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# An Empirical Analysis of Remittance – Inflation Relationship in Bangladesh : Post-Floating Exchange Rate Scenario

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## Abstract

*Workers' remittance inflows have been rising significantly over the past decade for Bangladesh. They have become one of the most stable sources of foreign exchange earnings and emerged as a crucial issue for monetary and fiscal policy. In 2012, remittances contributed to 12.3% of GDP of Bangladesh while the contribution was 6.4% in 2003. Besides lowering poverty and stimulating economic growth through different microeconomic and macroeconomics channels, remittances like other massive capital inflows can induce inflation and appreciate the real exchange rate and thereby hurt the competitiveness of the tradable sector along the lines of the Dutch Disease phenomenon. In this paper, we have empirically tested whether growing remittances cause an inflation (Model 1) as well as food inflation (Model 2) in Bangladesh using monthly data over the time period July 2003- July 2013 (post - floating exchange rate scenario). We have considered two models as the pattern of expenditure varies by consumption categories suggesting that the effect of remittances may also vary across them. Monthly data is used to better represent the changes in inflation as it is well known that inflation changes occur very quickly in response to shocks. The reason for specifically concentrating on the post-floating exchange rate scenario comes from the fact that the impact of remittances on a economy depends on the exchange rate regimes and studies not controlling for regimes may be biased as suggested by Ball et al. (2013). Johansen (1988) and Johansen & Juselius (1990) cointegration technique is used to determine the long run relationship between remittances and inflation. Then, a Vector Error Correction Model (VECM) approach is applied for estimating the direction, extent and significance of the relationship. The results of both the models show that remittance inflows cause an inflationary pressure in Bangladesh while the responsiveness of food inflation is almost two and half times higher than general inflation.*



**Keywords:** Remittances, Inflation, Dutch Disease, Cointegration, VECM, Connectedness Analysis

**JEL Classification:** E31, F24

## Table of Contents

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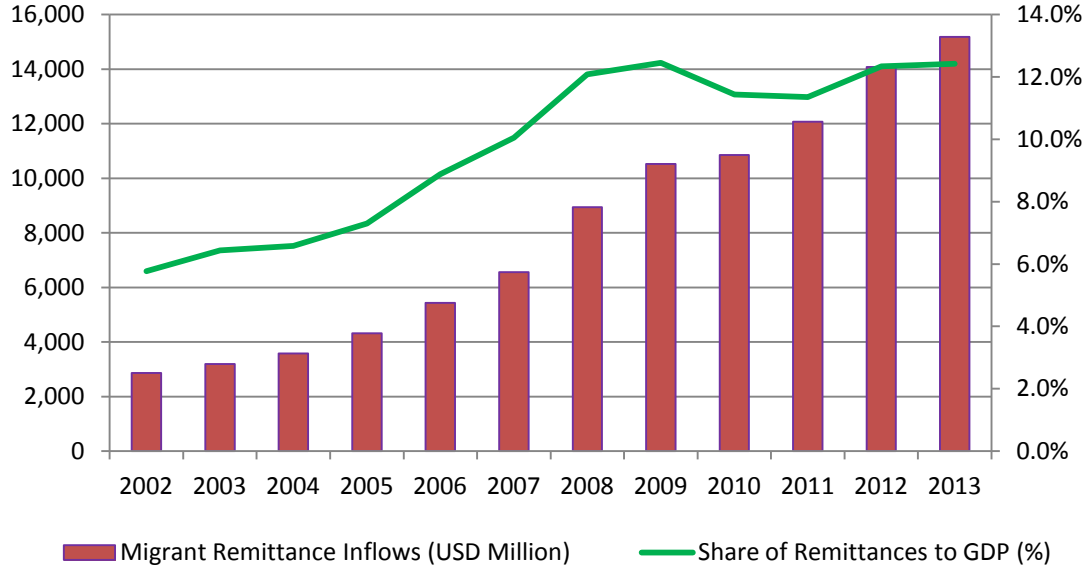
## Introduction

Inflows of workers' remittances to Bangladesh have experienced a sharp rise in recent years. Remittances have also evolved as a more stable and important source of foreign exchange earnings compared to official development assistance, foreign direct investment or other types of capital flows. Remittances have some comparative advantages as they do not create future repayment obligation like capital flows and the recipient countries do not need to comply with certain political and economic conditions like foreign aid. Moreover, foreign aids come to the government and work as public aid while remittances come to the households and work as private aid. The spending nature of the government is largely different from that of individual households as government spends a significant portion on development projects whereas households spend more on consumption purposes thus inducing consumer price index (CPI). While some studies conclude that a high inflow of remittances lower poverty and stimulates economic growth (e.g. Acosta et al., 2009; Giuliano & Ruiz-Arranz, 2009), some studies suggest that remittances can induce inflation in the recipient economies (e.g. Balderas & Nath, 2008; Narayan et al., 2011; Nisar & Tufail, 2013; Khan & Islam, 2013).

**Figure 1: Remittance Inflows and Share of Remittances to GDP**




Source: Compiled by authors from Migration and Remittances data and World Development Indicators (WDI) Database of World Bank (2013, 2014) & various issues of Monthly Economic Trends of Bangladesh Bank (2014a)

Workers' remittances have grown significantly compared to other more traditional sources of foreign exchange like aid and exports for Bangladesh. Given the growing share of remittances in GDP and foreign exchange earnings, it is important to identify the economic impacts of remittances. In this paper, we have attempted to examine whether workers' remittances induce inflation in Bangladesh particularly after adopting the floating exchange rate regime in 2003. The reason for specifically concentrating on the post-floating exchange rate scenario comes from the fact that the impact of remittances on a economy depends on the exchange rate regimes and studies not controlling for regimes may be biased as suggested by Ball et al. (2013). By using a theoretical model, they show that remittances temporarily increase domestic money supply and inflation under a fixed exchange rate regime. Conversely, remittances temporarily generate no change in the money supply, decrease inflation and appreciate the real exchange rate under a flexible exchange rate regime. However, Reinhart and Rogoff (2004) show that, an increase in remittance inflows causes a transfer of resources from the tradable to the non-tradable sector which generates a rise in the price level. Under a fixed exchange rate regime, international relative prices cannot be adjusted after a negative shock to the tradable sector. Thus the nominal depreciation is prevented. The resulting effect will be a contracting tradable output sector and a rising price level. On the other hand, remittance inflows can increase the price level and appreciate the exchange rate as the international relative prices can be adjusted under a flexible exchange rate regime.

This paper will help to understand the various impacts of remittances on Bangladesh economy and assist in the development of policies maximizing benefits of these income inflows. The paper is organized in the following way. It starts with discussing the channels through which remittances can influence inflation. This is followed by literature review which captures the relevant theories, empirical studies and their results concerning remittances - inflation relationship. The next section specifies the models by discussing the determinants of inflation. Data issues, econometric methodology, empirical results and some limitations are presented following. The final section includes the conclusions and policy implications.

## Remittance – Inflation Relationship

Workers' remittance inflows, an important demand side variable of inflation, are expected to affect inflation from the perspectives of spending effect, exchange rates, money supply and balance of payments. At the micro level remittances directly lead to an increase in household income which in turn raises their demand for goods and services. If this excess demand exceeds the domestic production, then there arise a positive output gap and inflationary pressure to the economy (Khan et al., 2007).

The Salter-Swan-Corden-Dornbusch paradigm provides an avenue for understanding the theoretical linkages among remittances, price level and real exchange rate in developing economies. The paradigm suggests that an increase in remittance inflows can appreciate the real exchange rate through raising the domestic prices while the extent of the effect on domestic prices depends on the country's exchange rate regime. Acosta et al. (2007) explained the case of increasing price level when remittance is high by developing a micro-founded dynamic stochastic general equilibrium (DSGE) model. The transmission mechanism they suggest is: an increase in remittance inflows raises the household income which in turn causes a fall in the labor supply. The shrinking labor supply induces higher wages which leads to higher production costs and further contraction of the tradable sector. Therefore, both the real exchange rate and the ratio of tradable to non-tradable output stimulate high spending and resource movement which can potentially generate an inflationary pressure.

The inflows of large amount of foreign exchange by expatriates in the form of remittances increases the money supply of the recipient economy through the conversion of foreign exchange into domestic currency. If this increase in money supply is not channelized towards productive sectors and capital investment, it can fuel inflation by shifting to consumption expenditure. Moreover, remittances can drive up inflation by creating a short run excess demand through raising consumption expenditure which originates from a boost in real wealth.

Remittances can also contribute towards foreign reserves accumulation and thus generate a surplus in balance of payment. If the central banks fail to fully sterilize the rise in foreign reserves, it will lead to an increase in monetary base and appreciation of real exchange rate. Thus there will be a rise in the price level.

## Literature Review

Keynes (1929) and Ohlin (1929) were the first who debated on having significant effects of transfers on receiving economies what has been dubbed as the Transfer Problem. The debate which extends to the present time suggests that the theoretical welfare impacts of capital inflows are ambiguous and largely depends on the various characteristics of the sending and receiving countries (Djajic, 1998).

Literature on the effects of remittance inflows mostly focuses on the exchange rate or Dutch Disease issues (e.g. Amuedo-Dorantes & Pozo, 2004; Bourdet & Falck, 2006; Lartey et al., 2012) and terms of trade issues. Adelman and Taylor (1992) pointed out that, workers' remittance inflows may also have effects on inflation through their direct and indirect effects on aggregate demand. Remittances are spent partly on consumption and partly on investment. The direct effect of remittances on aggregate demand is resulted by the increase in consumption expenditure of the receiving households which in turn creates an inflationary pressure.

Existing empirical works in the area of the relationship between remittances and inflation have been undertaken by using time series models (single country level) and panel data models (cross-country level). However, the findings of most of the studies are compatible with the existence of inflationary pressure caused by remittance inflows.

The majorities of the single country studies are undertaken by using cointegrating equations and vector autoregressive models and come to somewhat similar conclusions. Using generalized impulse responses derived from a vector autoregression (VAR) model, Ulyses Balderas & Nath (2008) examined the effects of remittances on inflation and the distribution of relative price changes in Mexico for the period 1980 to 2005. While they found little evidence of any significant impact of remittances on inflation and relative price variability for the entire sample period, remittances seemed to have significant positive effects after 1994.

Kim & Yang (2008) explored why an increase in capital inflows can increase asset price by using output, price level, capital inflows or portfolio inflows (as a ratio to trend GDP) stock price and land price. By using a VAR model, they found that the capital inflows have actually contributed

to the asset price appreciation in the emerging East Asian economies although the capital inflow shocks explain a relatively small part of asset price fluctuations.

Rashid & Husain (2010) examined the effects of capital inflows on domestic price level, monetary expansion and exchange rate volatility in Pakistan for the period 2001-2007. By using linear and nonlinear cointegration and Granger causality tests, they found that there exists a significant inflationary impact of capital inflows. Mukhtar (2012) reexamined Romer's Hypothesis [1] for Pakistan over the period from 1960 to 2007. By using cointegration analysis, he confirmed the existence of Romer's hypothesis in Pakistan. Nazir et al. (2012) checked the impact of capital inflows on Pakistan's domestic inflation from 1980-2010. Using cointegration test and Error Correction Mechanism (ECM), they found that there is a long run and significant relationship among foreign direct investment (FDI), remittances, export and inflation. Nisar & Tufail (2013) examined the impact of remittances on inflation, food inflation, footwear & textile inflation and housing & construction inflation for Pakistan by using Johansen (1988) and Johansen & Juselius (1990) cointegration technique over the time period 1970-2010. They found that remittances have positive impact on inflation and its different categories.

Khan & Islam (2013) verified how remittances inflows affect the inflation rate in Bangladesh for the 1972-2010 time period by applying vector autoregressive (VAR) techniques. Their empirical results conclude that a 1 percent increase in remittance inflows lead to a rise in inflation by 2.48 percent in the long run, whereas no significant relationship is evident between these two variables in the short-run.

The panel studies in this area have used Keynesian type econometric model, generalized method of moments (GMM) and Arellano & Bond (1991) panel dynamic estimator, Arellano & Bover (1995), Blunddell & Bond (1998) system GMM estimator. GMM and instrumental variable approach are used to deal with the potential endogeneity problem in the models.

Glytsos (2002) builds a Keynesian type econometric model for investigating the short and long-run multiplier effects of remittances on consumption, investment, imports and output using

[1] Romer (1993) postulates a hypothesis that inflation is lower in small and open economies.

data of five Mediterranean countries. Glytsos (2002) reveals that “a uniform country performance of instability and uncertainty, with great temporal and inter-country fluctuations of remittance effects. The findings point to different inter-country priorities of remittance spending and to an asymmetric impact of remittance changes, in the sense that the good done to growth by rising remittances is not as great as the bad done by falling remittances.”

Narayan et al. (2011) modeled the impact of remittances and institutional variables on inflation in both short run and long run using a panel data set of 54 developing countries over the period 1995-2004. Using Arellano & Bond (1991) panel dynamic estimator, Arellano & Bover (1995), Blunddell & Bond (1998) system GMM estimator, they found that remittances generate inflation in developing countries and the effect is more pronounced in the long run.

Given the above discussions on the literature, it seems that there is a space of more research to determine the influence of remittances on inflation of Bangladesh in a scenario of steady remittance growth and floating exchange rate regime. Moreover, almost all the past studies are based on yearly data. In this paper, we have used monthly data which can better represent the inflation as it changes on a frequent basis.

## Determinants of Inflation

In our research, we want to specifically test the hypothesis that remittances result in an inflationary pressure in Bangladesh. To do that, we need to control for other explanatory variables which could also influence inflation. There is an extensive literature on the determinants of inflation (see, surveys by Bronfenbrenner & Holzman (1963); Laidler & Parkin (1975); Berk (1999) and papers by Cotarelli (1998); Galí et al. (2001); Ulyses Balderas & Nath (2008); Ball et al. (2013); Khan & Islam (2013)). In empirical analyses, there are also different choices of determinants of inflation. Sometimes the set of determinants are chosen relying on the availability of data. Besides remittances, the following additional determinants are thought to influence inflation.

**Fiscal Policy / Government Expenditure / Budget Deficit:** Fiscal policy has the tendency to stimulate economic growth through an expansion of the government expenditure. This in turn generates higher inflation and government budget deficits. The budget deficit of the government is financed either by borrowing from domestic and international sources or by directing the central bank to increase the money supply by printing new money (seigniorage). Thus the deficit financing by the government for funding increased government expenditures have liquidity effects which in turn lead to a rise in the aggregate demand and generate an inflationary pressure in the economy (Mohammad & Wasti, 2009).

**Output / GDP / Industrial Production Index:** Real GDP is an important supply side variable that may determine inflation. It is expected that there exist a negative association between output and inflation through the channel of aggregate supply. Other things remaining the same, an increase in output will increase the aggregate supply in market which will reduce the inflationary pressure.

**Monetary policy / Money Supply / Interest Rate:** According to Milton Friedman (1970) "Inflation is always and everywhere a monetary phenomenon." The quantity theory of money suggests that the growth in the quantity of money is the primary determinant of the inflation particularly in the developed economies. In contrast, inflation is not a purely monetary phenomenon in developing countries and often linked with higher money growth and exchange rate depreciation arising from fiscal imbalances and balance of payments crisis. The

pass-through of money supply into inflation involves two transmission mechanisms. The direct mechanism works through the channel of aggregate demand while the indirect mechanism works through the channel of interest rate. However, the effect of money supply may have diverse effect on different categories of inflation as its impact differs across different categories of consumption as suggested by Qayyum (2006) & Kemal (2006).

**Exchange Rate:** The exchange rate can affect inflation through both direct and indirect channels. An appreciation of the domestic currency usually reduces the price of imported consumer goods and durables, raw materials and capital goods thus influencing consumer price index directly. The indirect channel works through aggregate demand and output gap. However, the pass-through of the indirect channel is relatively slow compared to the direct channel.

The above discussion shows that all variables mentioned above have strong theoretical relationship with inflation. In sum, we can represent the determinants of inflation by the following expression:

$$\underset{}{\mathbf{q}} \quad = \quad \underset{}{\mathbf{f}}\,(\ \underset{+}{\mathbf{GOV}},\ \underset{-}{\mathbf{IPI}},\ \underset{+}{\mathbf{M2}},\ \underset{+}{\mathbf{ER}},\ \underset{+}{\mathbf{REM}})$$

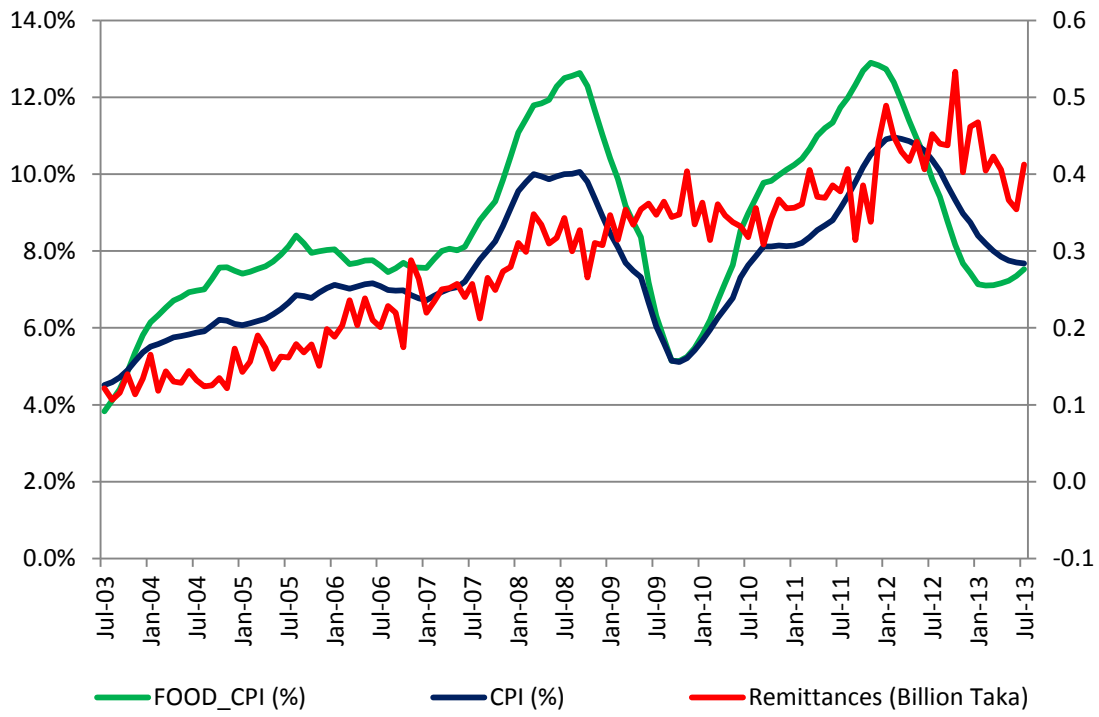
where q represents Inflation; Government Expenditure (GOV), Industrial Production Index (IPI), Money Supply (M2), Exchange Rate (ER) and Remittances (REM) are the determinants of inflation. The sign beneath each variable show the expected direction of inflation in response to that variable.

## Data

In this part, we briefly describe each variable that is included into the models and the way in which the variables are constructed. We also provide a rationale for choosing that particular variable versus other alternatives. The study employs monthly data for general and food consumer price index (CPI), industrial production index, remittance inflows, money supply, exchange rate as well as monthly government expenditure data interpolated from yearly data series.

Logarithm of CPI is used as a proxy of overall inflation rate. In this regard, we have followed Nisar & Tufail (2013) and Khan & Islam (2013) who used yearly CPI data to represent inflation in their studies. All these CPI and Food CPI series come from various Monthly Economic Trends and Major Economic Indicators of Bangladesh Bank.

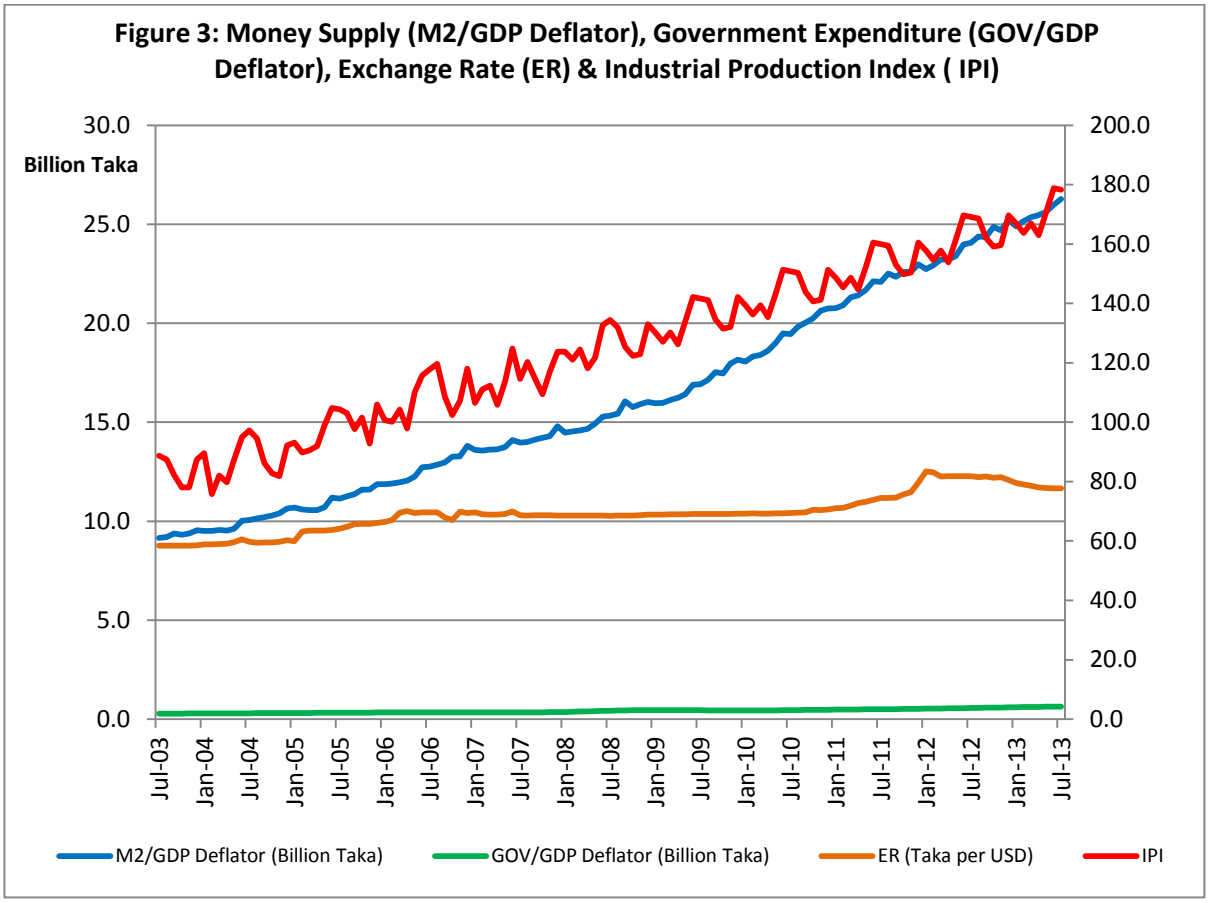
**Figure 2: Food Inflation (FOOD_CPI), Inflation (CPI) & Remittances (REM)**




Source: Compiled by authors from various issues of Monthly Economic Trends and Major Economic Indicators of Bangladesh Bank (2014a, 2014b)

Industrial Production Index (IPI) is used as a measure of output. Nisar & Tufail (2013) and Khan & Islam (2013) used per capita GDP as they used yearly data. However, as we are using monthly data, it becomes more convenient to work with IPI. Ulyses Balderas & Nath (2008) also used IPI in their monthly data study of remittance, relative price variability and inflation relationship. Remittances, money supply (M2) and government expenditure are taken in real terms by dividing the variables with the GDP deflator. Remittances data are available in millions of US dollars, and have been converted into billions of taka using the nominal exchange rate (BDT per USD). The impact of money supply on inflation is captured by broad money (M2). Monthly government expenditure data is interpolated from yearly data of Bangladesh Economic Review published by Ministry of Finance, Government of Bangladesh. Additionally, monthly exchange rate data is derived by taking the average of nominal exchange rate for the whole month. These data come from the Monthly Economic Trends of Bangladesh Bank.

**Figure 3: Money Supply (M2/GDP Deflator), Government Expenditure (GOV/GDP Deflator), Exchange Rate (ER) & Industrial Production Index ( IPI)**




Source: Compiled by authors from various issues of Monthly Economic Trends and Major Economic Indicators of Bangladesh Bank (2014a, 2014b) and Bangladesh Economic Review of Ministry of Finance, Government of Bangladesh

The data covers the monthly data for the time period July 2003 to July 2013. The choice of the sample period is dictated as it covers the post floating exchange rate scenario of Bangladesh. The data is collected from Monthly Economic Trends and Major Economic Indicators of Bangladesh Bank, Bangladesh Economic Review of Ministry of Finance and International Financial Statistics (IFS) database of IMF. Almost all the studies in this area are done with yearly data while in this paper we tried to focus on the monthly data. The reason for using monthly data is to better represent the changes in inflation rate as it is well known that inflation rate changes occur very quickly in response to shocks and both the key variables are available in monthly basis. Moreover, by running two models, we tried to make a comparison of the responsiveness of different types of inflation to remittance inflows.

*(Definitions & sources of the variables are summarized in Appendix A.1 and statistical descriptions are summarized in Appendix A.2)*

## Estimation and Discussion of Results

Johansen (1988) and Johansen and Juselius (1990) cointegration technique is used to assess the long run relationship between remittances and inflation for the time period July 2003 to July 2013. The study has incorporated two models for the purpose of comparative analysis.

| Model | Specification |
|---|---|
| 1 | $CPI_t = \alpha_1 + \alpha_2 IPI_t + \alpha_3 REM_t + \alpha_4 GOV_t + \alpha_5 M2_t + \alpha_6 ER_t + \varepsilon_t$ |
| 2 | $FOOD\_CPI_t = \beta_1 + \beta_2 IPI_t + \beta_3 REM_t + \beta_4 GOV_t + \beta_5 M2_t + \beta_6 ER_t + \omega_t$ |

Before doing any estimation, we perform several transformations on our data. First, remittances, money supply (M2) and government expenditure are transformed in real terms by dividing the variables with the GDP deflator. After that all the variables are taken in natural logarithm. The log values of the variables are renamed with a LN sign at the front. Then the stationarity of the variables are assessed by testing the presence of unit roots. Cointegration analysis requires that all the variables are to be integrated of same order. We use the Augmented Dickey Fuller (1979) unit root test for checking the stationarity or the order of integration of each variable. The Augmented Dickey Fuller (1979) test is done by estimating the following regression:

$$\Delta Y_t = \alpha \quad + \beta_t + \gamma_i Y_{t-1} + \sum_{i=1}^{n} \lambda_i \, \Delta Y_{t-1} + \varepsilon_t$$

Where $Y_t$ is the variable under consideration, $\Delta$ is the first difference operator and α, β, γ, $\lambda$ are the parameters to be estimated. The test of unit root involves testing, $\lambda = 0$. The null hypothesis is that the variables have a unit root. The results of the Augmented Dickey Fuller (1979) tests are reported in the Table1.

**Table 1: Augmented Dickey Fuller (ADF) Unit Root Tests**

| Variables | Level | | First Difference | | Order of Integration |
|---|---|---|---|---|---|
| | Statistic | Prob. | Statistic | Prob. | |
| Inflation (LN_CPI) | -2.093 | 0.247 | -2.054 | 0.038 | I(1) |
| Food Inflation (LN_FOOD_CPI) | -2.803 | 0.061 | -2.358 | 0.018 | I(1) |
| Industrial Production Index (LN_IPI) | -1.050 | 0.931 | -3.888 | 0.003 | I(1) |
| Workers' Remittances (LN_REM) | -1.797 | 0.699 | -13.706 | 0.000 | I(1) |
| Broad Money (LN_M2) | -1.686 | 0.751 | -5.699 | 0.000 | I(1) |
| Government Expenditure (LN_GOV) | -2.249 | 0.457 | -4.819 | 0.000 | I(1) |
| Exchange Rate (LN_ER) | -1.842 | 0.677 | -9.043 | 0.000 | I(1) |

According to ADF (1979) test results, for all the variables the null hypothesis of unit root could not be rejected in their levels at 5% level of significance implying they are nonstationary although food inflation is stationary at 10% level of significance. Given these unit root test results, we transform the nonstationary series to a stationary process by differencing. The first differences of these variables are indeed stationary at 1% significance level except the first difference of inflation which is stationary at 5% level of significance. Thus all these variables are claimed to be integrated of order one [ I(1) ].

After that the optimal lag length is found by using the proper information criteria. At least M2, IPI, GOV and ER contain trends so a linear trend is included in the VAR model. The data for remittances and IPI show seasonality so we add eleven seasonal dummies and exclude one to avoid the Dummy Variable Trap. To find out the optimal lag length, we use the Schwarz Information Criterion (SC). The results of the VAR lag selection criteria using SC are reported in the Table 2.

**Table 2: VAR Lag Order Selection Criteria**

| | Model 1 | Model 2 |
|---|---|---|
| Lag | SC | SC |
| 0 | -16.41 | -15.69 |
| 1 | -28.40 | -27.49 |
| 2 | -32.87 | -32.07 |
| 3 | -34.54* | -33.74* |

* denotes minimum value according to Schwartz Information Criteria (SC)

For the both cases, SC suggests VAR(3) models which are also the most parsimonious models. The next step involves doing the cointegration test. The multivariate cointegration test can be expressed as:

$$Z_t = \eta_1 Z_{t-1} + \eta_2 Z_{t-2} + \cdots + \eta_{k-1} Z_{t-k} + v + \varepsilon_t$$

Where $Z_t$ (inflation, government expenditure, industrial production index, remittances, exchange rate and money supply) is a 6*1 variables that are integrated of order one, $v$ is a vector of constant and $\varepsilon_t$ is normally and independently distributed error term. To determine the existence and the number of cointegrating vectors, Johansen cointegration technique is used. There are two hypothesis tests used for cointegration testing, called the Trace (λtrace) test and Maximum Eigen value (λmax) test. The cointegration test results at 5% level of significance are presented in Table 3. For both the models, these two tests show that there are two cointegrating vectors among CPI (general and food), GOV, IPI, REM, ER and M2 as the test value is greater than the critical value. This result also confirms the long run association between the variables of the study. These implications are also supported by the p-values.

**Table 3: Johansen Cointegration Test Results**

| Model 1 | | | | | |
|---|---|---|---|---|---|
| Null Hypothesis | Alternative Hypothesis | Eigen Values | | 0.05 critical Value | Prob.** |
| Trace Test | | | Trace Statistic | | |
| $H_0$ : r=0 | $H_1$ : r=1 | 0.589 | 188.28* | 95.75 | 0.000 |
| $H_0$ : r=1 | $H_1$ : r=2 | 0.349 | 83.33* | 69.81 | 0.002 |
| $H_0$ : r=2 | $H_1$ : r=3 | 0.126 | 32.62 | 47.85 | 0.577 |
| Maximum Eigenvalue Test | | | Max-Eigen Statistic | | |
| $H_0$ : r=0 | $H_1$ : r>0 | 0.589 | 104.94* | 40.07 | 0.000 |
| $H_0$ : r≤1 | $H_1$ : r>1 | 0.349 | 50.71* | 33.87 | 0.000 |
| $H_0$ : r≤2 | $H_1$ : r>2 | 0.126 | 15.91 | 27.58 | 0.673 |
| **Model 2** | | | | | |
| Null Hypothesis | Alternative Hypothesis | Eigen Values | | 0.05 critical Value | Prob.** |
| Trace Test | | | Trace Statistic | | |
| $H_0$ : r=0 | $H_1$ : r=1 | 0.613 | 186.17* | 95.75 | 0.000 |
| $H_0$ : r=1 | $H_1$ : r=2 | 0.306 | 73.96* | 69.81 | 0.022 |
| $H_0$ : r=2 | $H_1$ : r=3 | 0.128 | 30.83 | 47.85 | 0.675 |
| Maximum Eigenvalue Test | | | Max-Eigen Statistic | | |
| $H_0$ : r=0 | $H_1$ : r>0 | 0.613 | 112.20* | 40.07 | 0.000 |
| $H_0$ : r≤1 | $H_1$ : r>1 | 0.306 | 43.12* | 33.87 | 0.003 |
| $H_0$ : r≤2 | $H_1$ : r>2 | 0.128 | 16.20 | 27.58 | 0.648 |

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Trace and Max-Eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level.

The results of cointegration test are interpreted through Vector Error Correction Model (VECM) which is a restricted version of VAR model designed for non stationary time series. VECM captures the linear relationship among multiple time series by adding error correction features. The error correction term (ECT) tells how much the error is being corrected to a

deviation in the long run. The expression used to denote a VECM has the following form: (Nisar & Tufail, 2013)

$$\Delta Z_t = \tau_1 \Delta Z_{t-1} + \tau_2 \Delta Z_{t-2} + \tau_3 \Delta Z_{t-3} + \ldots . + \tau_{k-1} \Delta Z_{t-k-1} + \pi Z_{t-1} + u + v_t$$

Where $\tau_i$ = (I – $A_1$ – $A_2$ …. – $A_i$); i = 1, 2, 3….. (k–1) and $\pi$ = – (I – $A_1$ – $A_2$ ….. –$A_k$). The coefficient matrix $\pi$ provides information about the long-run relationships among the variables in the data. $\pi$ can be factored into αβ where α will include the speed of adjustment to the equilibrium coefficients while the β will be the long-run matrix of coefficients. The estimated cointegrating vectors (β), adjustment coefficients (α) and the cointegrating equations (with the constant terms and t-statistics) are reported below:

$$\boldsymbol{\beta}\,\widehat{\textbf{Model 1}} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \\ 1.335 & -1.349 \\ -0.713 & 0.402 \\ -1.656 & 0.263 \\ 0.017 & -0.306 \end{pmatrix} \qquad \boldsymbol{\beta}\,\widehat{\textbf{Model 2}} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \\ 4.629 & -2.341 \\ -1.908 & 0.655 \\ -1.481 & 0.519 \\ -0.729 & 0.002 \end{pmatrix}$$

$$\boldsymbol{\alpha}\,\widehat{\textbf{Model 1}} = \begin{pmatrix} -0.114 & -0.243 \\ 0.000 & -0.000 \\ -0.049 & 0.136 \\ 0.414 & -0.128 \\ 0.064 & 0.042 \\ -0.021 & -0.028 \end{pmatrix} \qquad \boldsymbol{\alpha}\,\widehat{\textbf{Model 2}} = \begin{pmatrix} -0.121 & -0.406 \\ 0.000 & -0.000 \\ 0.002 & 0.197 \\ 0.162 & 0.044 \\ 0.044 & 0.094 \\ -0.006 & -0.028 \end{pmatrix}$$

| | |
|---|---|
| **Model 1** | $\mathrm{CPI_t} = -\underset{(-2.225)}{1.335}\,\mathrm{IPI_t} + \underset{(4.569)}{0.713}\,\mathrm{REM_t} + \underset{(6.093)}{1.656}\,\mathrm{ER_t} + \underset{(0.062)}{0.017}\,\mathrm{M2_t} + 2.412 + \widehat{z_{1,t}}$ |
| | $\mathrm{GOV_t} = \underset{(3.698)}{1.349}\,\mathrm{IPI_t} - \underset{(-4.240)}{0.402}\,\mathrm{REM_t} - \underset{(-1.592)}{0.263}\,\mathrm{ER_t} + \underset{(1.757)}{0.306}\,\mathrm{M2_t} - 7.649 + \widehat{z_{2,t}}$ |
| **Model 2** | $\mathrm{FOOD_{CPI_t}} = -\underset{(-2.862)}{4.629}\,\mathrm{IPI_t} + \underset{(4.535)}{1.908}\,\mathrm{REM_t} + \underset{(1.860)}{1.481}\,\mathrm{ER_t} + \underset{(0.936)}{0.729}\,\mathrm{M2_t} + 18.644 + \widehat{z_{1,t}}$ |
| | $\mathrm{GOV_t} = \underset{(4.679)}{2.341}\,\mathrm{IPI_t} - \underset{(-5.034)}{0.655}\,\mathrm{REM_t} - \underset{(-2.108)}{0.519}\,\mathrm{ER_t} + \underset{(0.010)}{0.002}\,\mathrm{M2_t} - 10.822 + \widehat{z_{2,t}}$ |

The estimates of VECM corresponding to CointEq1 and CointEq2 are summarized in Table 4 for both the models.

**Table 4: Comparing the Results of Vector Error Correction Model (VECM) [a]**

| Regressors | Model 1 | | | | Model 2 | | | |
|---|---|---|---|---|---|---|---|---|
| | CointEq1 | | CointEq2 | | CointEq1 | | CointEq2 | |
| | Coefficient | t-statistic | Coefficient | t-statistic | Coefficient | t-statistic | Coefficient | t-statistic |
| IPI | −1.34** | −2.225 | 1.35*** | 3.698 | −4.63*** | −2.862 | 2.34*** | 4.679 |
| Remittances | 0.71*** | 4.569 | −0.40*** | −4.240 | 1.91*** | 4.535 | −0.66*** | −5.034 |
| Exchange Rate | 1.66*** | 6.093 | −0.26 | −1.592 | 1.48* | 1.860 | −0.52** | −2.108 |
| Broad Money | 0.02 | 0.062 | 0.31* | 1.758 | 0.73 | 0.936 | 0.002 | 0.010 |
| Error Correction Term | −0.11*** | −4.513 | −0.24*** | −4.611 | −0.12*** | −5.577 | −0.41*** | −5.022 |
| Autocorrelation LM Test | **Lags** | **LM-statistic** | | **p-value** | **Lags** | **LM-statistic** | | **p-value** |
| | 1 | 47.104 | | 0.102 | 1 | 40.343 | | 0.284 |
| | 2 | 38.351 | | 0.363 | 2 | 38.787 | | 0.345 |
| | 3 | 39.235 | | 0.326 | 3 | 35.696 | | 0.482 |
| N | 117 | | | | | | | |

[a] The regression includes a constant term

*Indicates statistical significance at the 10% level

**Indicates statistical significance at the 5% level

***Indicates statistical significance at the 1% level

The estimated result (CointEq1) shows that an increase in remittance inflows causes an increase in both inflation and food inflation at 1% level of significance. The significance of both the coefficients at 1 percent level shows the strength of the relationship between remittance inflows and different categories of inflation (general and food). Besides workers' remittances, we have also got statistically significant parameters for industrial production index and exchange rate. While industrial production index has negative effect on inflation and food inflation at 5% and 1% level of significance respectively, exchange rate has positive effect on them at 1% and 10% level of significance respectively. The result also shows that broad money does not have statistically significant effect on both inflation and food inflation.

The results suggest that 1 percent increase in remittance will cause 0.72 percent increase in overall inflation. This magnitude is very close to the study of Nisar and Tufail (2013) who got a coefficient of 0.78 for Pakistan. However, the magnitude of the coefficient found by Khan & Islam (2013) is much higher (2.48) for Bangladesh than ours. But Khan & Islam (2013) have not converted some of their variables in real terms thus their findings may be inflated. But this result also contradicts with Ball et al. (2013) who argued that remittances temporarily generate no change in the money supply, decrease inflation and appreciate the real exchange rate under a flexible exchange rate regime. However, the result accords with Reinhart and Rogoff (2004) who argued that the effect of remittance inflows will be a rising price level and an appreciation of the exchange rate under the flexible exchange rate regime.

This behavior of remittances implies that they are not directed towards the productive sector rather they are spent on consumption which fuels inflation. These findings accord well with the wealth transfer – inflationary pressure argument developed by Obstfeld and Rogoff (1996). They argued that a country's global market competitiveness is depleted by resource transfers through triggering real exchange rate appreciation thus fueling inflation further. Moreover, there exists a situation of asymmetric information between the remitters and their family members whereby the remitters are incapable to monitor how the remitted funds are used. If they could monitor, then the fund would be guided to capital investment contributing to build sustainable livelihood. In absence of this monitoring remittances are used for the consumption purposes (Meyers, 2002).

The magnitude of this positive effect of remittances is almost two and half times higher for food inflation (1.91). This happens because most of the migrant households in Bangladesh belong to low or lower middle income brackets. In absence of the remittance money they are not able to spend properly on food to fulfill their demand of nutrition. As their family members and relatives send remittances for their families, there occurs a rise in the household income. This in turn increases the purchasing power of them and they immediately respond by spending more on food consumption since food is the most basic need for them. Once they satisfy their basic need of food then they strive to improve their standard of living. After attaining a reasonable standard of living people are interested in investing in other areas.

The results also indicate that both inflation and food inflation have shown close magnitudes of change in response to 1 percent increase in exchange rate which are 1.66 percent and 1.48 percent respectively.[2] This is because when the exchange rate depreciates, it increases net exports by making imports dearer. The increase in net exports causes a rightward shift of the aggregate demand curve. For a given aggregate supply, this shift in the aggregate demand will increase the price level. Moreover, a depreciation of the domestic currency usually increases the price of imported consumer goods and durables, raw materials and capital goods thus influencing consumer price index directly. However, food inflation is relatively less responsive to changes in exchange rate. This result is very similar to the results of Narayan et al. (2011) in terms of sign and significance although Khan & Islam (2013) found an insignificant coefficient in their study.

The coefficient for broad money is not significant for both general and food inflation which is a very surprising result. One possible explanation in this case is that the transmission mechanism is indirect and involves the role of interest rate. This may also explain the neutrality of money growth on inflation for the entire sample period. The broad money may also have negative impact on inflation as demonstrated by the famous Price Puzzle [3] observed in the US. This insignificant result does not accord well with the findings of Grauwe & Magdalena (2005), Nisar & Tufail (2013) and Khan & Islam (2013) who found a statistically significant positive association between money growth and inflation. However, they have different estimation approaches like some studies use the wholesale prices instead of consumer prices. Particularly, Khan & Islam (2013) who used a sample of yearly data of Bangladesh for the period 1974-2010, thus containing both fixed (1974- July, 2003) and floating exchange rate regimes (after July, 2003) while our sample is entirely after the adoption of the floating exchange rate regime. The choice of both the fixed and floating exchange rate regime in their sample period may also lead to these results which could be biased as suggested by Ball et al. (2013).

[2] In our study we represent exchange rate as, BDT per USD. Thus an increase in exchange rate implies a depreciation of BDT.

[3] A rise in the aggregate price level in response to a contractionary innovation to monetary policy.

The results show that industrial production index affects negatively both inflation and food inflation. However, the response of food inflation is almost three times higher for a one percent change in industrial production index. The explanation comes from the fact that an increase in industrial production index implies that there are more goods and services available in the market for a given amount of money. The increase in the supply of commodities relative to money in the market puts downward pressure on inflation by hitting inflation negatively. Aisen &Viega (2006) and Desai, Olofsgard & Yousef (2003) also found a negative relationship between economic growth and inflation for a panel of 75 developing countries and 100 developed and developing countries respectively.

On the other hand, the estimated result (CointEq2) shows that an increase in industrial production index leads to a rise and remittances leads to a fall in government expenditure for both models at 1% level of significance. Exchange rate becomes insignificant for Model 1 while for Model 2 it has significant negative effect on government expenditure at 5% level. Broad money becomes significant at 10% level for Model 1 implying that a rise in broad money will lead to a rise in government expenditure while it still remains insignificant for Model 2.

In the presence of the cointegrating relationships, some of the adjustment coefficients are significant while some are not, showing which variables in the system adjust to disequilibrium. In Model 1, all the variables have at least one significant adjustment coefficients except that for IPI and M2 implying that they do not adjust when the variables depart from their two long run relationships. Thus they are Weakly Exogenous and the cointegration is maintained by adjustments from the other four variables. Similarly for Model 2, the Weakly Exogenous variables found are GOV and M2.

The ECT represents both the percentage of correlation and the speed of correction to any deviation in the long run equilibrium. The results show that the error correction term for overall inflation and food inflation is negative and statistically significant at 1% level, showing the stability of both the models. Speed of correction is higher for food inflation compared to general inflation. Particularly the short run disequilibrium of inflation and food inflation is corrected at the rate of 11% and 12% per month respectively. Moreover, we use autocorrelation LM test to detect the autocorrelation of the residuals. Results of the LM test suggest the non-violation of no autocorrelation assumptions for the both models.

For checking the robustness of the results further, we use log(1+(CPI/100)) and log(1+(FOOD_CPI/100)) instead of inflation and food inflation as suggested by Narayan et al. (2011). [4] We find that remittances growth rate has a significant positive effect on both inflation and food inflation at 1% level. All other variables of the two models have coefficients with similar sign and significance as reported previously.

We use the concept Connectedness Analysis for analyzing the result of forecast error variance decompositions (FEVD). The two Cholesky Orderings that are used: **Inflation (CPI), Government Expenditure (GOV), Industrial Production Index (IPI), Remittances (REM), Exchange Rate (ER) and Money Supply (M2)** for Model 1 and **Food Inflation (FOOD_CPI), Government Expenditure (GOV), Industrial Production Index (IPI), Remittances (REM), Exchange Rate (ER) and Money Supply (M2)** for Model 2 respectively. The forecast horizon used in connectedness analysis is 5 steps ahead (i.e. 5 months ahead).

**Model 1**

| | CPI | GOV | IPI | REM | ER | M2 | Own | From Others |
|---|---|---|---|---|---|---|---|---|
| CPI | 73.260 | 10.696 | 4.066 | 0.326 | 11.580 | 0.072 | 73.260 | 26.740 |
| GOV | 9.583 | 89.194 | 0.049 | 0.604 | 0.001 | 0.568 | 89.194 | 10.806 |
| IPI | 2.736 | 1.413 | 79.436 | 4.195 | 8.833 | 3.387 | 79.436 | 20.564 |
| REM | 2.683 | 2.214 | 15.424 | 63.806 | 11.872 | 4.001 | 63.806 | 36.194 |
| ER | 11.550 | 1.700 | 6.040 | 3.584 | 71.708 | 5.418 | 71.708 | 28.292 |
| M2 | 4.470 | 6.371 | 6.034 | 6.513 | 0.775 | 75.837 | 75.837 | 24.163 |
| To Others | 31.022 | 22.394 | 31.613 | 15.223 | 33.060 | 13.447 | Spillover Index 24.460 | |

**Model 2**

| | FOOD_CPI | GOV | IPI | REM | ER | M2 | Own | From Others |
|---|---|---|---|---|---|---|---|---|
| FOOD_CPI | 76.361 | 8.119 | 6.295 | 1.864 | 6.797 | 0.563 | 76.361 | 23.639 |
| GOV | 10.808 | 88.313 | 0.189 | 0.088 | 0.002 | 0.600 | 88.313 | 11.687 |
| IPI | 4.572 | 0.385 | 75.362 | 6.932 | 8.489 | 4.260 | 75.362 | 24.638 |
| REM | 4.145 | 0.880 | 12.399 | 66.647 | 11.002 | 4.927 | 66.647 | 33.353 |
| ER | 11.345 | 1.838 | 4.026 | 4.867 | 73.702 | 4.222 | 73.702 | 26.298 |
| M2 | 3.028 | 10.066 | 10.568 | 1.983 | 1.915 | 72.439 | 72.439 | 27.561 |
| To Others | 33.897 | 21.288 | 33.478 | 15.734 | 28.206 | 14.572 | Spillover Index 24.529 | |

[4] The results of the robustness check are provided in the Appendix A.3 and A.4.

CPI's own contribution is about 73.26% indicating that it is strongly affected by itself. The contributors to CPI's forecast error variance (FEV) are ER (11.58%), GOV (10.69%), IPI (4.06%), REM (0.33%) and M2 (0.07%). For FOOD_CPI own contribution increases to 76.36% and other contributors are GOV (8.12%), ER (6.80%), IPI (6.30%), REM (1.86%) and M2 (0.60%). Thus remittances have very little contribution towards the FEV of inflation and food inflation compared to the other significant variables of the models. The highest own contribution is for GOV (89.19% in Model 1 and 88.31% in Model 2) indicating that it is strongly affected by itself and lowest is for REM (63.80% in Model 1 and 66.65% in Model 2) indicating that it is strongly affected by the other variables. The Spillover Index indicates that 24.46% and 24.53% of the FEV for the system as a whole is due to cross-variable effects in Model 1 and Model 2 respectively (i.e. spillovers between the variables) and they are almost same across the two models. This indicates that all the variables in Model 1 and Model 2 are mutually dependent and that internal and external factors are roughly equally important.

We must mention some caveats that remain in the study. First, it was really difficult to get monthly data for all of the variables. For some of the variables the monthly data is interpolated from the yearly data. These interpolations might produce some bias in the results. Second, most of the remittances in Bangladesh flow to the rural areas while CPI calculation is based on the cities. Third, remittances that come through informal channels are not taken into account thus the data on remittances may be under reported. The unofficial channels normally dominate in Bangladesh as they are not only less expensive but also more easily accessible (Barua et al., 2007). Moreover, some of the remittances come in the form of gifts (goods) and the extent and effects of those are very hard to measure (Ulyses Balderas & Nath, 2008). Fourth, in the literature there is no agreement on a common set of determinants of inflation. For example, some studies suggest that there should be a variable in the model representing trade openness where more openness can reduce inflation as suggested by Romer (1993). We have not addressed trade openness in our model but can be addressed in further research on this topic.

## Conclusions and Policy Recommendations

Workers' remittance inflows have emerged as a crucial issue for the fiscal and monetary policy of Bangladesh. Emigrants send remittances to benefit their families living in their origin country. These inflows also benefit the recipient country by lowering poverty, funding investment and earning foreign exchange. But at the same time like other capital inflows remittances have the potentiality to induce an inflationary pressure in the recipient country. By using Johansen (1988) and Johansen & Juselius (1990) cointegration technique and VECM approach, we checked this relationship empirically for Bangladesh in the post-floating exchange rate regime. The results show that all the explanatory variables explain the changes in inflation and food inflation in statistically significant way except broad money. The results also indicate that remittance inflows are positively associated with inflation and food inflation. Particularly, we find that a percent increase in remittances inflows will increase inflation and food inflation by 0.72% and 1.91% respectively. Thus the inflationary pressure arising from remittance inflows is almost two and half times higher for food inflation compared to general inflation. Apart from remittances; industrial production index has negative effect on inflation and food inflation while exchange rate has positive effect on them. One of the unexpected and interesting results is that broad money does not have statistically significant effect on both inflation and food inflation which demonstrates the neutrality of money growth over inflation for the entire sample period. Our study also agrees with some micro level studies of remittances which found both positive and negative effects of remittances on the economy. For example, Funkhouser (1992) concludes that remittances lead to depress the overall labour force participation rate in Nicaragua and Salvador as some family members of the recipient families need not to participate in the labour market. But at the same time remittances might promote self employment as the credit constraints become more relaxed.

The study reveals the need to more deeply understand the economic impacts of incoming workers' remittances. We provide empirical evidence showing that remittances can induce inflation of the recipient economies thus may involve welfare costs. Therefore, in devising economic policies, it is important to consider both the positive and negative impacts of remittance inflows. Some policy implications:

- The results suggest that remittances create higher responsiveness for food inflation compared to the general inflation. It implies that remittances are more guided towards food consumption of the recipient households. Most of these households belong to low or lower middle income brackets. In absence of the remittance money they are not able to spend properly on food and fulfill their demand for nutrition. Remittance inflows increase their purchasing power and they immediately respond by spending more on food consumption. Thus remittances contribute significantly towards the development of the health status of the recipient families.

- But as the households continuously receive remittances they will become more solvent. After attaining a reasonable standard of living, they will look upon investing in other areas. If these investments are not properly channelized in the productive sectors, they can create booms in other markets. Thus in future it is expected that the result of inducing inflation will spread in other areas too. As inflation may have some welfare costs, policies should be taken to guide remittances from consumption motives to investment in productive sectors that causes economic growth. In this context, the development of the financial sector can also play a role in channelizing remittances into productive investment through developing investment opportunities like secondary bond market.

- Moreover, remittances have very little contribution towards the FEV of inflation and food inflation compared to the other significant variables of the models. The estimation results show that an increase in industrial production index causes a sizeable deflationary pressure. Thus the inflationary effect originating from remittance inflows can be sufficiently neutralized by promoting GDP growth. Therefore, ensuring the flows of remittances in productive sectors has benefits from both ends.

## References


Acosta, P., Baerg, N., & Mandelman, F. (2009). Financial development, remittances, and real exchange rate appreciation. Retrieved from https://openknowledge.worldbank.com/handle/10986/4797

Adelman, I., & Taylor, J. (1990). Is structural adjustment with a human face possible? The case of Mexico. *The Journal of Development Studies*. Retrieved from http://www.tandfonline.com/doi/abs/10.1080/00220389008422161

Aisen, A., & Veiga, F. (2007). Does political instability lead to higher and more volatile inflation?: A panel data analysis. *Panoeconomicus*. doi:10.2298/PAN0701005A

Amuedo-Dorantes, C., & Pozo, S. (2004). Workers' Remittances and the Real Exchange Rate: A Paradox of Gifts. *World Development*, *32*, 1407–1417. doi:10.1016/j.worlddev.2004.02.004

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies*. Retrieved from http://restud.oxfordjournals.org/content/58/2/277.short

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*. Retrieved from http://www.sciencedirect.com/science/article/pii/030440769401642D

Ball, C., Lopez, C., & Reyes, J. (2013). Remittances, Inflation and Exchange Rate Regimes in Small Open Economies1. *The World Economy*. Retrieved from http://onlinelibrary.wiley.com/doi/10.1111/twec.12042/full

Bangladesh Bank. (2014a). Major Economic Indicators. *2006-2014*. Retrieved from http://www.bangladesh-bank.org/pub/publictn.php?cat_id=3&pub_id=11

Bangladesh Bank. (2014b). Monthly Economic Trends. *2009-2014*. Retrieved from http://www.bangladesh-bank.org/pub/publictn.php?cat_id=3&pub_id=10

Barua, S., Majumder, M., & Akhtaruzzaman, D. (2007). Determinants of workers' remittances in Bangladesh: An empirical study. Retrieved from http://mpra.ub.uni-muenchen.de/15080/

Berk, J. (1999). Measuring inflation expectations: a survey data approach. *Applied Economics*. Retrieved from http://www.tandfonline.com/doi/abs/10.1080/000368499323337

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*. Retrieved from http://www.sciencedirect.com/science/article/pii/S0304407698000098

Bourdet, Y., & Falck, H. (2006). Emigrants' remittances and Dutch disease in Cape Verde. *International Economic Journal*. Retrieved from http://www.tandfonline.com/doi/abs/10.1080/10168730600879323

Bronfenbrenner, M., & Holzman, F. (1963). Survey of inflation theory. *The American Economic Review*. Retrieved from http://www.jstor.org/stable/1811017

Cotarelli, G. (1998). The Non-monetary Determinants of Inflation: Panel Data Study. *IMF Working Paper WP/98/23 Http:// …*. Retrieved from http://scholar.google.com/scholar?q=the+non-monetary+determinants+of+inflation:+a+panel+data+study&btnG=&hl=en&as_sdt=0,5#8

Desai, R. M., Olofsgard, A., & Yousef, T. M. (2003). Democracy, Inequality, and Inflation. *American Political Science Review*, *97*, 391–406. doi:10.1017/S0003055403000765

Dickey, D. A., & Fuller, W. A. (1979). Distribution of the Estimators for Autoregressive Time Series With a Unit Root. *Journal of the American Statistical Association*, *74*, 427–431. doi:10.2307/2286348

Djajic, S. (1998). The transfer problem and the intertemporal terms of trade. *Canadian Journal of …*. Retrieved from http://ideas.repec.org/a/cje/issued/v31y1998i2p427-436.html

Friedman, M., & Allen, G. (1970). The counter-revolution in monetary theory: first Wincott memorial lecture, delivered at the Senate House, University of London, 16 September, 1970. Retrieved from http://www.getcited.org/pub/101362140

Funkhouser, E. (1992). Migration from Nicaragua: some recent evidence. *World Development*. doi:10.1016/0305-750X(92)90011-J

Galí, J., Gertler, M., & López-Salido, J. D. (2001). European inflation dynamics. *European Economic Review*, *45*, 1237–1270. doi:10.1016/S0014-2921(00)00105-7

Giuliano, P., & Ruiz-Arranz, M. (2009). Remittances, financial development, and growth. *Journal of Development Economics*, *90*, 144–152. doi:10.1016/j.jdeveco.2008.10.005

Glytsos, N. (2002). *Dynamic effects of migrant remittances on growth: an econometric model with an application to Mediterranean countries*. Retrieved from http://www.kepe.gr/pdf/D.P/dp_74.pdf

Grauwe, P., & Polan, M. (2005). Is Inflation Always and Everywhere a Monetary Phenomenon?*. *The Scandinavian Journal of Economics*. Retrieved from http://onlinelibrary.wiley.com/doi/10.1111/j.1467-9442.2005.00406.x/full

Hanson, M. S. (2004). The "price puzzle" reconsidered. *Journal of Monetary Economics*, *51*, 1385–1413. doi:10.1016/j.jmoneco.2003.12.006

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control*. doi:10.1016/0165-1889(88)90041-3

Johansen, S., & Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration—with applications to the demand for money. *Oxford Bulletin of Economics and Statistics*, *52*, 169–210. doi:10.1111/j.1468-0084.1990.mp52002003.x

Kemal, M. (2006). Is inflation in Pakistan a monetary phenomenon? *The Pakistan Development Review*. Retrieved from http://www.jstor.org/stable/41260754

Keynes, J. (1929). The German transfer problem. *The Economic Journal*. Retrieved from http://www.jstor.org/stable/2224211

Khan, A., Ahmed, Q., & Hyder, K. (2007). Determinants of recent inflation in Pakistan. Retrieved from http://mpra.ub.uni-muenchen.de/16254/

Khan, Z., & Islam, S. (2013). The Effects of Remittances on Inflation: Evidence from Bangladesh. *Journal of Economics and Business Research*. Retrieved from http://www.uav.ro/jour/index.php/jebr/article/view/94

Kim, S., & Yang, T. (2008). The Impact of Capitall Inflows on Emerging East Asian Economies: Is Too Much Money Chasing Too Little Good? Retrieved from http://aric.adb.org/pdf/workingpaper/WP15_Impact_of_Capital_Inflows.pdf

Laidler, D., & Parkin, M. (1975). Inflation: a survey. *The Economic Journal*. Retrieved from http://www.jstor.org/stable/2230624

Lartey, E. K. K., Mandelman, F. S., & Acosta, P. A. (2012). Remittances, Exchange Rate Regimes and the Dutch Disease: A Panel Data Analysis ∗. *Review of International Economics*, *20*, 377–395. doi:10.1111/j.1467-9396.2012.01028.x

Meyers, D. (2002). Migrant Remittances to Latin America. *Sending Money Home: Hispanic Remittances and …*. Retrieved from http://books.google.com/books?hl=en&lr=&id=HG_uXBksD6YC&oi=fnd&pg=PA53&dq=migrant+remittances+to+latin+america:reviewing+the+literature&ots=pMlVMIowgq&sig=NuNMy6JuEn7djOEadGbZQzbFdSI

Mohammad, S., & Wasti, S. (2009). An Empirical Investigation between Money Supply, Government Expenditure, output & Prices: the Pakistan Evidence. *European Journal of …*. Retrieved from http://www.econ-jobs.com/research/52433-An-Empirical-Investigation-between-Money-Supply-Government-Expenditure-Output--Prices-The-Pakistan-Evidence.pdf

Mukhtar, T. (2012). Does Trade Openness Reduce Inflation? Empirical Evidence from Pakistan. *Journal of Economic Cooperation & …*. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=13087800&AN=83439030&h=GkT9ik5zTVdM+t3cBGctha7Vd9mqZTp1ZgNYDmkKE34LiEFGLnb08HkogydqYAT3wTz4cHJxWS35hdHLYQp7Ng==&crl=c

Narayan, P., Narayan, S., & Mishra, S. (2011). Do remittances induce inflation? Fresh evidence from developing countries. *Southern Economic Journal*. Retrieved from http://journal.southerneconomic.org/doi/abs/10.4284/0038-4038-77.4.914

Nath, H., & Vargas-Silva, C. (2012). Remittances and relative prices. *Review of Development Economics*. Retrieved from http://onlinelibrary.wiley.com/doi/10.1111/j.1467-9361.2011.00645.x/full

Nazir, S., Sarwar, N., & Ullah, S. (2012). Impact of Capital Inflows on Domestic Inflation: A Case Study of Pakistan. *Globalcentre.org*. Retrieved from http://www.globalcentre.org/upload/Impact of Capital Inflows on Domestic Inflation p 4-12.pdf

Nisar, A., & Tufail, S. (2013). An Analysis of Relationship between Remittances and Inflation in Pakistan. *Zagreb International Review of Economics and Business*. Retrieved from http://hrcak.srce.hr/file/162277

Obstfeld, M., & Rogoff, K. (1996). *Foundations of International Macroeconomics*. *Southern Economic Journal* (Vol. 64, p. 337). doi:10.2307/1061063

Ohlin, B. (1929). The reparation problem: a discussion. *Economic Journal*. Retrieved from http://www.hifreqecon.com/nyu/ohlin29.pdf

Qayyum, A. (2006). Money, Inflation, and Growth in Pakistan. *The Pakistan Development Review*. Retrieved from http://www.jstor.org/stable/41260753

Rapoport, H., & Docquier, F. (2006). Chapter 17 The Economics of Migrants' Remittances. *Handbook of the Economics of Giving, Altruism and Reciprocity*. doi:10.1016/S1574-0714(06)02017-3

Rashid, A., & Husain, F. (2010). Capital Inflows, Inflation and Exchange Rate Volatility: An Investigation for Linear and Nonlinear Causal Linkages. *Working Papers & Research Reports*. Retrieved from http://72.9.146.122/pdr/index.php/wp/article/view/2947/2896

Reinhart, C., & Rogoff, K. (2004). The modern history of exchange rate arrangements: A reinterpretation. *Quarterly Journal of Economics*, *119*, 1–48. doi:10.1162/003355304772839515

Romer, D. (1993). Openness and inflation: theory and evidence. *The Quarterly Journal of Economics*. Retrieved from http://qje.oxfordjournals.org/content/108/4/869.short

The World Bank. (2013). Bangladesh | Data. *Bangladesh Data*. Retrieved from http://data.worldbank.org/country/bangladesh

The World Bank. (2014). Migration & Remittances Data. *Annual Remittances Data & Monthly Remittance Flows to Selected Countries*. Retrieved from http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTDECPROSPECTS/0,,contentMDK:22759429~pagePK:64165401~piPK:64165026~theSitePK:476883,00.html

Ulyses Balderas, J., & Nath, H. K. (2008). Inflation and relative price variability in Mexico: the role of remittances. *Applied Economics Letters*. doi:10.1080/13504850600722070

Yang, D. (2008). International Migration, Remittances and Household Investment: Evidence from Philippine Migrants' Exchange Rate Shocks*. *The Economic Journal*, *118*, 591–630. doi:10.2307/20108814

Zarate-Hoyos, G. A. (2004). Consumption and Remittances in Migrant Households: Toward a Productive Use of Remittances. *Contemporary Economic Policy*, *22*, 555–565. doi:10.1093/cep/byh042

# Appendix

## A.1. Definitions and Sources of Variables

| Variables | Definitions | Sources |
|---|---|---|
| Inflation (CPI) | 12 Month Average CPI | Monthly Economic Trends, Bangladesh Bank |
| Food Inflation (FOOD_CPI) | 12 Month Average FOOD CPI | Monthly Economic Trends, Bangladesh Bank |
| Government Expenditure* (GOV) | Government Consumption Expenditure (Billion Tk.)@ | Bangladesh Economic Review, 2013 |
| Industrial Production Index (IPI) | Monthly IPI | International Financial Statistics (IFS) Database, 2013 |
| Workers' Remittances* (REM) | Monthly Remittance Inflows (Billion Tk.) | Major Economic Indicators, Bangladesh Bank & Migration and Remittances Data, World Bank, 2013 |
| Exchange Rate (ER) | Monthly Average Exchange Rate (BDT per USD) | Monthly Economic Trends, Bangladesh Bank, 2014 |
| Money Supply* (M2) | M2 (Billion Tk.) | Monthly Economic Trends, Bangladesh Bank, 2014 |

* deflated by using GDP deflator @ interpolated from yearly data

## A.2. Statistical Description of the Variables

| Variable | CPI | FOOD_CPI | GOV | IPI | REM | ER | M2 |
|---|---|---|---|---|---|---|---|
| Mean | 7.634 | 8.617 | 0.416 | 125.865 | 0.287 | 69.373 | 16.326 |
| Maximum | 10.960 | 12.900 | 0.636 | 178.156 | 0.533 | 83.420 | 26.281 |
| Minimum | 4.510 | 3.830 | 0.282 | 75.800 | 0.106 | 58.400 | 9.149 |
| Std. Dev | 1.673 | 2.197 | 0.099 | 27.397 | 0.105 | 6.496 | 5.147 |
| Observations | 121 | 121 | 121 | 121 | 121 | 121 | 121 |

## A.3. VECM Results [Using (*log(1+(CPI/100))* instead of Inflation]

Vector Error Correction Estimates
Date: 03/27/14 Time: 20:10
Sample (adjusted): 2003M11 2013M07
Included observations: 117 after adjustments
Standard errors in ( ) & t-statistics in [ ]

| Cointegrating Eq: | CointEq1 | CointEq2 |
|---|---|---|
| ROB_CPI(-1) | 1.000000 | 0.000000 |
| LN_GOV(-1) | 0.000000 | 1.000000 |
| LN_IPI(-1) | 0.133898 | -0.919548 |
| | (0.04132) | (0.28259) |
| | [ 3.24059] | [-3.25402] |
| LN_REM(-1) | -0.056498 | 0.265178 |
| | (0.01063) | (0.07269) |
| | [-5.31554] | [ 3.64794] |
| LN_ER(-1) | -0.106296 | 0.253178 |
| | (0.01871) | (0.12796) |
| | [-5.68133] | [ 1.97858] |
| LN_M2(-1) | -0.020633 | -0.427417 |
| | (0.01967) | (0.13452) |
| | [-1.04903] | [-3.17737] |
| C | -0.285604 | 5.775941 |

| Error Correction: | D(ROB_CPI) | D(LN_GOV) | D(LN_IPI) | D(LN_REM) | D(LN_ER) | D(LN_M2) |
|---|---|---|---|---|---|---|
| CointEq1 | -0.073539 | 0.002039 | -1.487460 | 5.330916 | 0.663325 | -0.248528 |
| | (0.02175) | (0.00271) | (0.60447) | (1.93811) | (0.23462) | (0.18920) |
| | [-3.38034] | [ 0.75098] | [-2.46077] | [ 2.75057] | [ 2.82728] | [-1.31361] |
| CointEq2 | -0.015107 | -0.001276 | 0.126877 | -0.464147 | 0.034403 | -0.008381 |
| | (0.00383) | (0.00048) | (0.10651) | (0.34149) | (0.04134) | (0.03334) |
| | [-3.94129] | [-2.66696] | [ 1.19127] | [-1.35918] | [ 0.83223] | [-0.25142] |

## A.4. VECM Results [Using (*log(1+(FOOD_CPI/100))* instead of Food Inflation]

Vector Error Correction Estimates
Date: 03/27/14 Time: 20:14
Sample (adjusted): 2003M11 2013M07
Included observations: 117 after adjustments
Standard errors in ( ) & t-statistics in [ ]

| Cointegrating Eq: | CointEq1 | CointEq2 |
|---|---|---|
| ROB_FOODCPI(-1) | 1.000000 | 0.000000 |
| LN_GOV(-1) | 0.000000 | 1.000000 |
| LN_IPI(-1) | 0.295412 | -1.758071 |
| | (0.10195) | (0.35583) |
| | [ 2.89763] | [-4.94076] |
| LN_REM(-1) | -0.131823 | 0.478393 |
| | (0.02622) | (0.09153) |
| | [-5.02675] | [ 5.22666] |
| LN_ER(-1) | -0.078066 | 0.471884 |
| | (0.05077) | (0.17720) |
| | [-1.53760] | [ 2.66293] |
| LN_M2(-1) | -0.042913 | -0.167548 |
| | (0.04879) | (0.17030) |
| | [-0.87948] | [-0.98383] |
| C | -1.229774 | 8.451211 |

| Error Correction: | D(ROB_FOODCPI) | D(LN_GOV) | D(LN_IPI) | D(LN_REM) | D(LN_ER) | D(LN_M2) |
|---|---|---|---|---|---|---|
| CointEq1 | -0.096429 | -0.000381 | -0.214583 | 1.586069 | 0.526858 | -0.085114 |
| | (0.01929) | (0.00159) | (0.33414) | (1.09403) | (0.12777) | (0.10665) |
| | [-4.99852] | [-0.24003] | [-0.64220] | [ 1.44975] | [ 4.12333] | [-0.79806] |
| CointEq2 | -0.027110 | -0.000667 | 0.205054 | -0.308570 | 0.089873 | -0.027934 |
| | (0.00654) | (0.00054) | (0.11320) | (0.37063) | (0.04329) | (0.03613) |
| | [-4.14807] | [-1.23977] | [ 1.81145] | [-0.83255] | [ 2.07619] | [-0.77314] |