



Impact of Macroeconomic Shocks on Remittance inflows to Jamaica: A VECM approach.

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Abstract

This research is the first of its kind to assess the dynamics of remittance inflows to Jamaica using the Cointegration technique and the Vector Error Correction (VEC) model from a single country standpoint; specifically, the exchange rate and interest rate movements are important to remittance inflows. Through the use of the Johansen Cointegration methodology, Variance decomposition and Impulse Response functions, the unemployment rate of the United States of America (USA) is shown to affect remittances more significantly than the domestic macroeconomic variables. Shocks to the unemployment rate of the USA reduce remittance inflows significantly within the first quarter of the shock, and this effect keeps remittances at significantly lower levels. Jamaica's Gross Domestic Product (GDP) is shown to be counter-cyclically related to remittances but does not have a major impact on them. Shocks to domestic Inflation also do not significantly affect remittances over the short to long run.

JEL classifications: **C32, D64, E20, F22, F24**

Keywords: Remittances, Cointegration, Altruism, VECM, Macroeconomic Shock

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1.0 Introduction

The demand and supply of foreign exchange have a significant impact on the overall macroeconomic stability of any one country through its effect on the balance of payments accounts, the exchange rate and interest rates. Not surprisingly, the Bank of Jamaica, whose mandate entails safeguarding the value of the domestic currency as well as fostering a stable and sound macro economy, should be at the centre of understanding the dynamics and impact of remittances on the Jamaican economy.

This research aims at understanding the macroeconomic factors that are linked significantly with remittance inflows to Jamaica in the long run. It also seeks to evaluate the impact of shocks to these variables, and the movement of remittances after deviating from its long term growth path by these shocks. Remittances have been found to be very volatile during the period of the global economic downturn; therefore, further investigation of the behaviour of these flows could enable policies to be implemented that are geared toward lessening the impact of the fallout in these flows.

There has been some research on the impact of remittances to the Caribbean region, in general, and Jamaica in particular. However, there has not been a study that looked at the long run relationship between remittances and selected macroeconomic variables for Jamaica as a single country. This paper will, therefore, explore this relationship through vector error correction modelling and seek to gain a greater understanding of the dynamics of remittance flows for more informed and accurate policy direction.

2.0 Literature Review

In the literature, many issues and factors affecting remittances have been analyzed with these studies mainly categorized as being either microeconomic or macroeconomic in nature. The microeconomic literature in general distinguishes between an altruistic (or pure altruism), investment (or self-interest) and loan repayment (tempered altruism) motives for sending remittances to the migrant's home country². For the altruistic motive, remittances are sent out of a general concern for those in the home country. Lucas and Stark (1985) believe that remittances sent because of this basic motive will tend to decline the longer the sender remains overseas.

Rapoport and Docquier (2005) also showed that there are very strong altruistic motives behind migrant remittances. Using data for Jamaica, Moulton, Henry and Ricketts (2009) using a VAR framework, revealed a mixture of both altruistic and investment motives for sending remittances to Jamaica.

There are also a number of studies that have looked at the macroeconomic factors affecting the level of real remittances (El Sakka & McNabb, 1999; Lianos, 1997), and remittance per migrant worker (Elbadawi and Rocha, 1992; Swami 1981).

Domestic (or home country) GDP is an important variable used in many of the studies and the nature of the relationship has been varied. Alleyne (2006) has explained that the endogeneity of Domestic GDP and remittances has been the reason for these varied conclusions. Swami (1981) and Hysenbegasi & Pozo (2002) have shown the

² Generally, 'Home' country refers to the country/economy receiving the remittance whereby the 'Host' country refers to the country/economy from which the emigrant is sending the remittances.

relationship to be positive while El Sakka and McNabb (1999) and Elbadawi and Rocha (1992) did not establish a significant relationship between the home country GDP and remittance receipts.

Previous researchers that have studied the macroeconomic factors affecting remittances to a single economy include El Sakka and McNabb (1999), Straubhaar (1986), Bougha-Hagbe (2004) and Gupta (2005).

Bougha-Hagbe (2004) used a Vector Error Correction (VEC) model to analyze remittance receipts to Morocco and found, among other things, that remittance inflows are inversely related to real GDP in Morocco. The results of his research, although accounting for endogeneity, may be questionable due to a small sample³. He also posited that the overall impact of the exchange rate on remittance inflows will ultimately be determined by the strength of the “substitution” and “wealth” effects. A depreciation, for example will enable the sender in the host country to send less foreign currency and get the same or more goods in the home country. This may also encourage them to substitute goods in the home country for those in the host country. The wealth effect is the perceived increase in wealth after the depreciation as the emigrant can now send more remittances to buy more goods in the receiving country.

Straubhaar (1986) found that wages and employment in Germany have a positive impact on remittances to Turkey. He concluded that incentive schemes set up by the Turkish government to attract remittances would be ineffective as host country factors as well as the political stability of Turkey are more important to migrants when

³ Twenty two (22) parameters estimated with 35 observations.

deciding how much to remit. His research, however, has been critiqued from the standpoint of not considering the time series properties of the variables used in his Ordinary Least Squares (OLS) model.

Lueth and Ruiz-Arranz (2007) analyzed the response of remittance receipts to selected macroeconomic shocks for Sri Lanka. Using a VEC model, they found that remittances decline when the country's currency depreciates and increases with oil price shocks (increases). They also showed that remittances and GDP are positively related or pro-cyclical.

Gupta (2005) came to the conclusion that remittances to India increase when the economic conditions in the source countries are favorable after regressing remittance inflows on oil prices and the real overseas earnings of migrants. For her, increases in the level of US employment were positively related to remittances.

There are also studies that have analyzed or tried to establish the links between remittances and macroeconomic variables from a multi-country perspective.

Vargas-Silva and Huang (2006) utilized variance decompositions, impulse response functions and Granger causality tests derived from a VEC model to test if home or host country macroeconomic conditions affect remittances. They used data for a number of countries⁴ and found that host country conditions were more significant in affecting remittances from the US to Mexico. They concluded that migrants focused more on the economic conditions of the host country relative to that of the home country when deciding the amount of remittances to send.

⁴ They are Brazil, Colombia, the Dominican Republic, El Salvador, Mexico and the United States of America.

Alleyne, Kirton and Figueroa (2008) used Panel models⁵ and a fully modified ordinary least squares (FMOLS) model to find the relationship between per capita remittances and selected macroeconomic variables to the Caribbean⁶. After analyzing the time series properties of the variables in the Panel, they concluded that interest rate differential, the Real Effective Exchange Rate (REER) and two measures of Real GDP were all significant in determining remittance inflows.

Faini (1994) believed that remittances represent a sizeable component of international trade flows in goods and services. The paper tried to assess to what extent workers' remittances are responsive to key macroeconomic variables. Econometric estimation of a remittance equation for a sample of five Mediterranean countries indicated that the real exchange rate depreciation of the home country's currency had a significant effect on remittances.

Elbadawi and Rocha (1992) using a Fixed Effects Panel estimation technique on the data on five major labour-exporting countries of North Africa and Europe⁷ showed that remittances are significantly affected by the economic policies in the home (labour-exporting) country. They also concluded that macroeconomic policy decisions that facilitated remittances are better than incentive schemes to attract remittances.

However it is noted that the earliest studies have not sufficiently examined the time series properties of the variables used in their study which can decrease the consistency and reliability of their results. This paper continues the trend of recent

⁵ They specifically used a balanced Two-Way Fixed Effects (FE) model and a Random Effects (RE) model.

⁶ Barbados, Dominica, Grenada, Jamaica, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines and Trinidad and Tobago.

⁷ They are Morocco, Portugal, Tunisia, Turkey, and the former Yugoslavia.

research that has sought to properly examine these time series properties to ensure the most accurate results.

3.0 Definition of Remittances

For the purposes of this research, the definition of remittances according to the Fifth edition of the Balance of Payments (BOP) manual will be used.

Remittances are defined by the fifth manual (IMF 1993) as ‘workers remittances’ which characterizes current transfers sent from migrants who are employed overseas. These migrants would have to be living overseas for at least a year which is crucial in distinguishing between ‘workers remittances’ or simply remittances, and ‘Compensation of Employees’. The latter represents current transfers sent by migrants who are either considered seasonal, short term workers⁸ or border workers. Two key factors that determine the qualification for consideration as remittances include the length of stay of the migrant and the ‘center of economic interest’⁹ of the migrant.

There have been some authors who have made distinctions between different types of remittances in the literature: Potential, Fixed, Discretionary and Saved remittances.

Wahba (1991) has distinguished between four types of remittances. ‘Potential’ remittances are the total funds a migrant has after all his expenses in the host country have been taken care of. ‘Fixed’ remittances are the minimum basic amounts of transfers needed for the migrants own financial obligations back home and to satisfy the

⁸ They have been employed in the overseas economy for less than a year.

⁹ See BOP Manual 5th Edition, pg 20 for additional information.

needs of family members also in the home country. 'Discretionary' remittances are the remittances sent in excess of fixed remittances which are influenced by the macroeconomic factors in both the home and host countries such as the interest rate differentials, exchange rates and so on. 'Saved' remittances according to Wahba (1991) is the difference between potential remittances and the actual amount sent.

It is important to add, however, that any measure of remittances has the strong possibility of being underestimated as it is believed that some portion of remittances are sent through an informal sector or channel. El-Qorchi (2002) has labelled this the 'hawala' in his study of India. Reddy (1997) had estimated it to be around US\$6 billion dollars in his study of the Indian economy.

4.0 Data description and sources

The research uses quarterly data for the sample period running from the first quarter of 1988 to the fourth quarter 2010. The variables chosen were the CPI, Nominal domestic GDP, the exchange rate and a variable representing the interest differential (relative rate of return) between Jamaica and the USA. For the host country conditions, the unemployment rate for the USA is used. The USA was selected as representing the host country as remittances from the USA to Jamaica is by far the largest for any single host¹⁰. Also, the US, as the largest economy in the world, does have a significant impact on most economies in terms of the movement of major macroeconomic variables. Both the measures of Gross Domestic Product and the Exchange Rate are expressed in

¹⁰ Ramocan (2010) estimated receipts from the US to be between 60-70% based on a national survey in Jamaica.

nominal terms. Only the Gross Domestic Product, Remittances and the CPI are expressed in logs.

Remittances (*Irem*), received from the External Sector Statistics Unit of the Bank of Jamaica, are quoted in millions of US dollars. The data for remittances between 1988 and 1993 is slightly different from the remainder of the sample period because of the definitional change in remittances as of 1993¹¹ when a revised edition of the BOP manual was released. The changes, however, are minimal and should not significantly affect the results.

The Interest differential (*int*) is defined as the difference between the Jamaica 180 Day end-of-quarter Treasury bill rates and its United States counterpart. This variable is aimed at capturing any investment motive in the transmission of remittances. The Jamaican T-Bill data was received from the Monthly Statistical Digest publication of the *Bank of Jamaica* while the United States Treasury bill data was received from *Bloomberg*. For the periods where there were no issues of the 180 Day tenors, the 90 day rates were converted to 180 Day rates¹². This amounted to 38 data points of the total 92 in the sample. Lueth and Ruiz-Arranz (2007) used the LIBOR on three months deposits as the representative overseas rate in their study of Sri Lanka. This might not be the best choice as the LIBOR is more representative of interbank or business conditions rather than overall market conditions.

¹¹ Remittances between 1986 and 1993 included both capital and current transfers in the measurement. The fifth Edition of the manual does not include Capital Transfers.

¹² Rates were converted from quarterly to semi-annually using the formula $((1+Rate/4)^2-1)*2$.

The Nominal GDP (lgdp) data is in millions of Jamaican dollars and was taken from the National Income and Product publication of the Statistical Institute of Jamaica.

The Consumer Price Index (lcpi) data was also received from the Research Services Department of the Bank of Jamaica. It was logged for comparability with similar trended variables in the model. The CPI is used to capture the effects of inflation on the demand for remittances and is specifically designed to reflect the effects of economic uncertainty due to the increased risk. Additionally, it provides a hint of the possible strength of the altruistic motive, if any, for sending remittances.

The US dollar exchange rate (usexch) was used to see if exchange rate movements have any long term impact on the demand for remittances. This data was received from the Domestic Sector Statistics Unit of the Bank of Jamaica and represents the end-of-quarter weighted average selling rates. The Real Effective Exchange Rate (REER) was considered for inclusion but the variable was stationary in levels and not difference stationary. Lueth and Ruiz-Arranz (2007) showed the exchange rate to be significant and negatively related with remittance inflows to Sri Lanka. The correlation matrix of table 3 shows that the exchange rate and remittances are highly correlated with a coefficient of 0.93. The sign of the coefficient is hinting at a possible positive relationship between the two variables. However, the correlation coefficients are valid for linear relationships and the variables do seem to have a trend from preliminary examination.

The US unemployment rate is intended to reflect the conditions in the host country that may affect the flow of remittances to Jamaica. The United States unemployment

rate was selected as the representative host country macroeconomic condition because it resulted in the best model compared to other host country variables that were tried. The US unemployment in levels, State specific unemployment rates as well as the GDP of the US, all produced lower performing models¹³. Straubhaar (1986) and Vargas-Silva and Huang (2006) found that unemployment in the host country was significant in explaining remittances to the home country. This data was also taken from *Bloomberg*. It is expected *a priori* that remittances should have a negative relationship with the rate of unemployment in the host country.

A dummy variable (dum1) was included to account for adverse weather patterns associated with major hurricanes and tropical storms that affected the island throughout the sample period¹⁴. The occurrence of the major hurricanes was concentrated in the last decade. Moulton, Henry and Ricketts (2009) showed where remittance inflows showed a significant increase immediately after adverse weather patterns affected the island.

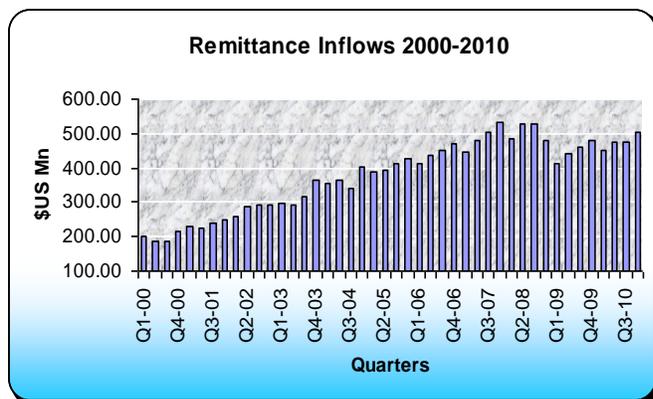
The other dummy variable (dum2) was used in the model to account for the significantly increased interest rates that prevailed during the financial sector meltdown of the 1990's. The period of the affected rates spanned between the years 1990 to 1997. At the end of the first quarter of 1992 for example, the interest rates on the 180 day T-Bill reached 52.94% where it was 16.49% only three quarters before.

¹³ The different models had either lower R^2 values or a higher AIC and SC statistics. The variables tried were the unemployment rates and levels of New York and Florida, the Health Services and Social assistance Employment levels of the United States. Most of the Jamaican Diaspora is concentrated in these States as showed by the survey of Ramocan (2010). Also approximately 20% of migrants are employed in the 'health services' sector followed by 'construction, with 5.3% the second largest sector employing migrants.

¹⁴ Hurricanes: Michelle 2001, Ivan 2004, Dennis 2005, Wilma 2005, Gustav 2008 and Tropical Storm Nicole 2010.

5.0 Stylized Facts

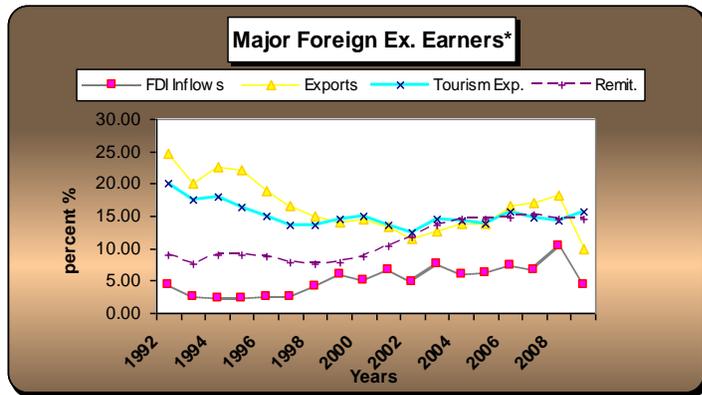
Figure1. Remittance Inflows 2000-2010



Source: Bank of Jamaica

Figure 1 illustrates the general upward trend in remittance inflows to the island from the first quarter 2000 to the last quarter 2010. The flows diminished significantly during the onset of the global economic downturn between 2007 and 2008 and have thereafter been showing steady increases as conditions in both the host and home countries gradually improve. Remittances had a decline in growth rate of 11.4 % between 2008 and 2009 after showing increases of approximately 10% on average for the previous five years. Remittances had been growing by approximately 12% on average between 1988 and 2010. Additionally, compared to the other major foreign exchange earners, remittances have been the most persistent in terms of growth.

Figure 2: Major Foreign Exchange earners* 1992-2009

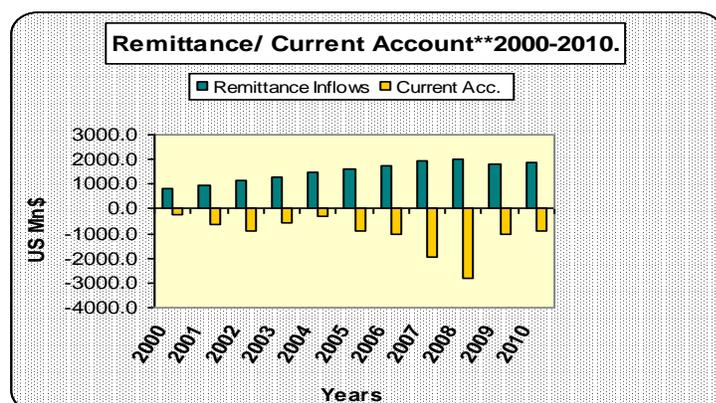


Source : Bank of Jamaica

* As a Percentage of GDP

Figure 2 underlines the relative importance of remittances among the four major traditional foreign exchange earners for the Jamaican economy. Remittances as a percentage of GDP are only outperformed by Tourism receipts as the top earner of foreign exchange between 1992 and 2009 in terms of consistency. In 1992 for example, remittance was only 9.1% of GDP compared to Exports at 24.8%, FDI inflows at 4.5% and Tourism at 20.2% of GDP. By 2009, remittance was 14.6% of GDP and was only marginally outperformed by Tourism expenditure inflows which fell to 15.7%. Also in 2009, FDI stood at 4.4% and the foreign exchange earnings from exports was 10% of GDP. In 2004 and 2005, remittance was the largest foreign exchange earner at 14.5 and 14.6% of GDP respectively whereby Tourism came in second at 14.2 and 13.9% respectively.

Figure 3: Remittances and Current Account 2000-2010**



** Current Account less Remittances

Source: Bank of Jamaica

Figure 3 further underscores the persistence of remittance inflows in the face of a worsening current account over the 2000 to 2010 period. The average current account deficit (less remittances) over the period was just over US\$1 Bn dollars. It peaked at around US\$2.8 Bn dollars in 2008 during the global economic downturn. However, this performance could have been worse if not for remittance inflows which averaged US\$1.5 Bn over the same period and peaked at just over US\$2.0 Bn in 2008 as depicted in the diagram.

6.0 Econometric Model and Methodology

6.1 The Vector Error Correction Model

The paper seeks to identify the macroeconomic variables that affect remittance inflows and after examining the time series properties of the variables, a Vector Error Correction Model (VECM) was seen to be the most appropriate specification based on these properties. This model is ideal since the variables on preliminary examination

seem to be trending, and also because of possible endogeneity problems. Additionally, if there exists any cointegrating relationship of the variables, it should be included in the model as an additional regressor. The VECM relies on the assumption that at least one cointegrating relationship exists among the variables to be analyzed. Engle and Granger (1987) showed that a linear combination of two or more non-stationary variables may be stationary or I (0). Estimation of the model using an Ordinary Least Squares (OLS) technique would yield potentially spurious regression results and may lead to misleading or erroneous conclusions.

If the variables are found to be cointegrated, the specification of the VECM would be:

$$\Delta X_t = \mu_0 + \Phi_0 \sum_{i=1}^n \Delta X_t - \mu_1 \left[X_{t-1} - \frac{\Phi_0}{(\mu_1 - 1)} X_{t-1} \right] + \varepsilon_t$$

Where:

$X_t = [\text{lrem}_t, \text{int}_t, \text{lgdp}_t, \text{usunem}_t, \text{lcpit}_t, \text{usexch}_t]$ (the vector of variables)

μ_0 is the vector of constants.

μ_1 measures the speed of adjustment of remittance from its long-run equilibrium.

Φ_0 is the vector reflecting the short-run dynamics or the short-run adjustment information.

ε_t is the vector of error terms.

6.2 Unit Root Tests

Both the Augmented Dickey-Fuller (ADF) and Phillips-Perron unit root tests were performed on the variables to determine their order of integration. Table 1 gives the results of both tests. For each estimate, the inclusion of a trend and/or intercept was based on inferences from the time series plots as well as *a priori* expectations according to the literature. The Phillips-Perron test is robust in the presence of both serial correlation and time dependent heteroscedasticity.

From Table 1, it can be seen that all variables are integrated of order 1 [I(1)] or difference stationary based on the results of both the ADF and the Phillips-Perron tests.

Before carrying out the cointegration test, an unrestricted VAR is estimated to find the appropriate lag length needed for the test. The VAR model is first selected for a large number of lags, then re-estimating the model for one less lag down to zero lags. After each estimation, the values of AIC and SBC criteria are inspected. The selected model minimizes both the SBC and AIC criteria. The selected lag length was three (3) lags.

6.3 The Johansen Cointegration test

Following the method of Johansen (1998), the Trace and the Max Eigen Value tests are used to test for the number of cointegrating vectors. The Trace Statistic tests the null hypothesis of no cointegration against the alternative that there is one or more cointegrating vectors. The maximum Eigen Value statistic tests the null hypothesis that the number of cointegrating vectors is some quantity (p) against the specific alternative

of (P+1) cointegrating vectors. The results presented in Table 2 show that there is one (1) cointegrating equation existing at the 0.05% level between remittances, GDP, the price level, interest differential, the exchange rate and the rate of US unemployment. The trend assumption was a linear trend and intercept.

7.0 Empirical Results

7.1 Long-run coefficients

It was found that there is a long-run relationship between remittances and all the variables in the model. The long term adjustment coefficients estimated were:

$$\mathbf{irem}_t = 48.31 + 0.07*\mathbf{int} + 0.04*\mathbf{usexch} - 3.76*\mathbf{lgdp} - 0.60*\mathbf{lcpi} - 0.27*\mathbf{usunem}$$

| | | | | |
|----------|----------|---------|---------|---------|
| (0.009) | (0.017) | (1.433) | (0.198) | (0.055) |
| [-7.602] | [-2.588] | [2.626] | [3.036] | [4.944] |

Where standard errors are in () and T-statistics in [].

The cointegrating vector was normalized using remittances. Remittances, in the long-run, increase with a widening interest rate differential gap and exchange rate depreciation. It is negatively related with rising prices in the domestic economy and with the rate of unemployment in the United States of America (host).

The increased remittances due to a weakening Jamaican dollar are in contrast to Bougha-Hagbe (2004) whose interest differential was found to be negative. A negative interest differential is hinting to a preference for foreign instruments and investments

when the gap¹⁵ increases. The importance of the Interest differential for remittance inflows was highlighted by Henry, Moulton and Ricketts (2009) in their research on the motives for sending remittances as well as the work of Alleyne, Kirton and Figueroa (2008) after looking at remittances to selected Caribbean countries.

The exchange rate coefficient was also positive and significant. In the long-run, remittances increase when the exchange rate depreciates or devalues. Alleyne (2006) believes this can be explained by remitters trying to capitalize on the opportunity to acquire assets or to counter the negative effect of rising domestic prices synonymous with a depreciating currency. This is also pointing to the prevalence of the 'wealth' effect as put forward by Bougha-Hagbe (2004). This finding, however, contrasts with Lueth and Ruiz-Arranz (2007) who found a negative long-run relation between remittances and the exchange rate for Sri-Lanka. They posited that migrants reduce the amount sent as the same amount of goods can be purchased with fewer dollars because of the depreciation.

However, acquisition of assets as posited by Alleyne (2006) may not be the case if the growth rate of CPI outweighs the growth rate of the exchange rate. It may be the case that remittances are merely sent for counter inflationary reasons. Even though the depreciation gives more JA dollars per US dollar sent, a faster inflation growth rate will erode that increased purchasing capacity. There is a strong case for this possibility as the average, quarter to quarter growth rate of the exchange rate over the sample was 3.38% compared with that of the CPI at 4.04%.

¹⁵ This was represented by the difference between the interest rates on deposits in Morocco (the home country) and France (the host country).

Remittances are shown to be counter-cyclical which is more supportive of the altruistic motive. It increases as the Jamaican economy (GDP) declines and can be viewed as an insurance against the negative shock of adverse growth. This is in line with the work of Alleyne, Kirton and Figueroa (2008), Lucas and Stark (1985), Rapoport and Docquier (2005) and Bougha-Hagbe (2004). Lueth and Ruiz-Arranz (2007) found the relationship to be pro-cyclical which they believe is a strong indication of altruism and also suggesting that remittances are positively linked to the long-run domestic performance of the Moroccan economy.

The direction of the inflation relationship was not supportive of the altruistic motive, as it is found to be negatively related with remittances in the long run. The sign of this variable was varied in terms of the literature on the relationship between remittances and inflation. The negative relationship may be pointing to an increase in the perceived risk of sending these remittances because of the growing uncertainty normally associated with inflationary periods.

7.2 Error correction estimates

Table 5 provides the error correction estimates for the adjustment of remittances after shocks to the variables in the system. They specifically give the fraction of the gap that is closed each period after the shock. The first result which represents remittance inflows, shows that the remaining long-run remittance gap closes by approximately 11.4% in each quarter, while the gaps for the interest differential, inflation, the exchange rate, GDP and the US unemployment rate closes by 53 percent, 1.6 percent, 92 percent, 2 percent and 7.6 percent respectively. These results are indicating that shocks

to the interest differential and the exchange rate will return to equilibrium faster than shocks to Inflation, GDP and the unemployment rate of the USA. However, we are mainly interested in the rate at which shocks to remittances will persist.

7.3 Variance Decomposition

A variance decomposition was carried out to determine the amount of the error variance of remittances that can be explained by shocks to the other variables. It gives information about the relative importance of each innovation to the variables in the VECM. Specifically, it determines the portion of the forecast error variance of each variable that can be explained by exogenous shocks to the other variables.

The Cholesky ordering of the variables was the same for the impulse response functions. The decomposition was done for a ten month period and will seek to support the suggested relationships implied by the impulse response functions and the cointegrating relationships.

After the first period, remittances explain approximately 90.8% of its standard error. This is followed by the exchange rate which explains approx. 4.9% of the error variance in remittances. However from the second to the tenth period, most of the error variance in remittance inflows is explained by the unemployment rate of the host country. The variance decomposition confirms the importance of both the exchange rate and the interest rate differential as domestic macroeconomic variables to remittance inflows. For the tenth period forecast of the standard error, the unemployment rate of the United States, the interest rate differential and the exchange rate account for approximately 18.4%, 6% and 3% respectively for the total error of remittance inflows.

7.4 Impulse Responses

Table 6 shows the response of remittances after a Cholesky one standard deviation (S.D) innovation to the variables. The period selected for analysis was 12 periods (3 years).

The variables were ordered using the Cholesky decomposition method where any common effect among the variables is attributed to the variable that comes first in the VEC. Hence, the variables were placed in the following ordering: United States unemployment, interest rate differential, exchange rate, inflation (CPI), domestic GDP then remittance inflows. Specifically, however, other Cholesky orderings did not significantly affect the impulse responses.

A shock to the CPI causes remittances to fluctuate for the first six quarters before settling marginally above the pre shock levels for the first three years. Remittances show a marginal increase in the first quarter of the shock but the fluctuation is again confirming the uncertainty associated with increases in inflation.

Domestic GDP does not affect remittances until the second quarter after the initial shock. Remittances decrease sharply after which it increases, before remaining at a slightly lower level than the pre-shock levels for the remaining 8 quarters.

Shocking remittance inflows by a one S.D innovation in the interest rate differential causes remittance inflows to increase consistently for the first four quarters after which its growth declines to a still higher level for the remainder of the three year period. This is confirming that an increase in the interest rate differential will cause

remittances to increase certainly for the first three years after the initial shock. The importance of this variable is again highlighted.

Remittances decline sharply after an increase in the US unemployment rate which is also confirming the long-run relationship between both variables. Remittances show a slight increase in the second and fourth quarter however. There is then a huge gap between remittances before and after the one standard deviation shock. The unemployment of the emigrant renders them unable to send remittances after a fallout in their income and this could be explaining the size of the change in remittances after the shock. The shock in the unemployment rate of the migrants' economy seems to have the most significant effect on remittances. The importance of this variable was also seen in the variance decomposition.

A shock to the exchange rate (specifically a depreciation), decreases remittances sharply for the first month after the shock. It then increases and returns to the pre shock levels after about two years after the initial shock. The long-run effect however, is shown to be a positive one.

8.0 Conclusion

Remittances are to some extent determined by domestic as well as external factors. Over the long term, shocks to the US unemployment rate, however, seem to have the most significant impact on remittances to Jamaica both in the short and long run.

The results show that the exchange rate and the interest differential are also significant as domestic macroeconomic variables as the shocks from domestic GDP and Inflation are not as significant in affecting the flows of remittances in the long run.

The research is pointing to a smaller possibility of a foreign exchange shortfall with Jamaican dollar depreciation, increases in the interest rate differential, as well as decreases in the rate of unemployment in the United States. These conditions will also have the effect of providing some insurance against any prolonged current account deficit.

Additionally, any policy action taken by the Bank towards a desired exchange rate target through foreign exchange supply adjustments, should be cognizant of external market conditions, in particular the unemployment rate of the United States. This variable is shown to have a significant impact on the domestic foreign exchange market, through remittances.

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10.0 Appendix

Table 1: Augmented Dickey-Fuller and Phillips-Perron Unit Root tests

| | Levels | | 1st Difference | |
|---|------------------|----------------------------------|------------------|----------------------------------|
| | ADF Statistic | Phillips- Perron Statistic | ADF Statistic | Phillips- Perron Statistic |
| Remittances (lrem) (\$US Mn changes) | -1.42 | -1.03 | -7.14** | -28.04** |
| Interest Differential (int) (%) | -1.77 | -2.97 | -8.74** | -7.71** |
| US exchange rate (usexch) (%) | -0.49 | -0.18 | -6.33** | -5.88** |
| Nominal GDP (lgdp) (\$JA Mn) | -1.60 | 1.19 | -3.08 | -10.4** |
| Consumer Price Index (lcpi) (Units) | -2.04 | -1.53 | -3.46** | -4.34** |
| US Unemployment Rate (usunem) (%) | -2.29 | -1.02 | -4.83** | -4.88** |

** Denotes rejection of the Null Hypothesis of a Unit Root

Augmented Dickey-Fuller and Phillips- Perron 5% critical value = -3.43

Table 2: Trace and Maximum Eigenvalue test results

Endogenous Series: LREM INT USEXCH LGDP LCPI USUNEM

Exogenous series: DUM1 DUM2

Unrestricted Cointegration Rank Test (Trace)

| Hypothesized | | Trace | 0.05 | |
|--------------|------------|-----------|----------------|---------|
| No. of CE(s) | Eigenvalue | Statistic | Critical Value | Prob.** |
| None * | 0.565 | 162.593 | 117.708 | 0.000 |
| At most 1 | 0.272 | 88.567 | 88.804 | 0.052 |
| At most 2 | 0.252 | 60.371 | 63.876 | 0.095 |

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

| Hypothesized | | Max-Eigen | 0.05 | |
|--------------|------------|-----------|----------------|---------|
| No. of CE(s) | Eigenvalue | Statistic | Critical Value | Prob.** |
| None * | 0.565 | 74.026 | 44.497 | 0.000 |
| At most 1 | 0.272 | 28.196 | 38.331 | 0.442 |
| At most 2 | 0.252 | 25.830 | 32.118 | 0.241 |

Trace test & Max-eigenvalue test indicates 1 cointegrating equation at the 0.05 % level

*** denotes rejection of the hypothesis at the 0.05 level**

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

Included observations: 88 after adjustments

Table 3: Correlation Matrix

| | REM | USUNEM | INT | CPI | USEXCH | GDP |
|--------|--------|--------|--------|-------|--------|-------|
| REM | 1.000 | | | | | |
| USUNEM | 0.196 | 1.000 | | | | |
| INT | -0.482 | 0.229 | 1.000 | | | |
| CPI | 0.949 | 0.359 | -0.423 | 1.000 | | |
| USEXCH | 0.933 | 0.310 | -0.321 | 0.969 | 1.000 | |
| GDP | 0.742 | 0.214 | -0.045 | 0.680 | 0.749 | 1.000 |

Table 4: Variance Decomposition

| Period | S.E. | LREM | INT | LGDP | LCPI | USUNEM | USEXCH |
|--------|-------|------|-----|------|------|--------|--------|
| 1 | 0.140 | 90.8 | 0.0 | 3.5 | 0.8 | 0.1 | 4.9 |
| 2 | 0.148 | 83.7 | 1.1 | 3.1 | 1.1 | 5.8 | 5.0 |
| 3 | 0.168 | 83.9 | 1.8 | 2.5 | 1.1 | 5.9 | 4.8 |
| 4 | 0.178 | 79.1 | 4.0 | 2.2 | 1.3 | 9.2 | 4.2 |
| 5 | 0.189 | 77.2 | 5.0 | 2.0 | 1.2 | 10.7 | 4.0 |
| 6 | 0.199 | 74.8 | 5.6 | 1.8 | 1.3 | 12.6 | 3.9 |
| 7 | 0.208 | 73.3 | 5.8 | 1.7 | 1.3 | 14.2 | 3.7 |
| 8 | 0.217 | 71.8 | 5.8 | 1.6 | 1.5 | 15.9 | 3.5 |
| 9 | 0.227 | 70.7 | 5.8 | 1.5 | 1.5 | 17.2 | 3.2 |
| 10 | 0.235 | 69.6 | 6.0 | 1.4 | 1.6 | 18.4 | 3.0 |

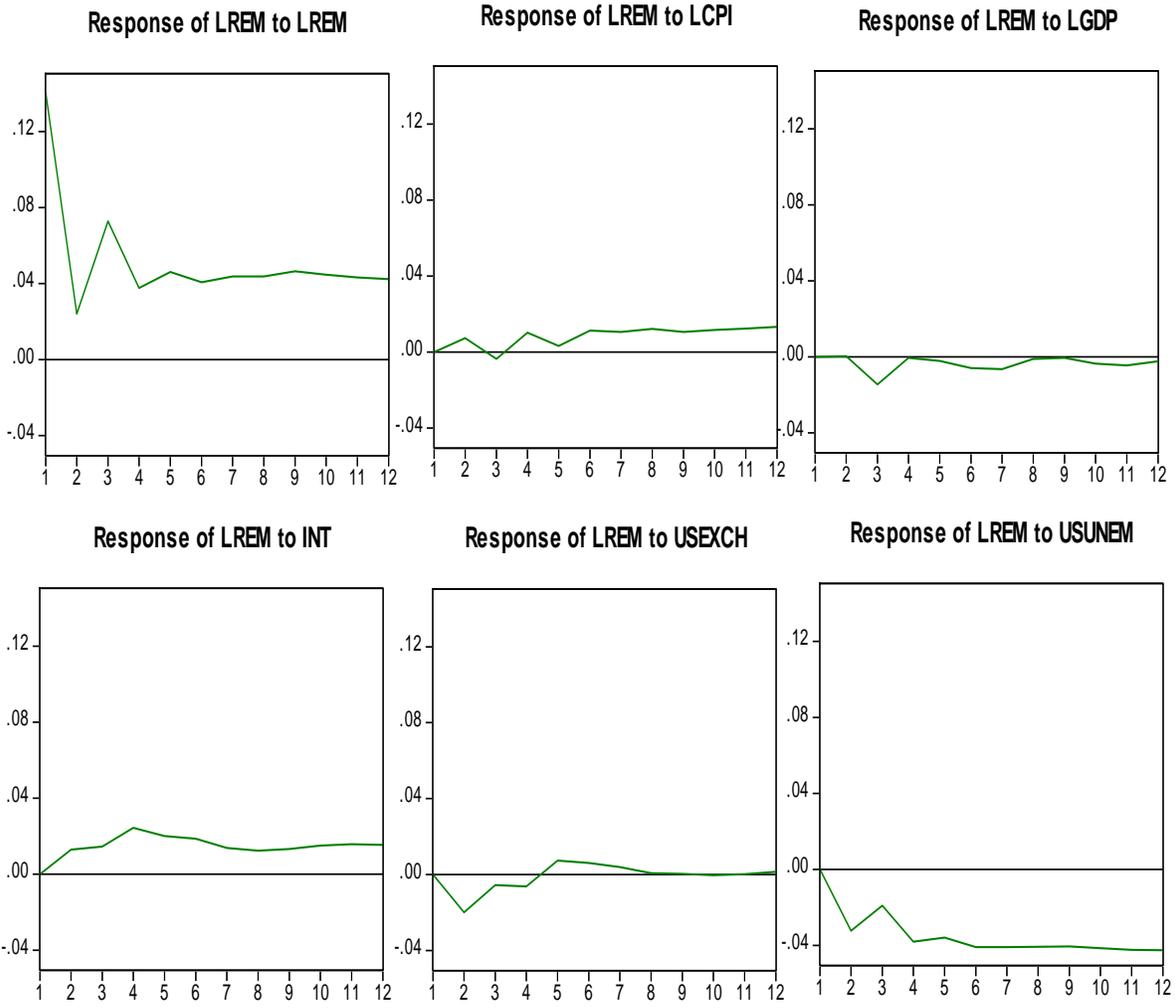
Cholesky Ordering: USUNEM, INT, USEXCH, LCPI, LGDP, LREM

Table 5: Vector Error correction Estimates

| Error Correction: | D(LREM) | D(INT) | D(LCPI) | D(USEXCH) | D(LRLGDP) | D(USUNEM) |
|--------------------------|----------------|---------------|----------------|------------------|------------------|------------------|
| CointEq1 | -0.114 | 0.530 | 0.016 | 0.926 | 0.020 | 0.076 |
| | (0.041) | (0.223) | (0.008) | (0.493) | (0.006) | (0.075) |
| | [-2.765] | [2.377] | [2.0169] | [1.878] | [3.518] | [1.015] |

Table 6: Impulse Response Functions

Response to Cholesky One S.D. Innovations



Cholesky ordering of variables: usunem, int, usexch, lcpi, lgdp, lrem.

Table 7: Annual Remittance inflows and Current Account

| | Current Acc.** \$ US Mn | Annual Remit. \$ US Mn |
|-------------|--|---|
| 1990 | -729.0 | 311.3 |
| 1991 | -1258.4 | 294.8 |
| 1992 | -1666.5 | 387.2 |
| 1993 | -1440.6 | 415.9 |
| 1994 | -1301.2 | 486.9 |
| 1995 | -1930.6 | 582.3 |
| 1996 | -2150.7 | 635.4 |
| 1997 | -3290.7 | 654.4 |
| 1998 | -4187.7 | 654.7 |
| 1999 | -2161.0 | 681.0 |
| 2000 | -2008.8 | 789.5 |

**Non-Remittance

Source: Bank of Jamaica

Table 8: Macroeconomic Share (% of GDP)

| | FDI Inflows | Exports | Tourism Exp. | Remit. |
|-------------|--------------------|----------------|-------------------------|---------------|
| 1992 | 4.5 | 24.8 | 20.2 | 9.1 |
| 1993 | 2.6 | 20.0 | 17.5 | 7.7 |
| 1994 | 2.4 | 22.6 | 18.0 | 9.0 |
| 1995 | 2.3 | 22.1 | 16.4 | 8.9 |
| 1996 | 2.5 | 18.9 | 14.9 | 8.7 |
| 1997 | 2.4 | 16.6 | 13.5 | 7.8 |
| 1998 | 4.2 | 15.1 | 13.7 | 7.5 |
| 1999 | 6.0 | 14.2 | 14.5 | 7.7 |
| 2000 | 5.1 | 14.6 | 14.9 | 8.8 |
| 2001 | 6.7 | 13.4 | 13.5 | 10.3 |
| 2002 | 5.0 | 11.6 | 12.5 | 11.7 |
| 2003 | 7.7 | 12.8 | 14.5 | 13.6 |
| 2004 | 5.9 | 13.9 | 14.2 | 14.5 |
| 2005 | 6.1 | 13.8 | 13.9 | 14.6 |
| 2006 | 7.4 | 16.7 | 15.7 | 14.9 |
| 2007 | 6.7 | 17.1 | 14.9 | 15.3 |
| 2008 | 10.4 | 18.3 | 14.3 | 14.6 |
| 2009 | 4.4 | 10.0 | 15.7 | 14.6 |

* Calculated using GDP at Current Prices

GDP converted to \$US using annual weighted average US selling rates

Table 9: Quarterly Series

