Estimating the Cyclicality of Remittance Flows to Jamaica from the USA

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Abstract

This study models the relationship between selected US economic indicators and remittance inflows to Jamaica, utilizing an Autoregressive Distributive lag (ARDL) model over the period 1997 Q3 to 2013 Q1. Results support the hypothesis that there exists a weak pro-cyclical relationship between selected US economic variables and remittance inflows to Jamaica. In particular, remittance flows to Jamaica are partially influenced by movements in US real GDP as well as employment in the Health Care & Social Assistance sector. In addition, the ARDL error correction model indicates a 50.0 per cent correction of the disequilibrium in remittances each quarter when controlling for the effect of shocks to domestic variables.

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[1] The views expressed in this paper are not necessarily those of the Bank of Jamaica.

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1. Introduction

Remittances transfers have contributed substantially to current account inflows to the Balance of Payments (BOP) for Jamaica during the past decade, thereby serving as a key source of foreign exchange for the Jamaican economy. Over the period 1997 to 2012, remittances to Jamaica have more than tripled, totalling US$2.0 billion in 2012 and recorded an average annual increase of approximately 8.0 per cent during the reference period (see **Figure 1, Appendix**). In a context where remittances account for approximately a third of Jamaica's foreign currency inflows, it is imperative to understand the dynamics of these flows and to empirically forecast changes in them.

The USA has been the most significant host country for Jamaica's migrant workers resulting in that country being the major source market for remittance flows to the domestic economy. The most recent Remittances Survey conducted by the Bank of Jamaica indicated that in terms of a breakdown of remittance inflows by country of origin, 62.0 per cent of remittance recipients received money from the USA, 17.0 per cent from the UK, 9.0 per cent from Canada, and 4.0 per cent from the Cayman Islands (Ramocan, 2010). Against this background, the moderation in real GDP growth in the recessionary period in the USA adversely impacted remittance flows to Jamaica, which in turn contributed to a deterioration in Jamaica's current account deficit. In this regard, this paper seeks to investigate the relationship between selected US macroeconomic variables including employment, housing and manufacturing indicators and inflows of remittances to Jamaica, in order to ascertain whether changes in the US business cycle influence remittance flows to Jamaica. In particular, the paper seeks to determine whether a downturn in the US economy would likely result in a commensurate contraction in the flow of remittances to Jamaica.

Similar studies have been conducted on the impact of remittances on the Caribbean and the Jamaican economy. However, this paper adds to the existing literature an analysis of the relationship between host country economic indicators and remittances with a view to identifying cyclical patterns in remittance flows which can in turn be utilized as an early warning signal for a downturn in the domestic economy stemming from external sources. It is anticipated that the results should provide information on the time taken for a dissipation of a shock to US economic indicators on remittance inflows to Jamaica. Furthermore, given the close relationship between the

aforementioned variables, the results should also indicate how sensitive remittance inflows are to changes in US sectoral employment indicators.

The remainder of the paper is organized as follows: section II provides a definition for remittances, section III presents stylized facts, section IV gives a literature review; section V describes the data and methodology employed in the study; section VI discusses the econometric results; and section VII provides concluding remarks.

2. Definition of Remittances

As outlined in the sixth edition of the Balance of Payments Manual (IMF, 2009), remittances are defined as household income from foreign economies arising mainly from the temporary or permanent movement of people to those economies. Remittances include cash and noncash items that flow through formal channels, such as via electronic wire, or through informal channels, such as money or goods carried across borders. They largely consist of funds and noncash items sent or given by individuals who have migrated to a new economy and become residents there, and the net compensation of border, seasonal, or other short-term workers who are employed in an economy in which they are not resident. Inflows of cash remittances will be the focus of this paper given that Jamaica is a net remittance-receiving country.[2]

3. Stylized Facts

With respect to Jamaica's major traditional foreign exchange earners, remittances and tourism earnings broadly trended upwards over the period 1997 to 2012 (see **Figure 2, Appendix**). Over the review period, remittance inflows to Jamaica accounted for approximately 30.0 per cent of total foreign currency (FX) earnings, following earnings from goods exports and tourism-related services, which have, on average, accounted for 36.0 per cent and 34.0 per cent, respectively, (see

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[2] There is no reliable source data on non-cash items termed Value of 'Gifts' in Barrels in Jamaican remittance statistics compilations (see Ramocan, 2010).

Figure 3, Appendix). Notably, there were shares of 35.0 per cent, 35.0 per cent and 30.0 per cent, respectively, for tourism expenditure, remittance inflows and exports in 2012.[3]

Based on the results of the Bank of Jamaica's 2010 Remittances survey, 24.0 per cent and 7.0 per cent of remittance transfers to Jamaica emanated from persons employed in the Private Health & Social Services and the Hotels & Restaurants sectors, respectively, in the USA (Ramocan, 2010). In this context, it is anticipated that a sizeable portion of total remittances from the USA to Jamaica would be associated with persons employed in these sectors. To substantiate this hypothesis, a correlation coefficient of 0.95 was observed between the earnings within the US Education and Health Services sector and remittance inflows to Jamaica over the period 1995 to 2013. In particular, there was a deceleration of growth in earnings within the US Education and Health Services sector to 2.7 per cent in 2012 relative to growth of 2.9 per cent in 2011. This compares to a slower pace of growth in remittance inflows to 0.9 per cent in 2012 from 5.9 per cent in 2011 (see **Figure 4, Appendix**). Similarly, a correlation coefficient of 0.94 indicated a strong co-movement between earnings within the Leisure and Hospitality sector in the USA and remittance inflows (see **Figure 5, Appendix**). However, it should be noted that the relationship between both variables has weakened since 2010. In general, the positive co-movement between employment in both sectors and Jamaica's remittances suggests that any directional change in the earnings in these sectors should influence remittance inflows to Jamaica and possibly serve as a short-term leading indicator for projected remittances.

In terms of the performance of remittances in the Latin America and Caribbean (LAC) region, there was a similar deceleration observed in 2012, reflecting a 0.7 per cent increase relative to growth of 5.7 per cent in the previous year. Regarding the share of remittances for each country in the region, Mexico recorded the highest share of remittances at 38.0 per cent followed by Guatemala at 8.0 per cent as well as Colombia and El Salvador both at 7.0 per cent. Of the countries in the region, Jamaica received the ninth largest share of remittances at 3.0 per cent, receiving amounts comparable to Brazil and Haiti for the year (see **Figure 6**).

There has been a notable deceleration in remittance flows to the LAC region since 2008, reflecting the impact of the global economic crisis on overall demand conditions in the US economy. During

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[3] FDI inflows were not included in this discussion, primarily because these flows do not form a part of the foreign exchange market. In addition, there is usually a heavy import content associated with FDI.

the period preceding the global crisis between 2002 and 2008, remittance flows to the region increased by approximately 17.0 per cent, peaking at US$64.9 billion in 2008 for the reference period (see **Figure 7, Appendix**). However, these inflows declined by 1.2 per cent on average over the post-crisis period from 2009 to 2012, with only the Dominican Republic recording significant growth in inflows in 2012 at 4.8 per cent relative to the previous year. In the case of Jamaica, private inflows were marginally higher by 1.9 per cent for 2012 in comparison to annual percentage increases of 7.2 per cent and 3.9 per cent in 2010 and 2011, respectively, following a contraction of 12.9 per cent in 2009.

Figure 6: Remittances Received in 2012
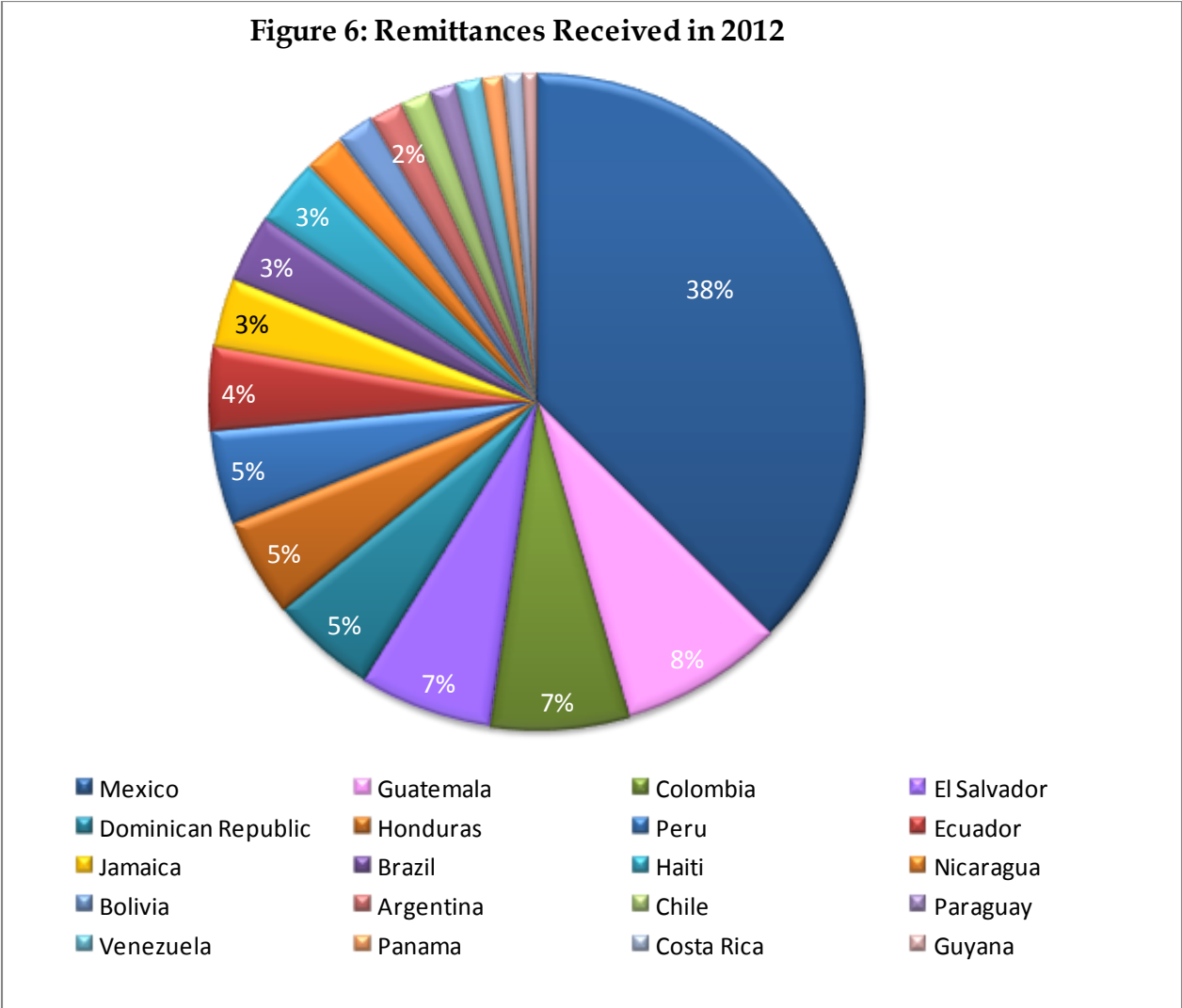
Source: IDB

4. Literature Review

In the context of an increasingly globalized economy and a faster pace of migration from developing countries (LDCs) to developed countries, studies on remittances have come to prominence. The macroeconomic literature elucidates the relationship between remittances, home country (remittance-receiving) and host country (remittance-sending) conditions through an examination of major macroeconomic aggregates while other studies have sought to determine whether the altruistic motive or the investment motive dominate remittance decisions.

With respect to the relationship between remittance flows and business cycles in home countries, Roache (2007) focused on remittances to the Latin American region and its relationship with the US business cycle over the period 1990 to 2007. Of note, the USA was chosen as the host country since it possesses the highest population of migrant workers from Latin America. Using a myriad of methods including inter alia cointegration and an autoregressive distributed lag approach (ARDL), the findings supported the premise that remittance transfers are insensitive to fluctuations in the key US macroeconomic indicators such as real GDP, housing, unemployment and manufacturing indices.

Magnusson (2009) examined linkages between regional US business cycles and remittance outflows to Latin American countries, namely Mexico and El Salvador, over the period 1995-2008 using an Autoregressive Distributed lag (ARDL) model. The key results of this study suggested that, in contrast to previous research, changes in economic conditions in selected US states which are highly populated by Hispanic migrants, in addition to US sectors of remitting importance for Hispanic immigrants, have a pro-cyclical relationship with remittance transfer decisions. However, the existing literature postulates that movements in the aggregate US business cycle have a miniscule impact on remittance flows.

There is a dearth of literature on the impact of host country conditions on remittance flows, particularly in the Caribbean context. Interestingly, much of the literature has focused on ascertaining the trade-off between the altruistic and investment motives for remittance transfers to the region. Against this background, Alleyne, Kirton, McLeod and Figueroa (2008a) estimated the relationship between macroeconomic variables including domestic income, foreign income, interest

rate differential, the unofficial exchange rate premium and cash remittances to Jamaica, over the period January 1983 to April 2001, using a time varying parameter model (TVP). The results highlighted a mixture of altruism and investment motives in remittance transfers to Jamaica. Similarly, Henry, Moulton and Ricketts (2008) employed a VAR framework using Jamaica's GDP, CPI, unemployment rate, the nominal exchange rate and US GDP over the period 1995-2008 to examine the factors influencing decisions by migrants to remit funds to Jamaica. The paper found that both altruistic and investment motives stimulated remittance inflows to Jamaica, particularly during periods of natural disasters such as floods and hurricanes to assist with rebuilding efforts (see also Gupta, 2005)).

Ricketts (2011) used cointegration and a VECM to examine the dynamics of remittance inflows to Jamaica. The paper indicated that remittances are counter-cyclical to movements in Jamaica's GDP while shocks to domestic inflation were found to have a minimal impact on remittances over the short to long run. Contrastingly, shocks to the US unemployment rate contributed to a significant decline in remittance inflows within the first quarter of the shock.

Using a structural vector autoregressive model (SVAR), Sayan (2010) examined the interrelationships associated with business cycle dynamics and remittance decisions of Mexican migrant workers. In particular, the paper analyzed the impact of changes in US GDP on Mexican remittances through the altruism effect and the income effect.[4] The results demonstrated that Mexican workers are more inclined to remit to their home country due to the altruistic motive rather than the income effect, which indicates that the remittances are countercyclical with respect to the business cycles in Mexico.

Silva and Huang (2005) employed a vector error correction model (VECM) and Granger causality tests to determine the behaviour of worker's remittances sent to Brazil, Colombia, the Dominican Republic, El Salvador, Mexico and the USA in the context of macroeconomic conditions of the host country and home country. The results pointed out that the economic situation of the host country dominates remittance decisions relative to economic conditions present in the home country. They concluded that policymakers in the home countries should investigate individual and demographic

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[4] The altruism effect is defined as the tendency for migrant worker in the USA to remit more due to worsening economic conditions in Mexico despite a fall in US GDP. The income effect represents a negative shock to US GDP which lowers the earnings of the Mexican workers in the USA and induces them to reduce remittance transfers to their home countries.

variables of migrants in the host country rather than domestic macroeconomic variables if increased remittance inflows are desired.

Most studies reveal a counter-cyclical linkage between remittances and home country conditions, while a pro-cyclical relationship is evident in relation to fluctuations in host country conditions. While there has been an increased emphasis on examining the sensitivity of remittances sent to the LAC region to fluctuations in the US business cycle, the literature pertaining to the Caribbean region is yet to fill this gap.

5. Data & Methodology

The paper employs quarterly data over the period 1997 Q3 to 2013 Q1. Data on remittances inflows (r_t), Jamaica's real GDP (lnjagdp), tourism expenditure, export earnings and FDI inflows were garnered from the Bank of Jamaica's database. A gamut of data on US indicators including real GDP (lnusgdp), ISM manufacturing index (ismm), retail sales (lnrs), the civilian labour force (lnlf), employment in the health care and social assistance sector (lnehsa), employment in the leisure and hospitality sector (lnelh), housing starts (lnhs), and the Dow Jones Industrial Average (lndjia) were obtained from Bloomberg L.P. The data are expressed in logs. All variables were also tested for stationarity using the Augmented Dickey Fuller test.

Utilizing the methodology of Roache & Gradzka (2007), correlation coefficients were computed to statistically examine the relationship between remittance flows to Jamaica and US economic and financial indicators included in the study. Contemporaneous correlation coefficients as well as correlation coefficients against 1 quarter lag of the US indicators were generated.

An ARDL model using the bounds testing approach as developed by Pesaran & Shin (2001) was then undertaken to estimate the relationship between remittances vis-à-vis contemporaneous and lagged values of exogenous US variables. An ARDL model is a general dynamic specification model which uses the lags of the dependent variable as well as the lagged and contemporaneous values of the independent variables to directly estimate the short-run (SR) effects and indirectly estimate the long-run (LR) equilibrium relationship (Sultan, 2010). Pesaran & Shin (2001) developed the ARDL bounds testing approach in order to test the existence of a cointegrating

relationship irrespective of whether the series are stationary or integrated of order one. They postulated that all previous methods of cointegration such as the Johansen methodology perform optimally only if the underlying variables are integrated of order one. To this end, they demonstrated that if there is a combination of stationary series and series containing a unit root, standard statistical inference based on conventional likelihood ratio tests is no longer valid and the Johansen procedure may generate spurious results.

Subsequent to ensuring that none of the variables are I(2), the first step to the bounds testing approach for remittances entails the estimation of an Unrestricted Error Correction Model (UECM). Borrowing from Pesaran & Shin (2001), the UECM for this study is shown below:

$$\Delta logr_t = \alpha + \sum_{i=0}^{m} \beta_i \Delta logx_{t-s} + \sum_{i=0}^{n} \gamma_i \Delta logz_{t-s} + \sum_{1=i}^{k} \emptyset_i \Delta logr_{t-s} + \theta_1 logx_{t-s} +$$
$$\theta_2 logz_{t-s} + \theta_3 logr_{it-s} + \varepsilon_t$$

(1)

where Δ denotes the first difference operator, r_t represents the quarterly percentage change in remittance flows to Jamaica in period t, α denotes a constant, x_{t-s} is a vector of US economic indicators in period t-s while z_{t-s} is a control variable and ε_t represents the error term.

The first part of equation (1) as denoted by β_i, γ_i and $\emptyset_i$ are the short-run dynamics of the model while θ_1, θ_2 and θ_3 represent the long-run relationship. The selection of the control variables z_{t-s} was borrowed from the rationale used in both Roache & Gradzka (2007) and Magnusson (2009) whereby economic conditions in the home country appear to be the most appropriate under the assumption that domestic output is exogenous to remittances. A few studies have shown that remittances move counter-cyclically with conditions in the home country, particularly with respect to specific issues such as natural disasters, in which case the effects may be absorbed by the residual term (e.g. Attzs and Samuel, 2007; and Yang and Choi, 2007). Thus the inclusion of domestic GDP as an explanatory variable is important to assess and control for the effect of shocks to domestic variables such as recipients' income. Furthermore, if business cycle or economic growth indicators are correlated between the two countries, the omission of origin country regressors would imply serious specification errors. Consequently, the models have been estimated with and without origin country GDP growth.

This bounds testing methodology tests for the absence of a LR equilibrium relationship between the variables based on the null hypothesis of no cointegration against the alternative of cointegration, using a joint significance Wald or F-test of the lagged variables $\theta_1 \log x_{t-1}$, $\theta_2 \log z_{t-1}$, $\theta_3 \log r_{t-1}$ as demonstrated in equation 2. The null hypothesis of the model is:

H$_o$: $\theta_1 \log x_{t-1} + \theta_2 \log z_{t-1} + \theta_3 \log r_{t-1} = 0$ (no long-run relationship)

(2)

H$_{1:}$ $\theta_1 \neq \theta_2 \neq \theta_3 \neq 0$

The calculated F-statistic is compared with the critical value provided by Pesaran & Shin (2001). The next step entails using the lower and upper bounds on the critical values for classifications of regressors at different levels of significance. In each case, the lower bound is based on the assumption that all of the variables are I(0) while the upper bound assumes that all of the variables are integrated of order one. If the computed F-statistic falls below the lower bound, the variables are stationary and as such there is no cointegrating relationship between remittances to Jamaica and US economic indicators. Contrastingly, there is cointegration if the F-statistic exceeds the upper bound. Finally, if the F-statistic falls between the bounds, the inference is inconclusive.

The long-run model as given in equation 3 is estimated in the following step, in the event that there is evidence of a long-run relationship (cointegration) among the variables:

$$logr_t = \alpha + \sum_{i=0}^{m}\beta_i \, logx_t + \sum_{i=0}^{n}\gamma_i logz_t + \varepsilon_t \qquad (3)$$

In the presence of a long-run relationship, the Error Correction Model (ECM) is then estimated, which indicates the speed of adjustment to long-run equilibrium after a short-run disturbance, as shown below:

$$\Delta logr_t = \alpha + \delta\,(ECM)_{t-1} + \sum_{i=0}^{m}\beta_i \, \Delta logx_{t-s} + \sum_{i=0}^{n}\gamma_i \Delta logz_{t-s} + \sum_{1=i}^{k}\emptyset_i \Delta logr_{t-s} +$$

$$\theta_1 \, logx_{t-s} + \theta_2 \, logz_{t-s} + \theta_3 \, logr_{it-s} + \varepsilon_t \qquad (4)$$

Diagnostic tests including the Breusch-Godfrey serial correlation LM tests and the Jarque-Bera test for normality were then conducted in order to evaluate the measures of fit. The cumulative residuals

(CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) were also undertaken to test for stability of the models.[5]

6. Discussion of Results

In order to assess the linkages between remittances and US indicators, contemporaneous correlation coefficients were calculated. There is evidence of a positive relationship between remittances inflows to Jamaica and US real GDP, the US labour force, US employment in health and social assistance sector, US employment in the leisure and hospitality sector, US retail sales as well as a moderately positive relationship with the Dow Jones Industrial Average. A mild negative relationship between remittances and the ISM manufacturing index and US housing starts, respectively, was also revealed based on the correlation coefficients. The latter result possibly suggests two things: (1) the existence of an altruistic motive whereby remittances continued to increase despite contractions in the US manufacturing sector and the US housing market or (2) the fact that not many Jamaican migrants are employed in the manufacturing sector relative to the other sectors. Concurrently, positive correlations between remittances and key US economic indicators were obtained at the first lag for all variables excluding the ISM manufacturing index and US housing starts (see **Table 1; Appendix)**.

The results of the ADF unit root tests revealed that all selected US indicators and remittance flows to Jamaica are integrated of order one. Against this background, the bounds testing approach to the ARDL cointegrating technique was undertaken in order to test for cointegration amongst the variables. Two models were tested for cointegration: a model which included Jamaica's real GDP as a control variable for the relationship between remittances and US economic indicators, henceforth referred to as Model A. The second model excluded domestic GDP, henceforth referred to as Model B. For both models, the null hypothesis of no cointegration was rejected at the 5.0 per cent level given the F-statistic from the Wald test of the joint significance of the lagged regressors of the UECM which surpassed the upper bound of the critical values (see **Tables 2-5; Appendix**).

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[5] The CUSUM test (Brown, Durbin, and Evans, (1975) is based on the cumulative sum of the recursive residuals. This option plots the cumulative sum together with the 5 per cent critical lines. The test finds parameter instability if the cumulative sum goes outside the area between the two critical lines.

The results indicated the existence of a return to equilibrium in the short-run for both models based on a negative and significant ECM term, as represented by the residual series from the long-run equation. In the case of Model A, the ECM term suggests that approximately 50.0 per cent of the disequilibrium between remittances flows to Jamaica and US economic conditions, while controlling for domestic output, would be corrected within one quarter. In the case where there is no control variable for Jamaica's real GDP, an estimated 33.0 per cent of the disequilibrium would be corrected during the first quarter following a shock (see **Tables 6 and 7, Appendix**).

With respect to the long-run models, accounting for domestic output, all US indicators excluding the ISM manufacturing index and employment in the leisure and hospitality sector were of the expected positive sign. To this end, a weak pro-cyclical relationship between these indicators and remittances to Jamaica was evident in the long run. However, just a few variables were found to be significant. These included US real GDP, employment in the leisure and hospitality sector in the USA, employment in the health care and social assistance sector in the USA, US housing starts and Jamaica's real GDP, which accounted for 2.5 per cent, 3.9 per cent (negative relationship), 2.2 per cent, 0.1 per cent and 2.9 per cent of the movement in remittances in the long-run, respectively. Notably, the negative sign obtained on the coefficient of the leisure and hospitality sector in the USA indicates some amount of altruism on the part of those respective senders employed in that sector. The remaining variables were insignificant. Regarding long-run model B which did not incorporate Jamaica's real GDP, the results for US GDP, the civilian labour force, employment in the health care and social assistance sector and US housing starts were all in keeping with a-priori expectations, demonstrating a positive co-movement with remittances. Notably, employment in the health care and social assistance sector, US labour force and US housing starts were significant at the 5.0 per cent level, signaling that adjustments to the respective US indicators result in respective changes of 1.6 per cent, 7.3 per cent and 0.2 per cent in remittances flows for the long-run (see **Tables 8 and 9, Appendix**).

In tandem with the short-run, model A for the long-run establishes a slightly stronger relationship between economic developments in the US economy and remittances to the home country, as indicated by higher R-squares. In addition, the exclusion of home country economic growth would represent a specification error if indicators between the two countries are highly correlated (Roache & Gradzka, 2007).

Several tests were undertaken to verify the robustness of the results. In terms of the diagnostics, the residuals on both ARDL and ECM models depicted white noise and were normally distributed. There was also no evidence of serial correlation (see **Table 10, Figures 8-9; Appendix**). The models were also found to be stable based on the results of the Cusum and Cusum squares tests whereby the cumulative sum remained inside the area between the 5.0 per cent significance lines in all cases (see **Figures 10-13 ; Appendix**).

7. Conclusion

In the context of the US economy accounting for a substantial portion of Jamaica's migrant workers, this paper sought to examine the linkages between fluctuations in the US business cycle via economic indicators and remittances inflows to Jamaica. Research on remittances sent to the Caribbean region and by extension Jamaica has primarily focused on the relationship between home country conditions and remittances. While previous studies have found minimal evidence of linkages between host country and home country economic and monetary aggregates, key US economic indicators, including those of remitting importance to Jamaican migrants, were examined in this paper. Also, in contrast to previous studies which looked at aggregate macroeconomic variables when conducting case studies, this paper included both aggregate variables in conjunction with sectoral employment data based on a high concentration of Jamaicans in specific sectors. These sectors include the health care and social assistance in addition to the leisure and hospitality sector. Furthermore, other US variables including housing starts, retail sales, the Dow Jones index as well as the ISM manufacturing index were examined.
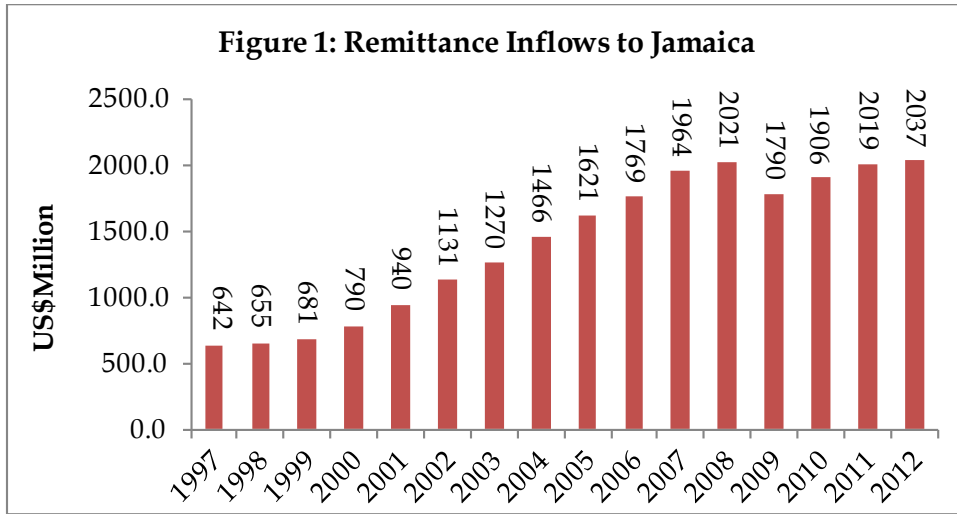
Using an ARDL model, the results of this paper indicated a moderate correction in the disequilibria between remittances and US economic indicators one quarter subsequent to a shock with half of the deviation being corrected within a quarter. The findings further revealed a relatively pro-cyclical linkage as it relates to US economic developments and remittances in the long-term, particularly in terms of employment indicators including increases in the size of the US labour force and employment in the health care and social assistance sector. US real GDP was also shown to possess a long-run relationship with remittances once the model was controlled for the impact of domestic GDP on remittances.

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In light of the relative importance of remittances as a major source of foreign currency for the Jamaican economy, a holistic understanding of factors underpinning such flows is integral to policy formulation. Gaining a better understanding of the role undertaken by host countries in remittance transfer decision-making would aid in fomenting this analysis. In this regard, this paper has contributed to the existing literature by providing an understanding of the directional effects of US business cycles on remittance flows to Jamaica. In other words, a downturn in the US economy will have negative implications for Jamaica and vice versa. Future research would entail a panel study of Caribbean countries incorporating both host and home country indicators.
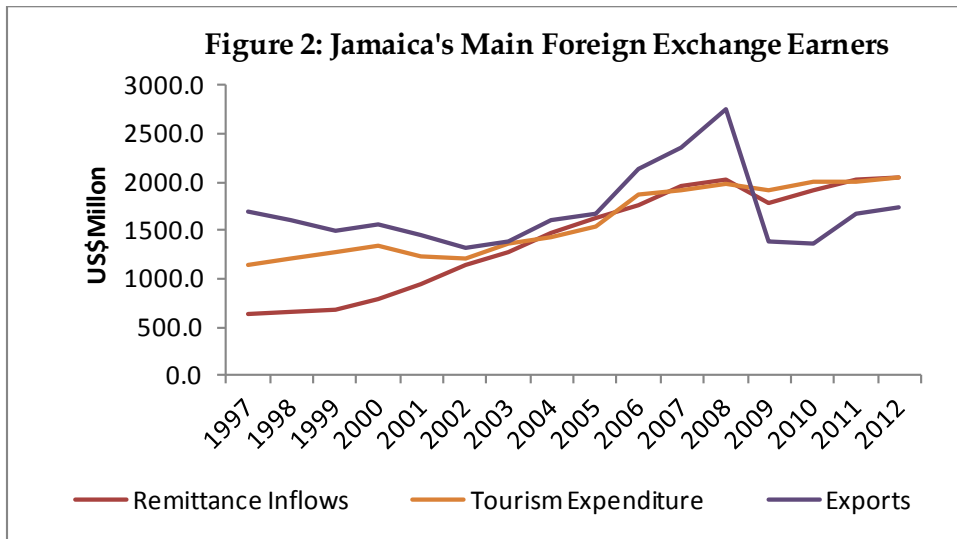
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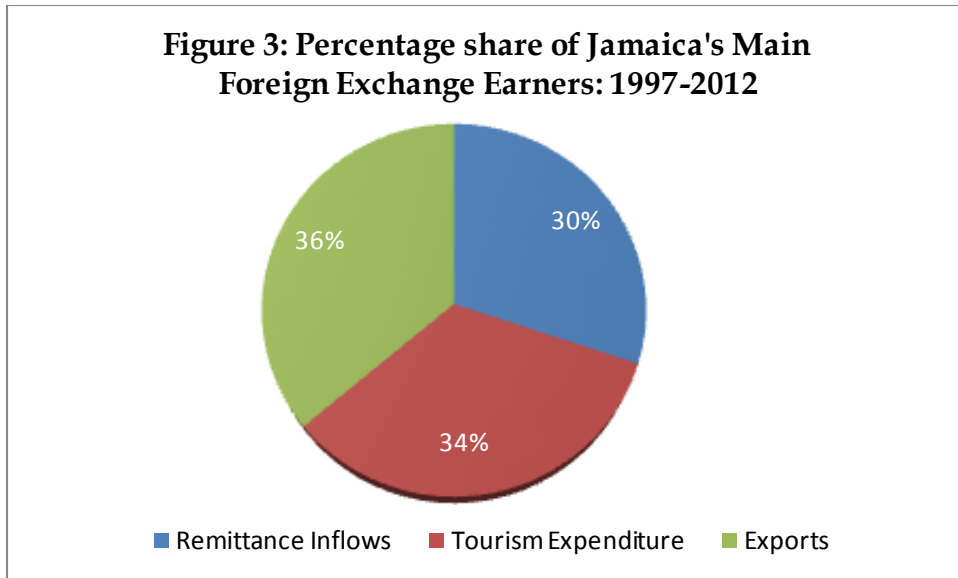
9. Appendix

Figure 1: Remittance Inflows to Jamaica

Values by year (US$Million):
- 1997: 642
- 1998: 655
- 1999: 681
- 2000: 790
- 2001: 940
- 2002: 1131
- 2003: 1270
- 2004: 1466
- 2005: 1621
- 2006: 1769
- 2007: 1964
- 2008: 2021
- 2009: 1790
- 2010: 1906
- 2011: 2019
- 2012: 2037

Source: BOJ

Figure 2: Jamaica's Main Foreign Exchange Earners

Legend: Remittance Inflows — Tourism Expenditure — Exports

Source: BOJ

Figure 3: Percentage share of Jamaica's Main Foreign Exchange Earners: 1997-2012

30%	Remittance Inflows
34%	Tourism Expenditure
36%	Exports

Source: BOJ

Figure 4: Average Weekly Earnings in the US Education and Health Services Sector vs. Private Inflows to Jamaica (% change)

Earnings — Remittances to Jamaica (RHS)
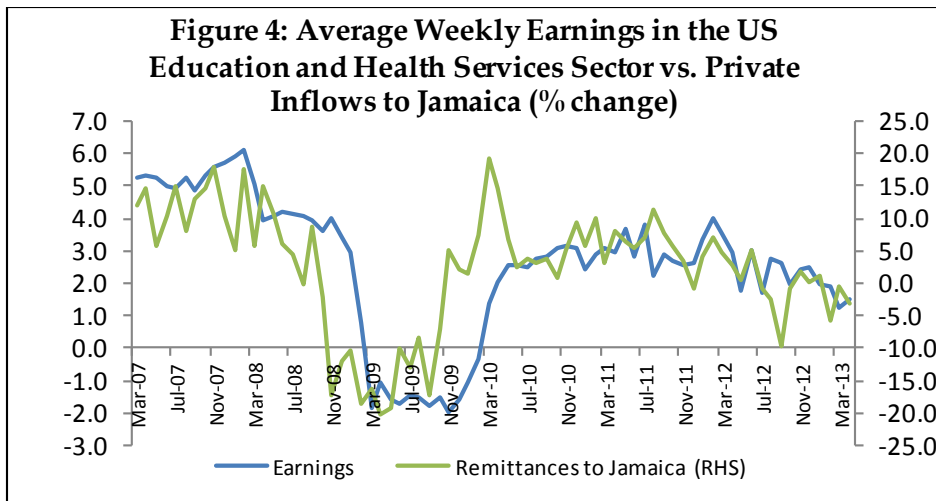
Source: US Bureau of Labor Statistics (BLS) & BOJ

Figure 5: Average Weekly Earnings in the US Leisure and Hospitality Sector vs. Private Inflows to Jamaica (% change)

Source: BLS & BOJ

Figure 7: Remittances to the LAC Region and Jamaica (% change)
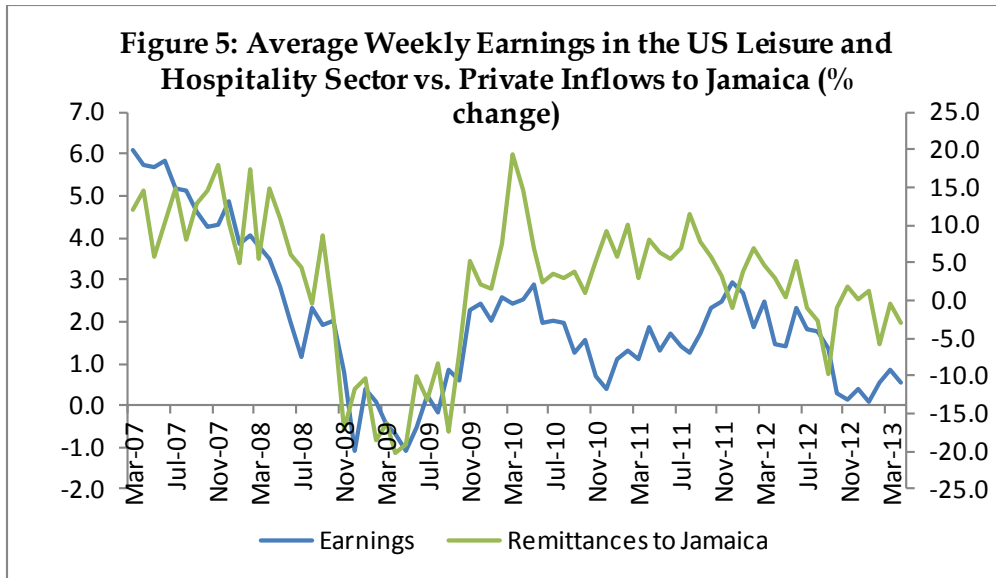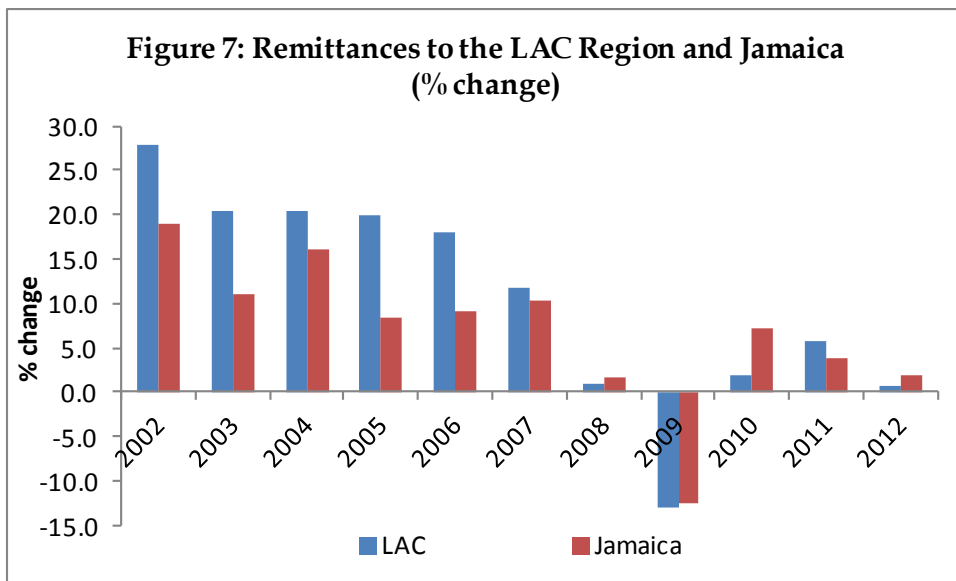
Source: World Bank

Table 1: Contemporaneous and 1 Quarter-lag Correlations between Remittances and US variables

US indicator	Coefficient	
	Contemporaneous	1-lag
Real GDP (usgdp)	0.9778	0.9780
ISM manufacturing (ismm)	-0.2087	-0.1826
Retail sales (rs)	0.9630	0.9685
US labour force (lf)	0.9763	0.9726
Employment in Health and Social Assistance (ehsa)	0.9568	0.9531
Employment in Leisure and Hospitality (elh)	0.9670	0.9675
Housing Starts (hs)	-0.5836	-0.5547
Dow Jones Industrial average (djia)	0.6022	0.6031

Source: Bloomberg L.P. & BOJ

Table 2: Unit Root Tests
(Augmented Dickey-Fuller t-statistic)

Variable	Level	1st difference	Degree of Integration
	T-Statistic	T-Statistic	
lnrem	-2.008073	-9.739148***	I(1)
lnusgdp	-2.285385	-4.747913***	I(1)
lnjagdpsa	-1.349120	-6.982918***	I(1)
lnismm	-2.598678	-7.657733***	I(1)
lnrs	-1.267016	-6.822093***	I(1)
lnlf	-0.861023	-9.084610***	I(1); trend
lnehsa	-1.373241	-2.769442***	I(1)
lnelh	-1.062651	-3.747630***	I(1)
lnhs	-0.998386	-6.117248***	I(1)
lndjia-	-2.093117	-7.834378***	I(1)

Lag lengths in the ADF regressions were chosen by the Bayesian information criterion.
Asymptotic critical values are: 1 percent, -3.51; 5 percent, -2.89; 10 percent, -2.58.

Table 3: Wald Bounds tests

	Critical Bounds		
	F-Statistic	Lower	Upper
Group regressors (Model A)	7.322146	2.22	3.89
Group regressors (Model B)	5.215380	2.22	3.89

Model A includes Jamaica's real GDP as a control variable while Model B does not. Critical values are based on significance at the 5% level.

Table 4: Unrestricted Error Correction Model: With Jamaica GDP as a control variable (Model A)

Variable	Coefficient
DLNREM$_{(t-1)}$	-0.747671***
DLNREM$_{(t-2)}$	-0.440286***
DLNREM$_{(t-3)}$	-0.320838***
DLNRS$_{(t-1)}$	-0.872108 *
DLNRS$_{(t-3)}$	1.609901***
DLNEHSA$_{(t-2)}$	15.62883***
DLNELH$_{(t-1)}$	6.287240***
DLNLF$_{(t-1)}$	-7.312150***
DLNLF$_{(t-2)}$	-9.908237***
DLNHS$_{(t-1)}$	0.277106***
DLNHS$_{(t-3)}$	-0.352799***
DLNISMM$_{(t-1)}$	0.470364***
DLNISMM$_{(t-2)}$	0.310653**
LNISMM$_{(t-1)}$	-0.310143*
LNRS$_{(t-1)}$	1.211533**
LNLF$_{(t-1)}$	3.596149**
LNEHSA$_{(t-1)}$	-2.308721***
LNELH$_{(t-1)}$	-3.727879***

*** Denotes rejection of the null hypothesis at the 1 per cent level and ** denotes rejection at the 5 per cent level and * denotes rejection at the 10 per cent level.

Table 5: Unrestricted Error Correction Model: Without Jamaica GDP as a control variable (Model B)

Variable	Coefficient
DLNREM$_{(t-1)}$	-0.865876***
DLNREM$_{(t-2)}$	-0.673151***
DLNREM$_{(t-3)}$	-0.491081***
DLNUSGDP$_{(t-2)}$	2.126320 *
DLNEHSA$_{(t-1)}$	8.866191**
DLNEHSA$_{(t-2)}$	15.31934***
DLNHS$_{(t-1)}$	0.230349***
DLNHS$_{(t-3)}$	-0.280187***
DLNRS$_{(t-3)}$	1.326327***
DLNDJIA$_{(t-1)}$	-0.147379*

DLNISMM(t-1)	0.420774***
DLNISMM(t-2)	0.273622***
DLNLF(t-1)	-8.948117***
DLNLF(t-2)	-6.992648***
DLNELH(t-1)	6.838737***
LNISMM(t-1)	-0.418780**
LNLF(t-1)	5.838700***
LNEHSA(t-1)	-4.507505***
LNELH(t-1)	-4.987820***

*** Denotes rejection of the null hypothesis at the 1 per cent level and ** denotes rejection at the 5 per cent level and * denotes rejection at the 10 per cent level.

Table 6: ARDL Error Correction Model: With Jamaica GDP as a control variable (Model A)

Variable	Coefficient
ECMJA(t-1)	-0.523620***
DLNJAGDP_SA(t-3)	-2.114873 ***
DLNRS(t-1)	0.852148*
DLNEHSA(t-1)	8.388954*
DLNEHSA(t-2)	10.58705 **

*** Denotes rejection of the null hypothesis at the 1 per cent level and ** denotes rejection at the 5 per cent level and * denotes rejection at the 10 per cent level.

Table 7: ARDL Error Correction Model: Without Jamaica GDP as a control variable (Model B)

Variable	Coefficient
ECM(t-1)	-0.328512***
DLNREM(t-1)	-0.329646**
DLNREM(t-2)	-0.291266**
DLNREM(t-3)	-0.259740**
DLNEHSA(t-1)	8.171115 *
DLNEHSA(t-2)	9.577518**
DLNLF(t-1)	-5.565786**

*** Denotes rejection of the null hypothesis at the 1 per cent level and ** denotes rejection at the 5 per cent level and * denotes rejection at the 10 per cent level.

Table 8: Long Run Equation Model A

Variable	Coefficient
LNUSGDP	2.487464 **
LNJAGDP_SA	2.853319***
LNEHSA	2.195863***
LNELH	-3.934006***
LNHS	0.108628**

*** Denotes rejection of the null hypothesis at the 1 per cent level and ** denotes rejection at the 5 per cent level and * denotes rejection at the 10 per cent level.

Table 9: Long Run Equation: Model B

Variable	Coefficient
LNLF	7.301986***
LNEHSA	1.587321**
LNHS	0.181420***

*** Denotes rejection of the null hypothesis at the 1 per cent level and ** denotes rejection at the 5 per cent level and * denotes rejection at the 10 per cent level.

Figure 8: Normality test ARDL ECM: Model A
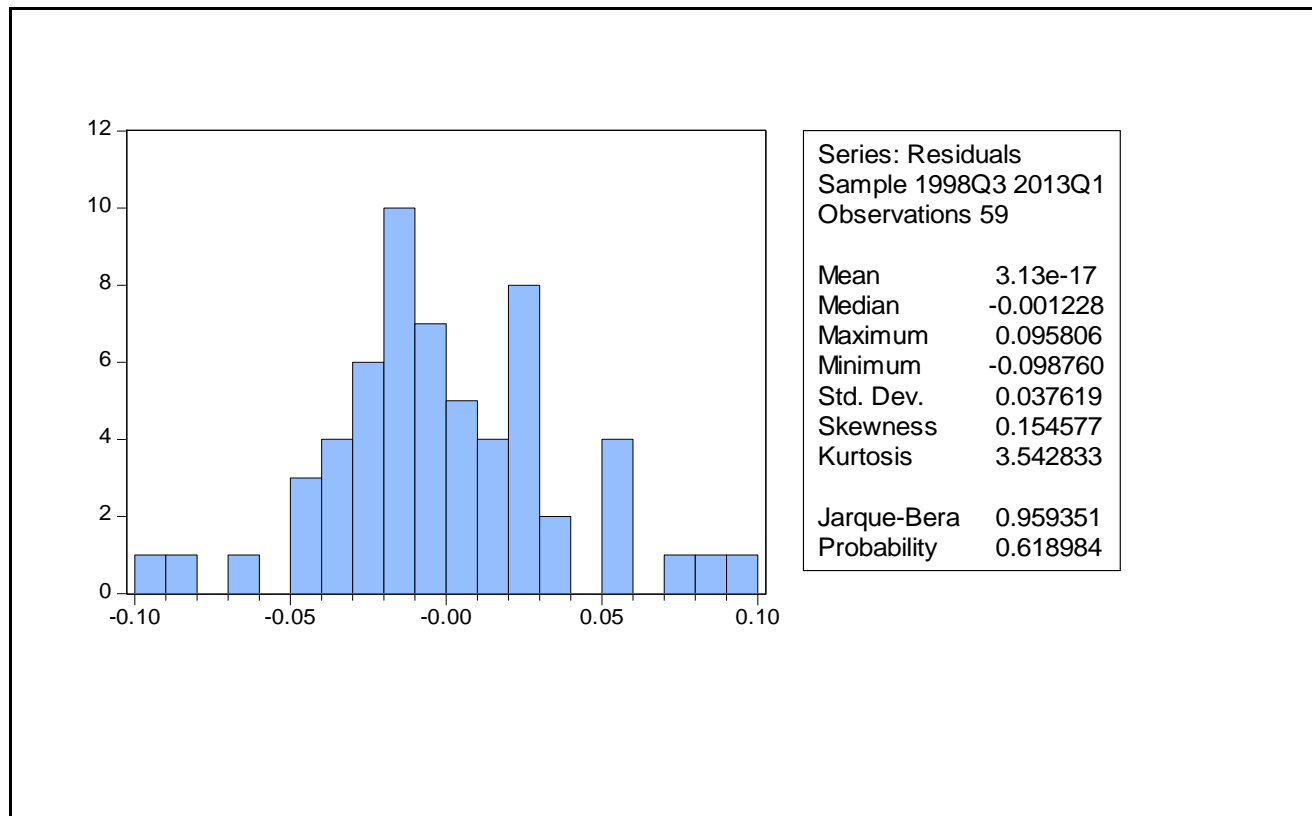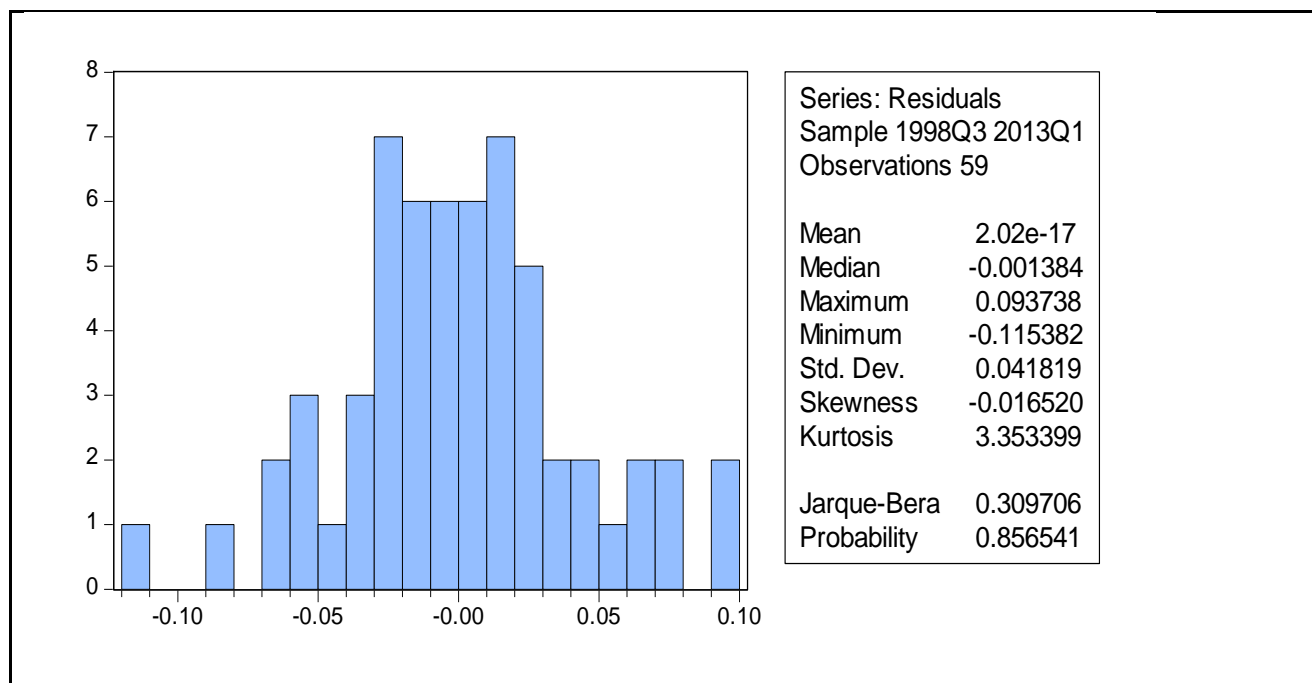

Figure 9: Normality test ARDL ECM: Model B

Table 10: Serial Correlation ARDL ECM Model A

Breusch-Godfrey serial correlation LM tests

F-Statistic	p-value
1.188921	0.3262

Table 11: Serial Correlation ARDL ECM Model B

Breusch-Godfrey serial correlation LM tests

F-Statistic	p-value
1.769527	0.1685

Figure 10: Cusum Stability test ARDL ECM Model A
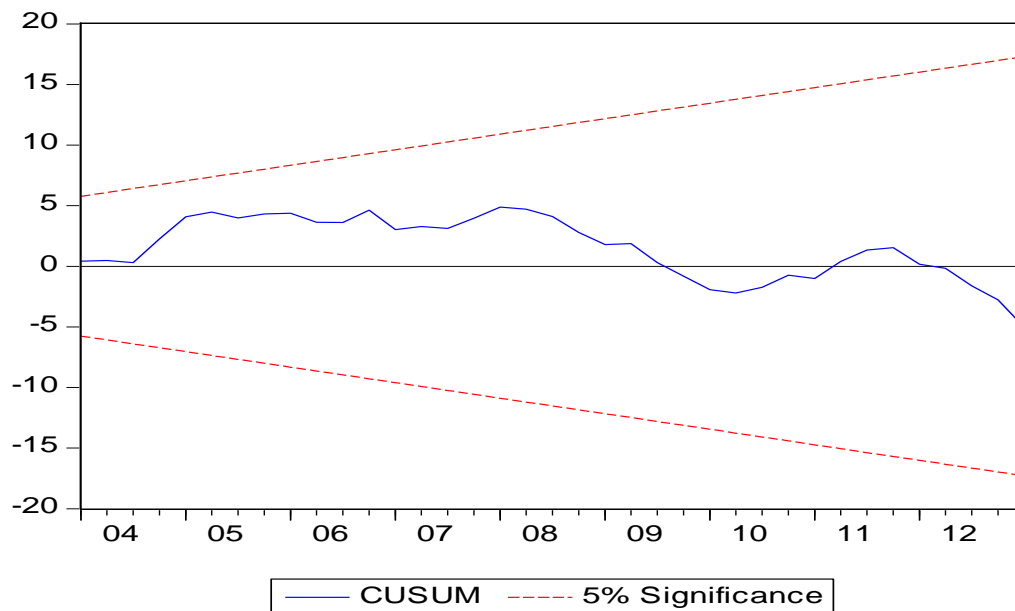
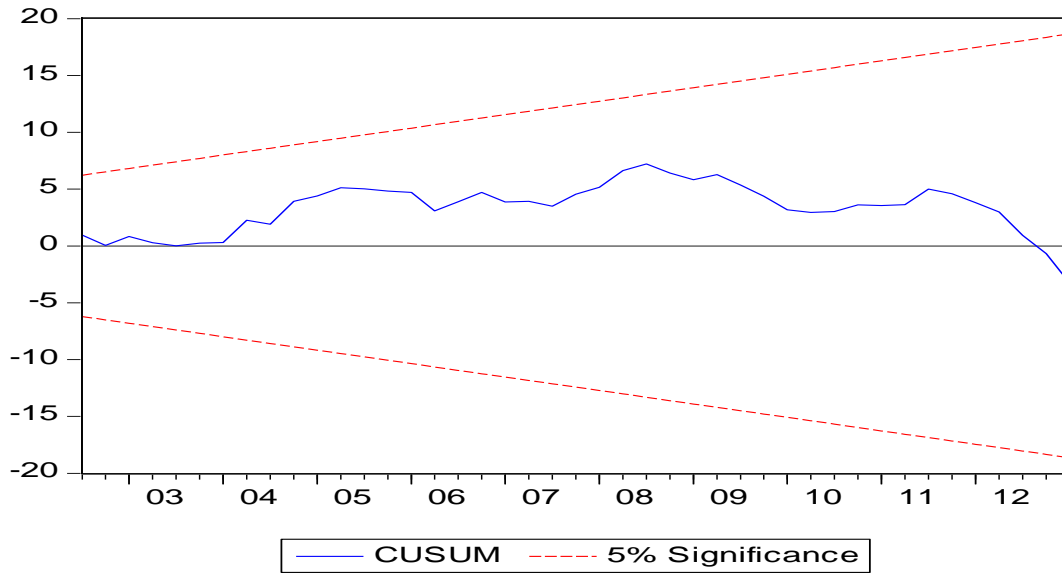**Figure 11: Cusum Stability test ARDL ECM Model B**

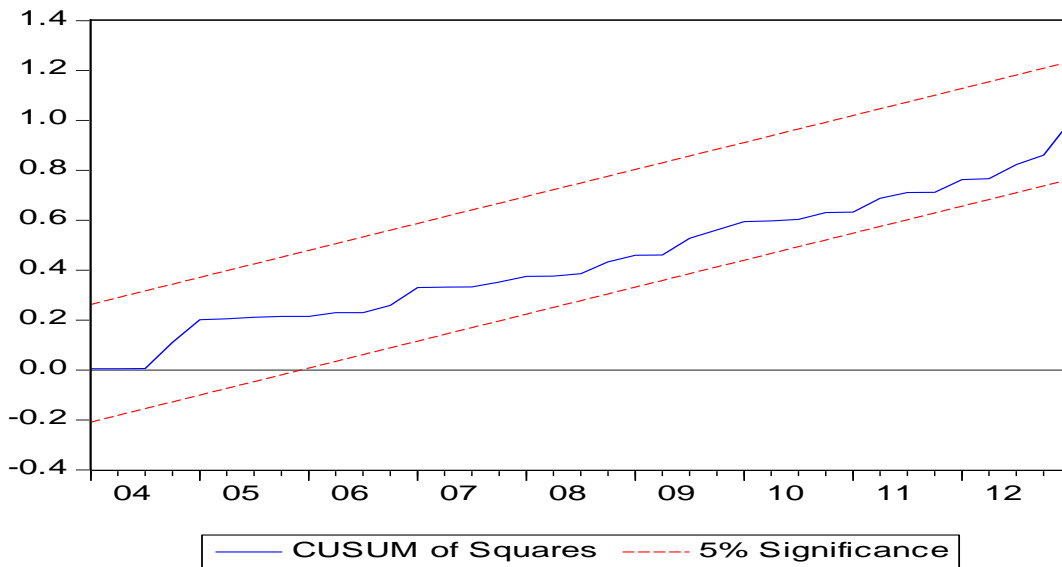**Figure 12: Cusum of Squares Stability test ARDL ECM Model A**

Figure 13: Cusum of Squares Stability test ARDL ECM Model B