. (2007). *An empirical inquiry into macroeconomic determinants of remittances inflow in Bangladesh* [Doctoral Dissertation]. Department of Economics, North South University, Bangladesh.

Page, J., & Plaza, S. (2006). Migration Remittances and Development: A Review of Global Evidence 1. *Journal of African Economies*, *15*(2), 245−336. https://doi.org/10.1093/jae/ejl035

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, *16*(3), 289−326. https://doi.org/10.1002/jae.616

Rahman, K. (2007). Studies on free radicals, antioxidants, and co-factors. *Clinical Interventions in Aging*, *2*(2), 219−236.

Shabir, S. (2013). *Financial Liberalization and its impact on Economic Growth of Pakistan*. [Unpublished Thesis]. Pakistan Institute of Development Economics.

Shoab, M. (2016). *A Micro-Level Analysis of the Effect of Remittances on Health Care Expenditures: A Case study of Pakistan* [Unpublished Thesis]. Pakistan Institute of Development Economics.

Sun, M. Y., & Kock, U. (2011). *Remittances in Pakistan: Why have they gone up, and why Aren't they coming down?* (Working Paper No. 11-200). International Monetary Fund.

Tibshirani, R. (1996). Regression shrinkage and selection via the lasso. *Journal of the Royal Statistical Society: Series B (Methodological)*, *58*(1), 267−288. https://doi.org/10.1111/j.25176161.1996.tb02080.x

Ullah, I., Rahman, M. U., & Jebran, K. (2015). Terrorism and Worker's Remittances in Pakistan. *Journal of Business Studies Quarterly*, *6*(3), 178−189.