The Effects of Workers' Remittances on Exchange Rate Volatility and Exports Dynamics - New Evidence from Pakistan

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This study examines the impact of remittances on the exchange rate and exports in Pakistan, using the system GMM aproach on annual data series. We carry out a full sample Granger causality test along with the sub-sample rolling window approach using monthly data series to find the causal relationship between remittances (REM) and the exchange rate (EXR). The System GMM results reveal that remittances depreciate the exchange rate and have a positive influence on export competitiveness. In addition to this, the remittance inflow appreciates the exchange rate only if it is used for savings and negatively affects competitiveness if it is channeled towards consumption. The change in exchange rate regime from multiple to flexible depreciated the exchange rate while, the global financial crises uplifted the currency rate and negatively affect the exports. The results show the bidirectional causal relationship between remittances and the exchange rate. The outcomes further reveal that the parameters in the VAR model are unstable, which is a clear indication of the presence of structural changes. The rolling window estimation approach with time-varying characteristics finds bi-directional causality between REM and the EXR in the different sub-samples. The results of this study fall in line with the portfolio model proposed by Mussa (1984) which states that the flow of remittances causes appreciation. The sub-sample causality is related to significant economic events, which means the results are not a statistical artifact.

Keywords: Remittances; Exchange rate; bootstrap rolling window; Granger Causality

JEL Classifications : F24, C32, F31

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Introduction

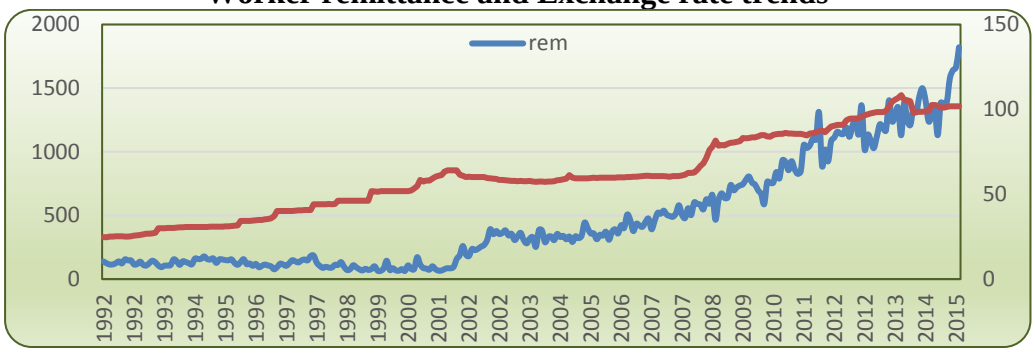
The link between remittances and the exchange rate got great attention in the recent literature. Remittances are a major source of external cash flows and represent an important determinant of the exchange rate (Mughal and Makhlouf, 2011). Both variables have great importance especially in shaping the economic policy in Pakistan. The volatility in remittances and exchange rate can affect macroeconomic variables namely interest rate, unemployment, prices, wages and exports while, their stability reduces the risk for both investors and households (Yang, 2004; Nieh and Wang, 2005). It has been demonstrated that remittances can appreciate the exchange rate of host economy causing also the concept known as the *Dutch disease*. As the higher inflow of remittances increases the demand for local currency, boosting spending, supplementary pressure is put on the real exchange rate and on competitiveness through a decline in the labour supply of a recipient economy (Bussolo and Medvedev, 2007). The increase in household income raises the prices in the non-tradable sector, but does not affect the tradable sector of the economy (Acosta *et al.,* 2009). The increase in the prices of the non-tradable sector and the movement of resources from tradable to non-tradable sector appreciates the exchange rate. The increase in the prices in the non-tradable sector encourages labour to move from tradable to the non-tradable sector (Amuedo-Dorantes and Pozo, 2006) that increases the wages in the traded sector. As a result, the production cost increases along with prices, which adversely affects the tradable sector and exchange rate in the recipient economy (Acosta *et al.,* 2009).

Pakistan is one of the top recipients of worker remittances in Asia. The first official remittance inflow was recorded in the 1970's when the boom in the construction sector of the Gulf States resulted in millions of Pakistanis employed. In the early 1980's the volume exceeded exports and constituted more than 10 percent of the country's GDP. From 1982 to 1998 the government of Pakistan adopted the managed floating exchange rate regime and linked it with the currencies of its trading partners. Therefore, during the 80s and until the early 1991, these changes in exchange rate regime in connection with the weak economic situation in the Arab world negatively affected both variables. In 1992, Pakistan economy achieved a GDP growth of 6.4 percent compared to 4.6 in 1990. It was due to the economic reforms such as: privatization of over one hundred state owned industrial units, liberalization of the exchange rate and the permission for residents to hold foreign currency accounts under the condition that the funds were surging in from other economies. The flow of credit to the domestic sectors expanded to 17.8 percent, which boosted the private investment

up to 24.8 percent, but only a marginal increase in worker remittances was observed during that period. During the period ranging from July 1998 to April 1999, the State Bank of Pakistan decided on multiple exchange rate regimes and on freezing foreign currency accounts, to maintain the foreign currency reserves. In May 1999, the State Bank paged the Pak-rupees to US dollar and defended the rate within a narrow margin until July 2000. From 1998 to 2000 the remittances tremendously dropped from 1490 to 796 million dollars. To attract the foreign investors and remitters, the government announced the launch of a flexible exchange rate regime from July 2000 to 2009. During the 2008-2010 period a notable increase in the flow of remittances was observed, originating especially from UAE and Saudi Arabia, but due heavy import bills and balance of payment problems, it negatively affected the foreign exchange reserves and depreciated Pakistani rupees by 16.3%, fact that uplifted inflation rate to 25.2%, which was the highest ever in the history of Pakistan. At the beginning of 2009, the government of Pakistan launched the remittances initiative program (RIP). The main aim was to help the households of remitters and encourage them to use official channels along with providing them with banking services and investment opportunities. Moreover, other elements such as: the 9/11 event, strict regulations against money laundering, the risk of life or property and the scrutiny of capital investments, persuaded individuals to transfer their savings back home through official channels. Due to these reasons, the remittances inflow to Pakistan in 2015 reached $15 billion in comparison with $6 billion in 2009. The remittances and exchange rate trends are shown in Figure I.

Figure 1

Worker remittance and Exchange rate trends



***Author Computation** by using Monthly data, **Data Source**: Economic surveys and Ministry or labour and manpower Pakistan*

1. Empirical Literature

A vast block of research has been conducted to examine the remittances and exchange rate relationship. During the panel study of 13 Latin American and Caribbean countries over a period of 1979 – 1998, Amuedo-Dorantes and Pozo (2004) found that worker remittances appreciate exchange rates. Moreover, the authors state that doubling the remittances to GDP ratio resulted into a real exchange rate appreciation above 22%. The stated result was endorsed by Lopez, Molina and Bussolo (2007) in a parallel panel study of 20 countries. Despite this fact, Izquierdo and Montiel (2006) report mixed results using a time series technique for six Central American countries. The results do not point to relevant effects in Honduras, Jamaica and Nicaragua. However, in the Dominican Republic remittances induced depreciation, while in El Salvador, remittances caused an appreciation of exchange rates. In a related investigation, Barajas et *al.* (2010) argue that the influence of remittances on exchange rates varies from country to country. More recently, Mandelman and Acosta (2012) found that remittances are a cause of real exchange rate appreciation. Similar results are reported in other panel initiatives conducted by (Acosta, Lartey and Mandelman, 2009; Hassan and Holmes, 2012; Combes, Kinda and Plane, 2011).

The flow of worker remittances in Cape Verde caused real exchange rate appreciation (Bourdet and Falck, 2003), while related results have been found for Pakistan and Jordan (Hyder and Mahboob 2005; Saadi-Sedik and Petri 2006). On the contrary, Rajan and Subramanian (2005) for example, argue that remittances do not cause the phenomenon known as the Dutch disease. According to Hyder and Mahboob (2006), an increase in remittances of about 1% of GDP is translated into a 0.16% appreciation of the exchange rate of Pakistan. Other related contributions can be observed in: Ahmed (2009), Janjua (2007), and Rehman et al. (2010). However, these studies do not characterize the relationship in detail and suffer from data and methodological limitations.

This study aims to answer the following research problems. Firstly, we try to determine whether remittances influence exchange rates. In addition to this, we aim to observe the manner in which the dynamics of exchange rates impacts the remittances inflows to Pakistan. Finally, we focus on finding regime domination effects.

Given the above mentioned objectives, this study fills an existing gap in the present literature in two ways. Firstly, to overcome data limitations, this study uses the conceptual framework found in (Khurshid et. al., (2016)) to construct remittances series by adding *worker remittances*, *migrant transfers* and *compensation of*

employees. The informal flow is expected to amount to a figure ranging from 10% to 40% of total remittances and in the absence of "*migrant transfers*" and "*compensation of employees*" this figure could rise to 60 percent of the whole remittance (Khurshid et. al., 2016). Secondly, this study contributes to the literature with a unique dimension of time-varying characteristics of the data considered. Pakistan has always been facing unstable economic conditions and with the beginning of the new millennium witnessed more challenges in high inflation, huge current account and trade account deficits, high foreign and external debt and political instability. The structural changes in the full-sample data of remittances and exchange rates will lead towards unstable and unreliable results. The full sample causality may no longer be valid in the presence of structural changes. This study uses a rolling bootstrap method to review the relationship between the above mentioned variables. The bootstrap rolling method examines the full sample and sub-sample considering structural changes in the model. After addressing the relevant issues, we expect to observe a bi-directional causality running between the two variables.

This research is organised as follows. Section 2, introduces the data and the methodological specifications. The empirical results that derived from our computations are shown in Section 3. The last section concludes focusing on the policy implications of the results obtained in the present analysis.

2. Theoretical Methodology and Empirical Approach

2.1. Portfolio Model

In this section, we use the portfolio model suggested by (Mussa, 1984) which explains the relationship between remittances and equilibrium exchange rate. It considers that the foreign funds are only transferred in the form of remittances (*REM*). In this model, the external exchange rate is determined by: current stock of net foreign assets f^a, the equilibrium and current asset holdings and remittances, so mathematically this is written as:

$$EXR = b\delta\left(f^a - \bar{f}^a\right) + \frac{(i^{ir} - g)}{\delta} f^a + \frac{1}{\delta} REM \qquad (1)$$

where g is GDP growth and $\bar{f}^a$ is equilibrium asset holdings.

The equilibrium external exchange rate $\overline{EXR}$ is consistent with asset holdings $f^a = \bar{f}^a$, *that is*

$$\overline{EXR} = \frac{(i^{ir} - g)}{\delta} \bar{f}^{a} + \frac{1}{\delta} REM \qquad (2)$$

The equation (2) shows that external equilibrium exchange rate is function of remittances:

$$\overline{EXR} = f\left(i^{ir}, \bar{f}^{a}, REM\right)$$

Where

i^{ir}- International interest rate

$\bar{f}^{a}$- Equilibrium net foreign asset position

REM - Remittances

The evolution of the internal exchange rate is determined by the distinctive response of sector-level prices between the two countries. The sector-wise prices are associated to the rise of sectorial productivity. These concepts can be represented with a basic model using two production factors, capital (*K*) and labor (*L*). The Cobb-Douglas production technology is used to determine the output in each sector, that is:

$$Y_N = A_N {L_N}^{\vartheta} {K_N}^{1-\vartheta} \qquad (3)$$

$$Y_T = A_T {L_T}^{\emptyset} {K_T}^{1-\emptyset}$$

where $0 < \vartheta, \emptyset < 1$ symbolize the intensity of labor while, Y_N and Y_T represent productivity in the non-tradable and tradable sector respectively. The labor force is perfectly mobile within the economy, inferring nominal wage leveling:

$$W_T = W_N = W \qquad (4)$$

The Labor force is rewarded per his marginal product $\partial Yi/\partial Li = W/Pi$. The Cobb-Douglas approach explains that the relation of marginal productivities is relative to average productivities:

$$\frac{\partial Y_T / \partial L_T}{\partial Y_N / \partial L_N} = \frac{\emptyset Y_T / L_T}{\vartheta Y_N / L_N} \qquad (5)$$

This expression explains that the sectorial prices are equal to productivity differentials plus a drift capturing the labor intensity. Stating by means of lower case the logarithms of sector-wise labor efficiencies, equation (5) change to:

$$\bar{P}_N - \bar{P}_T = \log {}^{\emptyset}/_{\vartheta} + [(Y_T - Y_N)] \quad (6)$$

Overlooking constant terms and symbolizing$n = [(Y_T - Y_N) - (Y_T^* - Y_T^*)]$, the internal equilibrium exchange rate is expressed as:

$$\overline{EXR} = \bar{n} \quad (7)$$

According to Balassa (1964) and Samuelson (1964), relative to foreign economy, the productivity differences in the tradable and non-tradable sectors can also affect the real exchange rate. In general, the output growth in tradable sector compared to non-tradable can appreciate the exchange rate (Lopez, et al, 2007).

How do remittances work in this unique circumstance? If the major portion of remittances is used to buy non-traded goods, this situation will encourage the labor force to move from the tradable sector of economy. (Amuedo-Dorantes and Pozo, 2006)

Subsequently, as of equation (3) $\partial y / \partial L < 0$, then it follows that output of the non-tradable sector compared to the tradable sector**.** Therefore, we expect that

$$(Y_T - Y_N) = \omega REM \quad (8)$$

If $\omega > 0$. So thus, remittances appreciate the internal real exchange rate.

Summing up, the above discussion shows that remittances can affect the internal and external balance of the economy and higher flows of remittances are linked with the appreciation of the exchange rate.

2.2. Methodology

2.2.1. System of Generalized method of Moments (SGMM)

The system GMM method proposed by the Arellano and Bover (1995) is used to address the possible endogeneity problem. In order to provide an analysis on the impact of remittances and other macroeconomic variables on the exchange rate and exports competitiveness we estimated the following two regressions:

$$EXR_{it} = \alpha_0 + \alpha_1 EXR_{i,t-1} + \alpha_2 REM_{it} + \alpha_3 (REM * GS)_{it-1} + \alpha_4 M2_{it} + \alpha_5 X_{it} + \varepsilon_{it} \quad (9)$$

where $EXR_{i,t-1}$ is the lag value of EXR, REM_{it} symbolizes remittances, $(REM * GS)_{it-1}$ represents the previous period savings due to remittance inflow while α_4 is the coefficient of money supply in the economy. In equation 9, X_{it} is the representation of the other explanatory variables such as: Consumer Price Index *(CPI)*, Foreign Direct Investment *(FDI)*, Exports *(EXP)*, Manufacturing value added *(MVA)*, Regime change 2000 *(RGM20)*, Economic and trade restrictions *(ETR98)* and Economic Crises 2008 *(EC08)*. The exogenous instrument includes, interest rate, and the remittances for consumption and age dependency ratio.

The relationship between remittances and exports is tested using the following equation:

$$EXP_{it} = \alpha_0 + \alpha_1 EXP_{i,t-1} + \alpha_2 REM_{it} + \alpha_3 (REM * GS)_{it-1} + \alpha_4 (REM * HHCE)_{it-1} + \alpha_5 LFPR_{it} + \alpha_6 X_{it} + \varepsilon_{it} \quad (10)$$

In equation (10), EXP indicate exports whereas α_4 is the coefficient of lag value of the remittances used for the consumption. Moreover, $LFPR_{it}$ represents the labor force participation rate. The other variables used in regression equation are: trade openness *(TOPN)*, foreign direct investment (FDI), economic and trade restrictions (ETR98) and interest rate (RIR). In equations (9) and (10), ε_{it} signifies the error term. The results of both regressions are summarized in Table 1.

2.2.2. Full and Subsample Causality Approach

This study is intended to find the causal link between remittances and exchange rate. However, this study will define Granger non-causality on the base of its predictive capability. Therefore, Granger non-causality is defined by whether; the available information set on a variable can improve the prediction of another variable. This procedure is done in the VAR framework by using the Lagrange Multiplier (LM), Likelihood Ratio (LR) and Wald test under the assumption that the data are stationary and that the standard asymptotic distribution does not hold. Different studies explain the difficulties during the estimation of nonstationary VAR models (Park and Phillips, 1989; Toda and Phillips, 1993, 1994).

To avoid conflicting results, Toda and Yamamoto (1995) and Dolado and Lutkepohl (1996) made further modifications in the standard Granger test to get a standard asymptotic distribution in the *VAR (p)* framework. To extend this work, Shukur and Mantalos (1998) evaluated the size and power properties of Granger non-causality tests in standard and modified forms, by using Monte Carlo simulations. Moreover, they included the modification recommended by Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996). Their results indicated that

the Wald test possesses size biases in small and medium size samples. Additionally, the bootstrap (*RB*) technique improves critical values and overcomes the size problem in the methods. However, with the co-integrated time series, bootstrap (*RB*) technique in VAR model gives more accurate critical values than the asymptotic one (Shukur and Mantalos, 1998). After examining the different properties of the Granger causality test, Shukur and Mantalos (2000) found that the *LR* test with small sample correction even with small sample size exhibits better power and size properties. The authors further argue that all tests not based on *RB* approach perform poorly, especially in a sample with small sample size. Irrespective of integrated features, the bootstrap (*RB*) technique shows better power and size after comparing corrected-*LR*, bootstrap and Wald causality test results (Mantalos, 2000). Hacker and Hatemi-J (2006) concluded that the asymptotic distribution has more size distortions than RB bootstrap technique.

Based on the above findings, this paper uses the *RB*-based modified *LR* statistics to examine the causality between worker remittances and the exchange rate in Pakistan. This study will consider the following bivariate *VAR* (*p*) process and the bootstrap-modified *LR*-Granger causality test procedure.

$$m_t = \vartheta_0 + \vartheta_1 m_{t-1} + \ldots\ldots\ldots\ldots + \phi_p m_{t-p} + \varepsilon_t \quad t = 1,2,\ldots\ldots\ldots,T \tag{9}$$

Where $\varepsilon_r = (\varepsilon_{1r} + \varepsilon_{2r})'$ means white noise with zero means and *p* represents the lag order. In the empirical portion *lag, the* order is selected by using the Akaike Information Criterion (AIC). To simplify, this study divides $y_t = (y_{1t} + y_{2t})'$ sub-vectors. The y_{1t} represents worker remittances, while y_{2t} the exchange rate. After the necessary changes equation (9) becomes:

$$\begin{bmatrix} REM_{1t} \\ EXR_{2t} \end{bmatrix} = \begin{bmatrix} \vartheta_{10} \\ \vartheta_{20} \end{bmatrix} + \begin{bmatrix} \vartheta_{11}(L)\vartheta_{12}(L) \\ \vartheta_{21}(L)\vartheta_{22}(L) \end{bmatrix} \begin{bmatrix} REM_{1t} \\ EXR_{2t} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} \tag{10}$$

where, REM and EXR are notations for remittances and exchange rate respectively.

$\vartheta_{ij}(L) = \sum_{k=1}^{p+1} \vartheta_{ij,k} L^k$, i & j = 1, 2 and L is the lag operator and define as $L^k x_t = x_{t-k}$ i= h, y. The null hypothesis that worker remittances do not Granger cause the exchange rate is tested under the restriction: $\vartheta_{12,k} = 0$ for k = 1, 2… *p*.

The idea that the exchange rate does not Granger cause remittances is tested by imposing the restriction: $\vartheta_{21,k} = 0$ for k = 1, 2… *p*

2.2.2.1. Parameter stability test

The standard Granger non-causality test is performed under the assumption that the parameter of the *VAR* model remains stable over the period. However, the presence of a structural change in the full sample period violates this assumption. As per Granger (1996), structural changes are always a challenging aspect in the empirical studies. During the entire sample period, the presence of structural changes makes causality tests invalid and the causal relationship unstable. This study will use rolling window Granger causality and a rolling bootstrap estimation approach, which uses modified bootstrap to overcome the parameter non-constancy and structural change problem. Andrews (1993) and Andrews and Ploberger (1994) used *Sup-F, Mean-F and Exp-F* tests to study the short run parameter stability. If the series are cointegrated, then the *VAR* model at the first difference becomes misleading and this needs to be compensated with error correction. It is necessary to test long term relationship and its parameter stability to have reliable results. Phillips and Hansen (1990) used modified ordinary least square (*FM-OLS*) to evaluate the parameter of the co-integration. We use the L_c test proposed by Nyblom (1989) and Hansen (1992) to test the parameter stability in the long run.

All the stated tests are performed from a sequence of *LR* statistics. This will examine the parameter constancy in the full sample against one-time structural change at each possible point of time. However, the bootstrap process will be used to calculate the *p-values* and critical values. As show in Andrews (1993), trimming in both sides of the samples is required while performing *Sup-F, Mean-F and Exp-F*. Therefore, given these elements, tests are performed on the sample in (*0.15, 0.85*) friction.

2.2.2.2. Sub-sample Rolling-window Causality Test

The structural changes are intimidating in today's research because they bring instability in the model. Different modifications are being made by using different techniques to avoid the structural change problem (sample splitting and including dummy variables). These techniques have a drawback, because they generate pre-test bias. This study uses a rolling window subsample Granger causality test based on the modified bootstrap estimation to overcome parameter non-constancy and the pre-test bias problem. As detailed above, structural changes bring instability in the sub-sample and non-constancy in the variables and represent two reasons that

justify applying rolling estimation approach. The rolling window technique is based on a fixed sample size rolling sequentially on the full sample period (Balcilar et al., 2010). If a fixed rolling window has *n* observations, then the full sample will be transformed into a subsample of order *Tn* that is τ-*n*+1, τ-*n*,..., T for τ= *n*, *n*+1... T.

All sub-samples are tested by using the *RB* based modified *LR* causality test. The causal relationships between worker remittances and the exchange rate are determined by the bootstrap *p*-values of the observed *LR*-statistic rolling through T-*n* sub-samples. This study will also examine the size of the effect of both series on each other.

The effect of worker remittances on the exchange rate is defined as the average of the total bootstrap estimates, and its values are calculated from $N_b^{-1}\sum_{k-1}^{p}\hat{\vartheta}_{21,k}^{*}$, where N_b is the number of bootstrap repetitions. Similarly, the effect of exchange rate on remittances is captured from $N_b^{-1}\sum_{k-1}^{p}\hat{\vartheta}_{12,k}^{*}$. Where $\hat{\vartheta}_{21,k}^{*}$ and $\hat{\vartheta}_{12,k}^{*}$ represent bootstrap estimates from the *VAR* models in *Eq.* (2). As stipulated by (Balcilar *et al.*, 2010), ninety percent confidence intervals are set in which the limits equal to fifth and 95th quantiles for each of the $\hat{\vartheta}_{21,k}^{*}$ and $\hat{\vartheta}_{12,k}^{*}$ respectively.

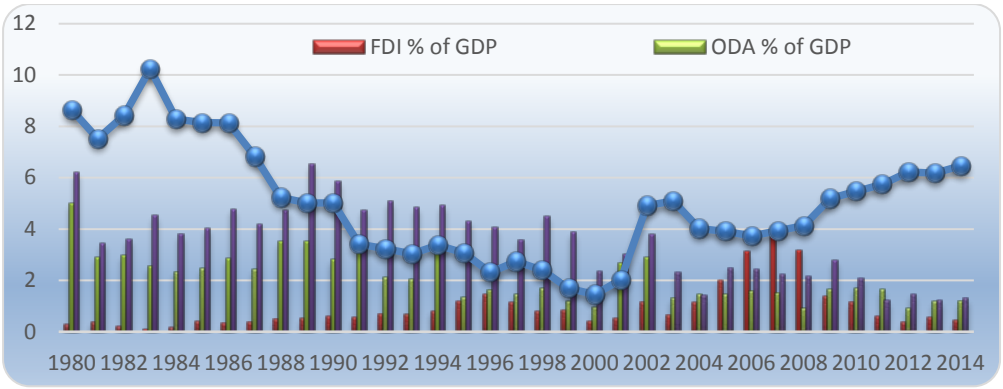
The interval and size of the window are pre-requisites in rolling window estimation. The accuracy of the parameter can be improved by including the large size and reducing the representation. Although the small window size can reduce the heterogeneity and boosts the representativeness of parameters, it may reduce the accuracy of the parameter, as the standard error increases. Ultimately, the selection of size is very important, so it should be selected in a way that can enhance the accuracy and the representativeness of the parameter. However, there is no specific standard in the selection of window size in rolling window estimation (Balcilar *et al.,* 2010). Despite this, Pesaran and Timmerman (2005) proposed that it should be computed from the mean square root process. As per Monte Carlo simulation, window size should be as low as 20, because it reduces the breaks and biases in the VAR model parameter. Furthermore, in the selection of window size, the degree of freedom and structural change should not be ignored. A larger window size is required to link the degree of freedom and the precision of parameter estimate. In this study, we tried window sizes between 20 and 50 and observed that the outcomes are not very sensitive in this range. So, due to this reason, the results with the 24-window size have been reported.

2.3. Data and Variables

We use monthly and annual data series from January 1992 to June 2015 to find the empirical relationship between remittances and the exchange rate. This study followed the Khurshid *et al.*, (2016) approach and constructed a series for Pakistan by adding, "*Worker remittances*", *Migrant Transfers*" and "*compensation of employees*". The data series are collected from the State Bank of Pakistan and the Ministry of Overseas Employment. The trend of different capital inflows can be seen in Figure II. The other variables used in different regressions are: Exports *(EXP)*, Consumer Price Index *(CPI)*, Foreign Direct Investment *(FDI)*, Money supply *(M2)*, Trade openness *(TOPN)*, Interest rate *(RIR)*, Labor force participation rate *(LFPR)* and Manufacturing value added *(MVA)*. We also used two proxy variables *(REM*GS)* and *(REM*HHCE)* to gauge the effect of remittances if used for saving and consumption. The effects of economic and trade restrictions in 1999 *(ETR98),* regime change in year 2000 *(RGM20)* and economic crises of 2008 *(EC08)* are tested on the exchange rate and exports using the time dummies. All variables except CPI are in the log form.

Figure II

Capital Inflow to Pakistan (%age of GDP)



3. Empirical results

3.1. System GMM outcomes

Table 1 reports the empirical results among remittances, exchange rate and exports. The results show that previous period fluctuation in the exchange rate has a significant positive impact on future exchange rate volatility. In the same time, remittances and increasing trends of exports depreciate the exchange rate in the Pakistan economy. The inflationary trend and money supply appreciate the exchange rate but has nominal effect on the export sector. The FDI cause of

depreciation but negatively affect the competitiveness. It is due to the reason that investors were buying the government owned institutions under the government privatization scheme started well after collapse of soviet economy back in 1989, privatization that continued until present. In addition to this, the lack of infrastructural facilities and the energy crises were the main reasons of decreasing trends in exports. Our results support the perspective of Hyder and Mahboob (2005) who claim that if FDI is oriented to the privatization process, it will not appreciate the exchange rate. The outcomes from our proxy variables (RGS) show that in the case in which remittances are used for saving, they will put a positive influence on the exchange rate and on exports. In the absence of the foreign capital the remittance inflow stored in the financial system can contribute to the lending process, adding to the growth of exports (Khurshid et al., 2016). However, if remittances are oriented to consumption, they negatively influence export competitiveness. The decreasing trends on labor participation rate negatively affect external sector, but trade openness boosts exports. The remittances inflow increases the personal disposable income, increases wages by decreasing the labor force participation rate and puts a negative effect on the trade sector of the economy (Bussolo and Medvedev, 2007). The change in exchange rate regime from multiple to flexible depreciated the exchange rate while, the global financial crises uplifted the currency rate and negatively affected the exports. Similarly, the economic sanctions due to nuclear tests appreciated the exchange rate and adversely affected the competitiveness. The AR and Hansan test confirm the validity of our instruments and we don't find traces of second order autocorrelation found in this case.

Remittances, exchange rate and exports results

Table 1

	Exchange Rate *(EXR)*			**Exports *(EXP)***		
Variables	**Coefficie**	**[95% Conf.**		**Coefficie**	**[95% Conf.**	
EXP(-1)				0.175	-	0.4148
EXR(-1)	0.733**	0.540	0.9268			
Exchange rate (EXR)				0.053**	0.023	0.0837
Exports (EXP)	-1.696**	-	-			
Remittances (REM)	-	-	-	0.207	-	1.3901
Consumer Price Index (CPI)	0.162**	0.037	0.2879	0.037	-	0.1307
Foreign Direct Investment	-	-	-	-0.066	-	0.3955
Money supply (M2)	0.048	-	0.5422			
Remittances used for saving) RGS	1.857**	0.331	3.3834	1.343**	0.567	4.1189
Remittances for Consumption)				-1.776**	-	-

	Exchange Rate *(EXR)*			Exports *(EXP)*		
Trade openness TOPN				0.359**	0.199	0.5194
Interest rate (RIR)				-0.032	-	0.0429
Labor force participation rate				-	-	-
Manufacturing value added MVA	1.350	-	3.2194			
Regime change 2000 (RGM20)	-3.143*	-	0.8511			
Economic Crises 2008 (EC08)	4.833	-	11.292	-0.707	-	0.8823
Economic and trade restrictions	1.269	-	7.1548	-0.328*	-	1.5591
Constant (C)	-71.103	-	23.762	48.892	9.489	88.294
AR(2)	0.707			0.112		
Hansan (*P-values)*	0.4			0.401		
Note: *, **, *** are representing significance at 10, 5 and 1 %.						

3.2.Full sample causality results

The first step in this analysis was to check that both series are stationary. To find the presence of unit root in the series we used the Augmented Dickey-fuller test (1979), Pillips Perron (1988) and the *KPSS* test proposed by Kwiatowski *et al.* (1992). The unit root test results presented in Table (2) shows that *REM* and *EXR* are stationary at first difference, signifying that series are integrated at 1 (1). To find the causal relation by using the *VAR* model, at first, we need to find the lag structure of the bivariate *VAR* model. The optimal lag length is selected by the Akaike Information Criteria (*AIC*). For our bivariate model, all lag length criteria selected four lags.

Unit root test

Table 2

Variables	Level			First Difference		
	ADF	**PP**	**KPSS**	**ADF**	**PP**	**KPSS**
REM	0.34553 (13)	-2.40372 (0)	0.47552 (14)	-5.82 (12)***	-38.9 (20)***	0.071 (17)*
EXR	-1.86010(1)	-1.98399(6)	0.2072 (14)	-14.093(0)*	-14.323 (5)*	0.0589(6) **

Note: *** indicate significance at all three levels (1%, 5% and 10%), while *, ** 5% and 10%respectively. The numbers in parenthesis indicate the lag orders selected based on the recursive *t*-statistic, as suggested by Perron (1989). The numbers in the brackets indicate the truncation for the Bartlett Kernel, as suggested by the Newey-West test (1987).

The bootstrap full sample Granger causality test rejected the null hypothesis that remittances do not Granger cause exchange rate. Similarly, it fails to accept the null hypothesis that the exchange rate does not Granger cause remittance. The results of both series are presented in Table 3. The outcomes show that there are two-way causal links between them. The Bootstrap *LR* full sample test results indicate that the EXR and REM have predictive power to explain each other in Pakistan.

Granger Causality tests (Full Sample)

Table 3

Tests	**H_0: REM does not Granger**		**H_0: EXR does not Granger**	
	Statistics	***p*-values**	**Statistics**	***p*-values**
Bootstrap *LR*	2.31846	0.0337	3.23426	0.0044

Note: Author computation by using EVIEWS software

The results of the full sample Granger causality test are stable and reliable only if the parameter estimate shows stability over the full sample period. If structural changes are present, the *VAR* model estimated above will shift with time and make the causal relation unstable (Balcilar *et al.*, 2013). The test results of full sample causality with parameter constancy assumption will be unreliable and the results of a single causal relationship across the whole period become meaningless over the whole sample period (Zeileis *et al.*, 2005). The structural breaks cause instability in the parameter estimation shifts and change the array of a causal relationship. Because of this reason different studies use different periods and present varying results. This study will use *Sup-F; Mean-F* and *Exp-F* tests with the null hypothesis tested for parameter constancy to check the short-run parameter stability. The *Sup-F* test will perceive the occurrence of regime shifts over the full sample period (Balcilar et.al. 2010). Furthermore, to test parameters in the overall *VAR* system, this study will use the L_c test proposed by (Nyblom, 1989; Hansen, 1992).

3.3. Parameter Stability results

The parameter constancy results of both series along with their *p-values* are presented in Table 4. The *p-values* are obtained by using a bootstrap approximation to null distribution of test statistics and by Monte Carlo simulation using 2,000 repetitions obtained with constant parameters. The test results of the *Sup-F* test reveal that a one-time sharp shift exists in REM and VAR system, whereas

exchange rates accept the null hypothesis of parameter consistency. As per *Mean-F* test results, EXR and the VAR system will follow the martingale process, but one-time sharp shift exists in REM. *Exp-F* results show that one-time sharp shift exists in the REM and *VAR* system, and they evolve gradually with time, whereas the EXR follows the martingale process. The L_c test results indicate that the overall *VAR* model shows instability in the short run.

Parameter Stability Tests

Table 4

	REM Equation		EXR equation		*VAR*(1) System	
	Statistics	**Bootstrap *p*-**	**Statistics**	**Bootstrap *p*-**	**Statistics**	**Bootstrap *p*-**
Sup-F	60.5808	0.000001	20.5125	0.589863	59.7263	0.005233
Mean-	32.3985	0.000039	14.1779	0.323223	23.5384	0.675233
Exp-F	25.4080	0.000003	7.80129	0.516244	25.0905	0.007875
L_c^b					8.2805	0.005000

Notes: *We calculate p-values using 2,000 bootstrap repetitions. Hansen-Nyblom parameter stability test for all parameters in the VAR jointly*

To test co-integration and long-run stability in the worker remittances and exchange rate model, this study applied *FM-OLS* test. The results of this test are summarised in Table 5. The L_c test fails to reject the null hypothesis of parameter stability. In the same way, *Sup-F* test results support the null hypothesis of parameter stability. Furthermore, *Mean-F, Exp-F* accepted the null hypothesis of unchanging parameters in the cointegration equation. This is evidence that the system will follow the martingale process. To sum up, the findings make it clear that there is a long-run association between remittances and exchange rates.

Parameter Stability Tests Results (FM-OLS)

Table 5

	Sup-F	***Mean-F***	***Exp-F***	L_c
REM = α + β*EXR	6.3454539	1.2688118	1.1467410	0.3310143
Bootstrap *p*-value	0.36907427	0.65721133	0.45168295	0.42914033

Notes: p-value by using 2,000 bootstrap repetitions

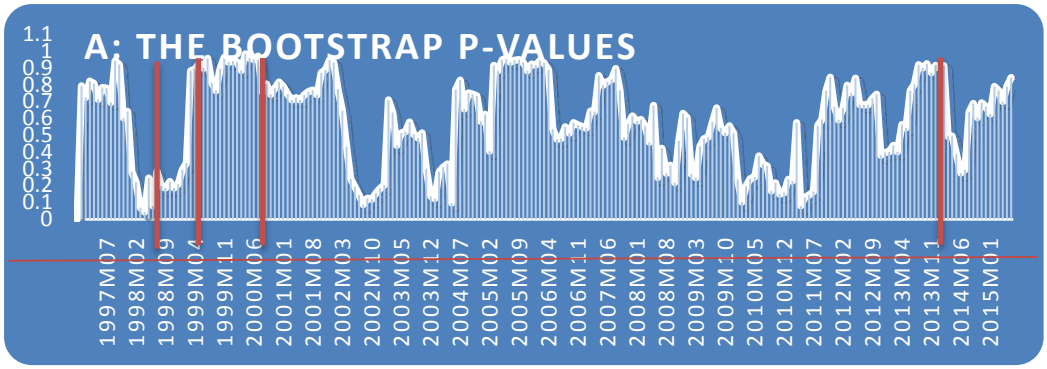
3.4. Sub-sample rolling window causality results

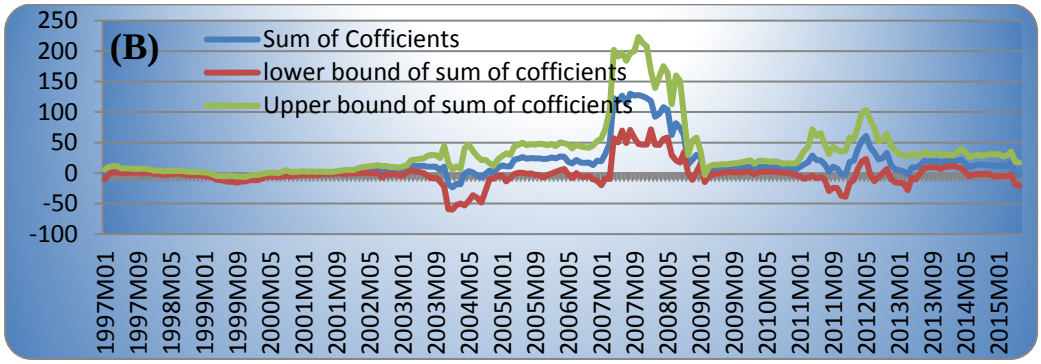
The dissimilar results presented in Table (4) and (5) show the presence of structural changes that bring instability in different sub-samples. To overcome this problem and find subsample causality, this study is using a rolling window regression methodology. This technique precisely checks the causal relation among the variables due to time varying across the different sub-samples, so these features make it dissimilar to a full sample causality test. In simple words, rolling window estimators are also called fixed-window estimators. This test is performed under the null hypothesis that remittances do not Granger cause the exchange rate and vice-versa. The bootstrap *p*-values of *LR*-statistics are estimated from the *VAR* model by using the rolling sub-sample data with a rolling window of size 30. This technique can capture the structural changes. It also detects instability and has the unique feature of determining how the model evolves over time (Balcilar et al., 2010). The procedure of rolling window starts with a fixed sample size and the procedure is updated by deleting the first observation at the start. The bootstrap *p-values* of rolling test can be observed in Figure III (a) under the null hypothesis that remittances do not Granger-cause the exchange rate. It also shows the magnitude and period during which causality occurs at 10% significance level. Figure III (b) shows the signs of the causality. The null hypothesis is rejected at 10% during sub-sample periods 1998/03-1998/04, 1998/06, 2002/08, 2004/05, 2010/02 and 2011/04.

Figure 3

Rolling window estimation results from remittances to exchange rate

*Note: **(a)** The Bootstrap p-values of LR test statistic testing the null hypothesis that remittance does not Granger cause exchange rate. **(b)** Bootstrap estimate of the sum of the rolling window coefficients for the impact of remittance on the exchange rate. **Note**: the red vertical lines show the breakup between different regimes*





The results from Figure III (a) show that worker remittances are positively related to the exchange rate. During the period 1998:3 – 1998:4 and 1998:6, the economic growth slowed down because of the fallout of Asian financial crisis as well as the atomic explosion of 1998. The worker remittances declined (30.9%) due to the economic sanction and freezing accounts. These developments induced balance of payment problems which resulted in the depreciation of the Pakistani rupees. The fiscal year 2002 was challenging because the world was undergoing cataclysmic changes like for example the events of September 11 and December 13. Their consequences adversely affected the peace and economic recovery of Pakistan. A 20% increase in worker remittances was observed that appreciated Pakistani rupees by 7% in interbank and 11% in the open market. During 2010:2 to 2011:4, SBP adopted a tight monetary policy and increased lending rate. By the end of April 2011, foreign currency amounted to $ 17.1 billion due to a substantial increase (23.8%) in worker remittances that shrank current account balance by 121.6% and slight appreciation of 0.8% observed in the exchange rate. The results follow the portfolio model proposed by Mussa (1984) that concludes that remittances appreciate the exchange rate in the recipient economy. It is further observed that remittances have a more robust effect on exchange rates during the flexible exchange rate regime.

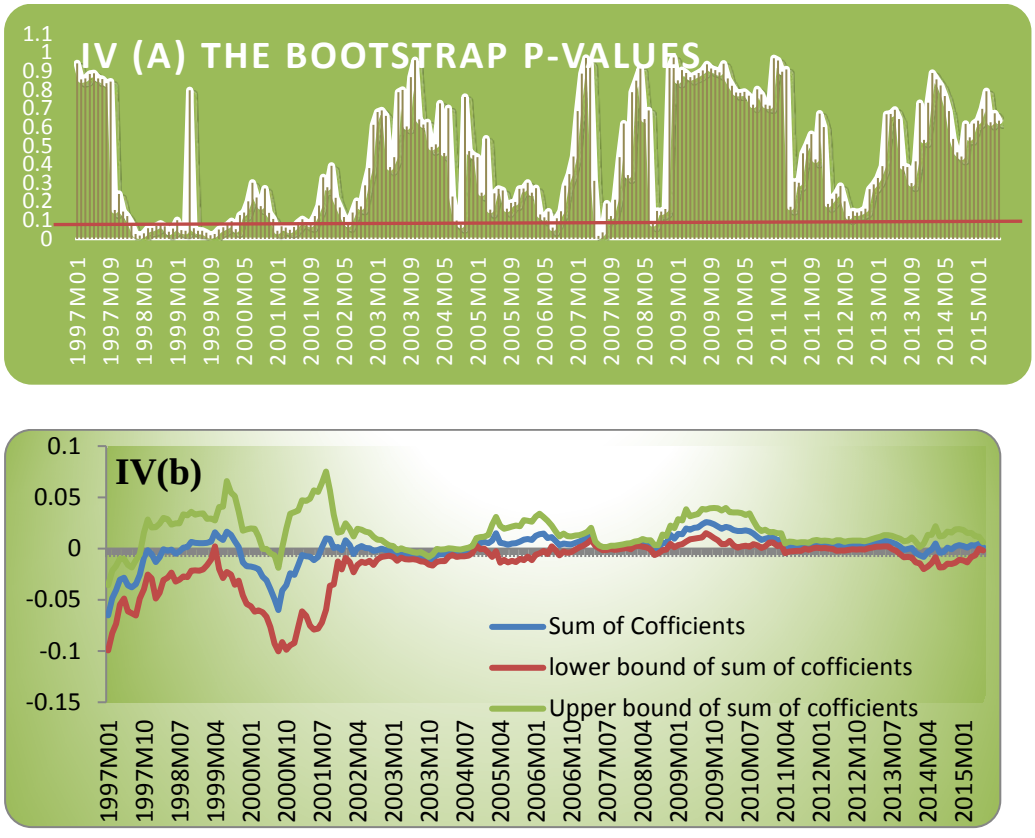
The *p-values* of the exchange rate and remittances Nexus are shown in Figure IV (a). During eight sub-sample periods, EXR have the predicting power to explain REM. By observing Figure IV (a), we notice the fact that these eight sub-sample periods are 1998/01-1999/01, 1999/05-2000/02, 2000/12-2001/09, 2002/05-2002/06, 2004/08-2004/09, 2006/06 - 2006/08 and 2007/06 - 2007/07. Analyzing Figure IV (b), we notice that during the sub-sample periods 2002/05-2002/06, 2006/06-2006/08, 2007/06-2007/07 and 2008/07 EXR is positively causing REM but, during 2004/08-2004/09 it has a negative impact on them. Mix

evidence is found during 1998/01 - 1999/01, 1999/05-2000/03 and 2000/12 - 2001-09.

The East Asian economic and financial crises and atomic blast during 1998:1 to 1999:1 had a devastating effect on Pakistan stock market and greatly reduced real estate prices causing a free fall of the currency. From 1998:1 to 1998:6, the currency depreciated by 9.11% while REM increased by 1.26%.

Figure 8

Rolling window estimation results from exchange rate to remittance



During 1998:7 to 1999:1 the State Bank changed the exchange rate regime from managed floating to dual rate (July 22). Because of economic sanctions, a decrease in export, freezing of foreign currency accounts and changes in regime, REM dropped 30% and because of that, foreign currency reserves went down at their lowest level (415 million). The structural reform and conversion into a market-

based unified regime during 1999:05 to 2000/03 strengthen the credit situation and boosted the remittances inflow. In 2000:7 the government adopted the free-floating regime. The increase in the import bill in addition to the repayment obligation badly affected the exchange rate and currency depreciated by 14.1% against US dollar but due to state bank measures to reduce "hundi" the official flow was increased up to 15.1% by 2001:9. The current account remained in surplus during 2002:05-2002:6 which strengthened the Pakistani rupees by 4% and encouraged the remitters to send money back to households. The notable increase of 41% in the import bills, loan repayments and downward trend in remittances inflow depreciated the currency in 2004:8-2004:9. The raising trend in remittances and other form of inflows helped in building the foreign currency liquid reserves of $ 13.74 billion in the period 2006:6 -2006:8. The currency more or less remained stable but an appreciation of 2.06% in the exchange rate was observed during 2007:6-2007:7. The results are similar several previous conducted by Hyder and Mahboob (2006), Janjua (2007) and Ahmed (2009).

To sum up, we find two-way causality evidence on the relationship between REM and EXR in different sub-sample periods. The outcomes also reveal that remittances have a more robust effect on the exchange rate during the flexible exchange rate regime. Furthermore, these periods are linked with historical events that occurred domestically or internationally.

4. Conclusion

This study examines the relationship between remittances, the exchange rate and export competitiveness using system GMM, full-sample Granger causality test and subsample bootstrap rolling window approach in Pakistan. The SGMM findings reveal that remittances depreciate the exchange rate, but in the same have a positive but insignificant impact on the export sector of the economy. In addition, remittances appreciate the exchange rate if used for saving while negatively affect the exports if they are diverted to the consumption path. The full-sample Granger causality test results show that a bi-directional causal relationship exists between REM and the EXR. The outcomes from the parameter stability tests show the presence of structural changes that bring short run instability. The results from the bootstrap sub-sample rolling window approach find causality evidences in different subsamples. The REM has a positive impact on EXR in all sample periods. The results support the portfolio model proposed by Mussa (1984) which stipulates that the REM inflow appreciates the EXR. Moreover, REM has a stronger impact on EXR during flexible EXR regime.

Given the observed fact that remittances put upward pressure on the exchange rates, this study gives some policy statements that may help to overcome this problem which may cause a potential loss of international competitiveness. *Firstly*, guidance in fiscal policy is the only measure the government can undertake to minimise its effect. In the presence of perfect mobility of capital, "fiscal expansions (contractions) lead towards real EXR appreciation (depreciation)". *Secondly*, sterilising operations on remittances along with fiscal adjustments can also help in the stabilisation of exchange rates. *Thirdly*, microeconomic interventions can lead the economy towards more competitiveness and can offset the EXR pressure. With regards to the Balassa-Samuelson type of arguments, rigidness in labour and product market can lead towards real appreciation. *Finally*, following the findings of Acosta and Fajnzylber (2007), it is clear that remittances have a negative impact on labour supply. On these grounds, reducing the payroll taxes or shifting them to VAT/ sales taxes can counter the adverse effects of the remittances inflow that may cause an appreciation in the exchange rate. Finally, monetary authorities should channel remittances and convert them into investments that will offset their negative implications.

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