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# Remittances and economic growth: Evidence from South Africa using ARDL in the presence of structural breaks

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## ABSTRACT

The aim of this study is to investigate the relationship between remittances and economic growth in South Africa, using data running from 1970 to 2019. We utilize the ARDL bounds testing approach to explore the relationship between remittances and economic growth, incorporating control variables and addressing structural breaks. Our findings suggest that the structural change in economic growth occurred in 2008 during the global financial crisis, while the break point for remittances emerged in 1997. After taking into consideration the presence of structural breaks, our study found the estimated coefficient for remittances to be statistically significant at the 1% level of significance. The coefficient is negative, indicating that remittances have a negative impact on economic growth. This result is robust to alternative estimators, including the fully modified least squares technique and the impulse response function. Despite employing different estimation methods, the consistent finding of a negative relationship between remittance inflows and economic growth underscores the reliability of our conclusion. Being a recipient of remittances, it is appropriate for a study of this nature to guide policy makers in formulating appropriate policies to benefit from the full impact of remittances, diversify the economy, and reduce reliance on remittance inflows.

**Contribution/Originality:** The study used an ARDL to test for the presence of structural breaks. This approach makes this study novel, as existing studies did not consider the presence of structural breaks. The study also looked at the impact of remittance inflow on economic growth from the perspective of South Africa.

## 1. INTRODUCTION

South Africa's Gross Domestic Product (GDP) has experienced and continues to experience turbulence since the global financial crisis of 2008. Before the global economic crisis, growth rates were unstable and fluctuated between 5% and -2% (World Bank, 2019). To help stabilize the economic situation, a number of policies were initiated to reduce the impact of the global economic crisis on South Africa's economy. The National Development Plan (NDP) in 2011 introduced the National Planning Commission, which came out with a plan to spur South Africa's economic growth until 2030, with GDP expected to grow at 5% per annum and domestic investment GDP pegged at 30% (National Planning Commission, 2012).

South Africa's economic growth for the period 1970-2017 saw an average growth rate of 2.5% per annum. The rates were 3.3% and 3.6% for the 1970s and 2000s, respectively. The late 1990s, however, recorded the worst GDP growth in the decade, with an average rate of 1.4% (World Bank, 2019). Most of the interventions put in place are aimed at attracting Foreign Direct Investment (FDI) with little or no mention of remittances inflow, even though there has been a rise in remittances inflow into South Africa in recent times.

The role of remittances in the development of economies, especially in developing countries, cannot be overlooked, as they remain one of the major external sources of finance (Ratha, 2012). Remittances from migrant workers have played critical roles in the lives of relatives left behind and the growth of economies. There has been an increase in the volume of workers' remittance inflows, which has impacted positively on the lives of dependents as it cushions them from shocks (Paranavithana, 2014).

Remittances are money that flows unidirectionally from migrants to their relatives, community, and country (Cohen, 2011; Maimbo & Ratha, 2005). It is estimated that there were 232 million international migrants as of 2013, up from the 2000 figure of about 175 million. Global finance now recognizes remittances as an important source. In 2013, remittances inflow into developing countries was approximately $404 billion, a 3.5 percent increase from the 2012 value. It is estimated that remittance flow in the coming years will experience an increase from an initial value of $436 billion in 2014 to $516 billion in 2016 (World Bank, 2014). Aside from foreign direct investment, remittances are the second-largest source of external funding for most developing countries. Remittances flow is three times the size of the development assistance developing countries source from donor partners (Stevanovic-Fenn, 2012).

Remittances discussions in South Africa have not received much attention, as most of the discussions are centered on remittances from South Africa to other developing countries. This is a result of the number of migrant workers living and working in South Africa due to the level of its development in relation to other developing countries in Africa (AfrAsia Bank, 2017). Discussions on remittance inflow into South Africa have been restricted to outflows, making it difficult to assess the impact of remittance inflow on economic development. The global financial crisis in 2008 has led to an increase in the number of South Africans seeking opportunities abroad. The deteriorating economic situation has compelled some people to seek opportunities, especially in New Zealand and Australia, among others.

Remittances inflow to South Africa has seen an increase due to an increase in the number of emigrants. Remittances into South Africa grew from US$258.6million, equivalent to 0.2% of GDP, to a peak of US$1.2 billion, equating to 3% of GDP, 2011 (World Bank, 2019). It, however, saw a decline to about US$755.4 million in 2016, before a mild recovery to US$873.2 million in 2017.

Theoretically, remittance inflows should drive economic growth. There are varied means through which remittances influence economic growth: they serve as a source of funds for investment, provide immediate cash flow for household consumption, and have a multiplier effect that is associated with remittance inflow (Catrinescu, Leon-Ledesma, Piracha, & Quillin, 2006). Remittance inflow improves aggregate demand, which leads to the creation of employment. Remittances inflow lead to an improvement in the recipient's country's capital assets through investment in key sectors such as health and education, which contribute to an improvement in the quality of human resources (Barajas, Chami, Fullenkamp, Gapen, & Montiel, 2009). South Africa was once a major recipient of migrant workers, but in recent times, it has seen a surge in the number of its people seeking opportunities outside South Africa. But studies that have looked at the impact of remittances on economic growth in South Africa have generalized remittances (thus inflow and outflow), which does not truly reflect the exact impact of remittances inflow on economic growth. As a recipient of remittances, it is appropriate for a study of this nature to guide policy makers in formulating appropriate policies to benefit from the full impact of remittances on the country's economic activities.

## 2. LITERATURE REVIEW

From a developmental perspective, remittance inflows have the potential to improve local livelihoods and development in the recipient country. Remittance inflows serve as a key source of funding for investments.

Households, through remittances, are able to smooth their consumption, which boosts the demand for goods and services (Chimhowu, Jenifer, & Caroline, 2005). There are varied findings on the impact of remittances on economic growth. The IMF (2005) study, using a time-invariant instrument and applying cross-section data for 101 countries from 1970 to 2003, concluded that there is no statistically significant effect of remittances on economic growth. However, a study by Jongwanich (2007) indicated that remittance has a positive impact on economic growth and poverty alleviation in Asia and Pacific countries. A study by Barguellil, Zaiem, and Zmami (2013), through the use of panel data, grouped remittance recipient countries into two groups: the largest remittance recipient by GDP percentage and the largest remittance recipient by amount for the period 1990-2006. The result shows that remittance has both direct and indirect effects on countries grouped under the largest remittance recipient of GDP. The effect, however, disappeared in countries with the largest remittance recipients in terms of amount.

Kyophilavong, Uddin, and Sjö (2013) concluded that the impact of remittances on financial development and economic growth in the long run is country-specific. They, however, found that remittances and financial development are key to the development of developing economies and proposed measures to reduce barriers that inhibit the flow of remittances. Bayar (2015) looked at the relationship among personal remittances, net foreign direct inflows, and real GPD per capita using a causality test for the period 1996-2013 and concluded that net foreign direct inflows and personal remittances unidirectionally cause economic growth in transition economies in Europe. Shahzad, Ali, Rehman, and Abbasi (2014) used Fully Modified OLS and Dynamic Ordinary Least Square estimation analysis to examine the effect of capital, remittances, exports, and FDI on economic growth. The findings show that capital, remittances, exports, and FDI have a positive effect on economic growth, whereas a negative impact of labor on growth is observed. The result further established a long term equilibrium relationship between remittances and economic growth. Feedback causality between remittances and capital in South Asian countries is also established.

The relationship between remittances and financial development on economic development, using a panel of 66 developing countries for the period 1991-2005, showed that an efficient financial system improves the impact of remittances on economic growth (Bettin & Zazzaro, 2009). Abida and Sghaier (2014) through Generalized Method of Moment (GMM) panel data analysis, established a positive relationship between remittances and economic growth. Ramirez and Sharma (2008) applied panel unit root and panel co-integration tests and Fully Modified OLS (FMOLS) and concluded that remittances have a positive influence on economic growth in selected upper- and lower-income Latin American and Caribbean countries. In addition, a study by Siddique and Selvanathan (2010) on the causal link between remittances and economic growth shows mixed findings. In Sri Lanka, a two-way directional causality is established, so both cause each other. In Bangladesh, the result shows that remittances influence economic growth. However, in India, there is no causal relationship between remittances and economic growth.

It is argued that remittance has elements of multiplier effects as it increases savings, which tends to propel economic growth (Stahl & Habib, 1989). In Bangladesh, the multiplier effect of remittances for the period 1976-1998 was 1.24. Mahmud (2003) and Siddique (2004) attributed Bangladesh's economic growth to remittances inflow. According to Paul and Das (2011) there is a positive relationship between remittances and GDP in the long run, but such a relationship does not exist in the short run. A study by Ali (1981) concluded that there is a positive relationship between remittance inflow and favorable balances of payment. However, Matiur, Rahman, Mustafa, Islam, and Guru-Gharana (2006) and Rahman (2009) concluded that there is no significant relationship between remittance and economic growth. In addition, a study by Ahmed (2010) found a negative relationship between remittances and economic growth in Bangladesh. See below Table 1, which presents a list of studies on remittances and economic growth.

**Table 1.** Summary of some studies on relationship between remittances and economic growth.

| Author | Region/Country of study | Methodology | Findings |
|---|---|---|---|
| Fayissa and Nsiah (2010) | 36 African countries | Panel | Positive |
| Bettin and Zazzaro (2009) | 66 developing countries | Panel | Positive |
| Ramirez and Sharma (2008) | Upper and lower income Latin American and Caribbean countries | Panel | Positive |
| Goschin (2014) | Ten countries in Central and Eastern Europe (CEE) | Panel | Positive |
| Cooray (2012) | South Asia | Time series | Positive |
| Barguellil et al. (2013) | Two groups of countries | Panel | Positive |
| Imai, Gaiha, Ali, and Kaicker (2014) | Asia and Pacific countries | Panel | Positive |
| Paranavithana (2014) | Sri Lanka | Time series | Positive |
| Nwaogu and Ryan (2015) | 53 African, 34 Latin American and Caribbean countries | Panel | Positive |
| Matuzeviciute and Butkus (2016) | 116 countries | Unbalanced panel | Positive |
| Ahlburg (1991) | Tonga and Western Samoa | Survey | Negative |
| Brown and Ahlburg (1999) | Pacific region - Tonga and Samoa | Survey | Negative |
| Chami, Fullenkamp, and Jahjah (2003) | 113 countries | Panel | Negative |
| Feeny, Iamsiraroj, and McGillivray (2014) | 136 developing countries | Panel | Neutral |
| Jouini (2015) | Tunisia | Time series | Neutral |
| Lim and Simmons (2015) | Caribbean community | Survey | Neutral |

**Source:** Nyasha and Odhiambo (2019).

Aside from the differences in study outcomes ranging from positive effects to negative effects to inconclusive findings, the approaches adopted by researchers are also varied and require further exploration to assess the impact of remittance inflow on economic development. In addition, most of the earlier studies looked at the effect of remittances on economic growth at aggregate levels, but the effect of remittances on economic growth should be looked at a country specific level since there are country-specific weaknesses and strengths that may hinder or complement the effect of remittances on economic growth. It is against this backdrop that this study seeks to examine the effect of remittances on South Africa's economic growth by using an empirical approach that has not received much attention among researchers in the study of the relationship between remittances and economic growth.

## 3. DATA AND METHODOLOGY

### *3.1. Unit Root Tests with Structural Brakes: The Zivot and Andrews Model*

Since South Africa was exposed to various global economic shocks (such as the East Asian crisis in 1997 and the global financial crisis in 2008) and went through significant political events (such as the period when it transitioned from an apartheid regime to democracy in 1994), we can't rule out the possibility of a structural break during the study period. Failure to account for structural breaks can lead to model misspecification, coefficient bias, and spurious estimates (Pesaran, Shin, & Smith, 2000). To account for this, we use Zivot and Andrew's unit root test, which has found great acceptance in the field of econometrics due to its ability to detect unit root and structure breaks in the data (Zivot & Andrews, 1992). Although we also performed the standard unit root tests such as Augmented Dickey Fuller (ADF) (Dickey & Fuller, 1979) and Phillips and Perron (PP) tests (Phillips & Perron, 1988), these tests do not allow for the possibility of a structural break. As suggested by Zevot and Andrews, there are three standard model specifications to test for a unit root within a structural break environment. The first model (see equation one) allows for the possibility of a one-time change in the level of the series. The second one allows for the possibility of a one-time change in the slope of the trend function. The last one (see Equation 3) attempts to bring together the one-time changes in the level and the slope of the trend function of the series. Consequently, we specify the following regression models:

$$\Delta y_t = \vartheta + \vartheta y_{t-1} + \beta t + \vartheta DV_t + \sum_{i=1}^{n} \vartheta_i \Delta y_{t-i} + \mu_t \quad (1)$$

$$\Delta y_t = \Omega + \Omega y_{t-1} + \beta t + \Omega DT_t + \sum_{i=1}^{n} \Omega_i \Delta y_{t-i} + \mu_t \quad (2)$$

$$\Delta y_t = \theta + \theta y_{t-1} + \beta t + \theta DV_t + \theta DT_t + \sum_{i=1}^{n} \theta_i \Delta y_{t-i} + \mu_t \quad (3)$$

Where

$DV_t$= Dummy variable capturing a shift in the intercept.

$DT_t$ = Dummy variable denoting a shift in the trend occurring at time TB (Possible break point).

TB = Possible break date.

Therefore

$DV_t$ =1 if t $\geq$ TB (i.e. break point) and zero otherwise.

$DT_t$ =t-TB if t $\geq$ TB and zero otherwise.

We opt to estimate Equation 3 for the purpose of this article, as it is the most comprehensive out of the three models, accounting for the possibility of structural breaks.

As noted earlier, our paper builds on and extends on the work of Nyasha and Odhiambo (2019) by using more recent data and a fairly lengthy time period of approximately 50 years for South Africa, running from 1970 to 2019. To empirically investigate the relationship between remittances and economic growth, we regress economic growth on remittances, including some standard covariates that are regarded as important in explaining economic growth. We draw data from two key sources: the World Development Indicators of World Bank and Penn World Tables. Following previous studies by Nyasha and Odhiambo (2019) and Das, McFarlane, and Jung (2019), we include the following variables in the models: REM = Personal remittances received (% of GDP), GDS = gross domestic savings (% of GDP), DC = Domestic credit to private sector by banks (% of GDP), TFP = total factor productivity, BM = Broad money (% of GDP), POP =population, GCF =Gross capital formation (% of GDP), and DV= dummy variable. We employ the autoregressive distributed lag (ARDL) advanced by Pesaran, Pesaran, Shin, and Smith (1999) and subsequently fine-tuned by Pesaran, Shin, and Smith (2001).

We decide on the ARDL model as a preferred model because it has been widely used in this field (see, for example, Das et al. (2019)) and has quite a few benefits compared to conventional methods that have been used in analyzing cointegration. For example, unlike Johansen's tests and Granger/Enger causality test, ARDL can be employed even if the variables are of mixed stationary— follow the I(0) and I(1) processes. In line with the previously mentioned studies, we transformed the control variables by taking natural logarithms. Given that the duration of the variables used in this study (over 48 years) is quite long, we can't rule out the possibility of structural breaks in the series. We therefore try to take this possibility into account by conducting Zivot-Andrews (ZA) unit root test. After establishing that most series underwent some structural breaks, an attempt was made to introduce a dummy variable (D08) in the model based on Zivot-Andrews (ZA) unit root test to represent a breakpoint in the series. Thus, the estimated ARDL in the presence of structural breaks is specified as follows:

$$\begin{aligned}\Delta lnGR_t = {} & \Phi_0 + \sum_{i=1}^{n} \mu_{1i} \Delta lnGR_{t-i} + \sum_{i=1}^{n} \mu_{2i} \Delta lnRem_{t-i} + \sum_{i=1}^{n} \mu_{3i} \Delta lnGDS_{t-i} \\ & + \sum_{i=1}^{n} \mu_{4i} \Delta lnDC_{t-i} + \sum_{i=1}^{n} \mu_{5i} \Delta lnTFP_{t-i} + \sum_{i=1}^{n} \mu_{6i} \Delta lnBM_{t-i} \\ & + \sum_{i=1}^{n} \mu_{7i} \Delta lnPOP_{t-i} + \sum_{i=1}^{n} \mu_{8i} \Delta lnGCF_{t-i} + \sum_{i=1}^{n} \mu_{9i} \Delta DV_{t-i} \\ & + \vartheta_{1i} GR_{t-1} + \vartheta_2 REM_{t-1} + \vartheta_3 GDS_{t-1} + \vartheta_4 DC_{t-1} \\ & + \vartheta_5 TFP_{t-1} + \vartheta_6 lnBM_{t-1} + \vartheta_7 POP_{t-1} + \vartheta \mu_8 GCF_{t-1} + \vartheta_9 DV_{t-1} + \pi_t \end{aligned} \quad (4)$$

Where:

$\Phi$ = constant, $\pi_t$ = an error term. $\mu$ = short term dynamics of the model. $\vartheta$ denotes The long run coefficients, while $\Delta$ indicates that the variables are in first difference form. Given the fact that our dependent variable experienced a structural break in 2008, we introduce a dummy variable DV in Equation 1 to specifically account for the structural break. The dummy variable takes the value of 0 from 1970 to 2008 and 1 from then on. Derived from the ARDL model indicated in (1), the following error correction model can be specified as follows:

$$\Delta lnGR_t = \psi_0 + \sum_{i=1}^{n} \mu_{1i} \Delta lnGR_{t-i} + \sum_{i=1}^{n} \mu_{2i} \Delta lnREM_{t-i} + \sum_{i=1}^{n} \mu_{3i} \Delta lnGDS_{t-i}$$

$$+\sum_{i=1}^{n}\mu_{4i}\,\Delta lnDC_{t-i}+\sum_{i=1}^{n}\mu_{5i}\Delta lnTFP_{t-i}+\sum_{i=1}^{n}\mu_{6i}\Delta lnBM_{t-i}$$
$$+\sum_{i=1}^{n}\mu_{7i}\Delta lnPOP_{t-i}+\sum_{i=1}^{n}\mu_{8i}\Delta lnGCF_{t-i}+\sum_{i=1}^{n}\mu_{9i}\Delta DV_{t-i}$$
$$+\Omega ECM_{t-1}+\pi_t \qquad (5)$$

Where $ECM_{t-1}$= Error-correction term lagged once and $\Omega$ = The coefficient of the $ECM_{t-1}$. The rest of the other variables are as defined above.

## 4. RESULTS

### *4.1. Stationarity Results*

The ARDL model is used to estimate the relationship between economic growth and remittances; however, before estimating this model, we conduct some preliminary tests, including stationarity. The unit root test developed by Phillips and Perron (1988), known as the Philips and Perron unit root test, is used to test for stationarity. This technique is chosen on the basis of being comprehensive compared to the widely used Augumented Dickey Fuller (ADF) developed by Dickey and Fuller (1981). Whereas the ADF test uses a parametric model to estimate the Autoregrressive Moving Average (ARMA) structure, the PP test is more robust to general forms of heteroskedasticity. The results presented in Table 2 show that economic growth and population are stationary at level 1, while the rest of the variables are stationary after being differentiated once, indicating that these variables are integrated by 1.

**Table 2.** Phillips-Perron (PP) unit root tests.

| | At level | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **GR** | **REM** | **GDS** | **DC** | **TFP** | **BM** | **POP** | **DV** | **GCF** |
| With constant | t-statistic | -4.635 | -1.208 | -1.147 | -0.567 | 0.566 | -0.652 | -8.695 | -0.534 | -1.468 |
| | Prob. | 0.0004 | 0.663 | 0.689 | 0.868 | 0.987 | 0.849 | 0.0000 | 0.875 | 0.541 |
| | | *** | ---- | ---- | ---- | ---- | ---- | *** | ---- | ---- |
| | At first difference | | | | | | | | | |
| With constant | t-statistic | -23.277 | -5.006 | -6.138 | -6.627 | -3.645 | -5.218 | -0.942 | -6.928 | -7.334 |
| | Prob. | 0.0001 | 0.0001 | 0.0000 | 0.0000 | 0.0084 | 0.0001 | 0.7657 | 0.0000 | 0.0000 |
| | | *** | *** | *** | *** | *** | *** | ---- | *** | *** |

**Note:** (***) significant at the 1% and (No) not significant.
Probability based on MacKinnon (1996) one-sided p-values.
GR=Economic growth, REM = Personal remittances, DS = Gross domestic savings, DC = Domestic credit, TFP = Total factor productivity, BM = Broad money, POP =Population, GCF =Gross capital formation and DV= Dummy variable.

Researchers have developed several tests that simultaneously test for unit roots and structural breaks. In this study, we employ the Zivot-Andrews test, which tests for a unit root with a break in the trend, and its alternative hypothesis, which states that the process is stationary. For economic growth, the results are presented in Table 3, and the findings show that the null hypothesis of a unit root with a structural break cannot be rejected. The break point for economic growth[1] in South Africa is shown to be around the 2008 global financial crisis. Figure 1 which is extracted from the Zivot-Andrews test, highlights the exact point of the structural break in economic growth.

**Table 3.** Zivot – Andrews unit root tests (Economic growth).

| | **t-statistic** | **Prob. *** |
|---|---|---|
| Zivot-Andrews test statistic | -4.953 | 0.141 |
| 1% critical value | -4.80 | |
| 5% critical value | -4.42 | |
| 10% critical value | -4.11 | |

**Note:** * Probability values are calculated from a standard t-distribution and do not take into account the breakpoint selection process.

[1] The results for the rest of the variables are presented in the Appendix 1.

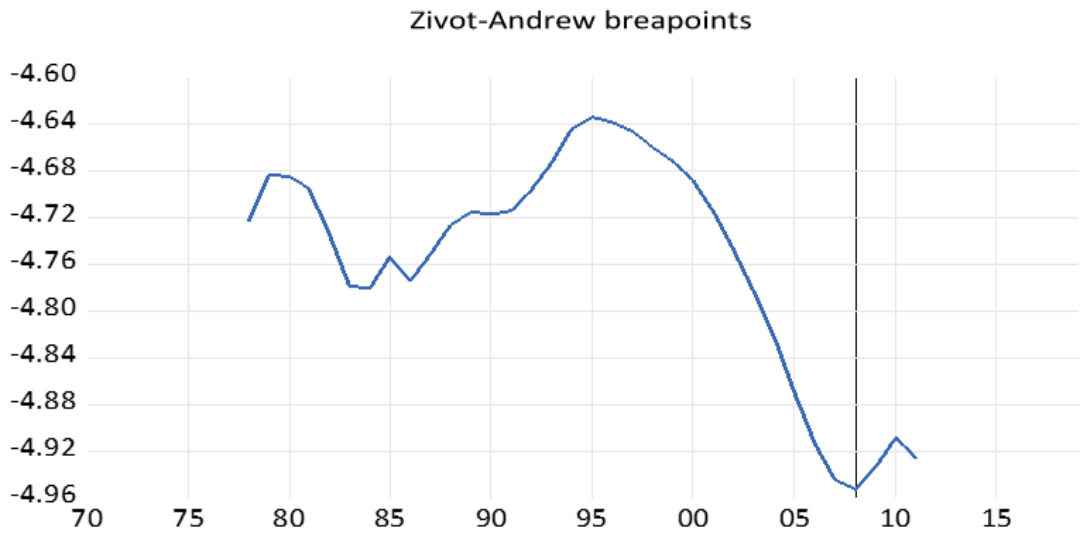


**Figure 1.** Graphical representation for economic growth rate breakpoint.

### *4.2. ARDL Bounds Test*

To empirically analyze the long-run relationship between economic growth and remittances to South Africa, we begin by employing the ARDL bounds test. While other co-integration tests require variables to be integrated in the same order, the ARDL bounds test does not. Moreover, the ARDL bounds test is relatively efficient, even with small sample sizes. The evidence presented in Table 4 shows that the null hypothesis of no co-integration should be rejected since the critical value is larger than both critical bounds.

**Table 4.** F-bounds test (Break point: 2008), lag (3, 2, 3, 2, 3, 1, 3, 3, 3).

| Test statistic | Value | Signif. | Critical bounds | | Decision |
|---|---|---|---|---|---|
| | | | I(0) | I(1) | |
| F-statistic | 5.965 | 10% | 1.95 | 3.06 | Co-integration |
| | | 5% | 2.22 | 3.39 | |
| | | 2.5% | 2.48 | 3.7 | |
| | | 1% | 2.79 | 4.1 | |

### *4.3. Long Run Estimates*

Before estimating our model, the optimal lag order has to be determined, and in this instance, we use the Akaike Information Criterion (AIC). According to the AIC values, the appropriate lag for the model is as follows: ARDL (3,3,3,2,3,13,3,3). Having determined the optimal lag order, the model is estimated, and the results are presented in Table 4.

**Table 5.** Long run estimates.

| Case 3: Unrestricted constant and no trend | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. error** | **t-statistic** | **Prob.** |
| PR | -3.523 | 0.723 | -4.876 | 0.001 |
| GDS | -7.600 | 3.861 | -1.969 | 0.077 |
| DC | 2.805 | 1.582 | 1.773 | 0.107 |
| TFP | -6.730 | 3.035 | -2.218 | 0.051 |
| BM | -0.082 | 0.037 | -2.199 | 0.053 |
| POP | -12.832 | 2.386 | -5.378 | 0.000 |
| DV | -2.542 | 0.826 | -3.076 | 0.012 |
| GCF | 14.670 | 2.578 | 5.691 | 0.000 |

**Note:** PR = Personal remittances, DS = Gross domestic savings, DC = Domestic credit, TFP = Total factor productivity, BM = Broad money, POP =Population, GCF =Gross capital formation and DV= Dummy variable.

Table 5 presents long-run estimates of the model.

We find the estimated coefficient for remittances to be statistically significant at the 1% level of significance. The coefficient is negative, indicating that remittances have a negative impact on economic growth. More specifically, a 1 percent increase in remittances leads to a 3.5 percent decrease in economic growth in the long run. These results are similar to those of Nyasha and Odhiambo (2019), who found that for South Africa, contrary to their expectations, remittances are detrimental to economic growth. The effect of remittances depends on the level of financial development of countries, with remittances having a positive impact on economic growth in countries that have less advanced financial sectors and a negative impact in those countries with a high level of development (Sobiech, 2015). Hence, the negative impact of remittances on economic growth in South Africa can be attributed to South Africa's well-advanced financial system. Moreover, the use of remittances for household consumption instead of productive purposes is another plausible explanation for the negative impact of remittances on economic growth.

Similar to remittances, the coefficients for domestic savings and broad money supply are found to be statistically significant, with negative effects on economic growth. The effect of domestic savings is in contrast to that of Amusa (2014), whose empirical analysis shows that corporate savings have a positive impact while household and government savings have a statistically insignificant effect on economic growth. Considering the effect of domestic credit on the private sector, we find that it is statistically insignificant, indicating that it does not influence economic growth in the long run. This is in contrast to Olowofeso, Adeleke, and Udoji (2015) findings. The dummy variable for the 2008 crisis is also found to be statistically significant, and as expected, its presence causes economic growth to decline in the long run. The rest of the variables are found to be statistically significant with negative coefficients except for capital formation, whose impact on economic growth is positive. These findings are supported by Ncanywa and Makhenyane (2016), whose study shows that gross capital formation has a positive impact on economic growth in both the short run and long run.

In order to analyze the short-term dynamics between economic growth and the independent variables, albeit with more emphasis on the effect of remittances, we follow Chandio, Jiang, and Rehman (2019) by estimating an error correction model based ARDL. The results presented in Table 6 most importantly show that the error correction parameter is statistically significant with a negative coefficient. This implies that there is a stable, long-term relationship between economic growth and the chosen independent variables. Interestingly, we notice a change in the sign for the remittances coefficient when the variable is lagged once. While a 1 percent increase in current period remittances will induce a 6 percent decrease in economic growth, a 1 percent increase in previous period remittances will induce a rise in economic growth worth around 5 percent. The dummy variable for the global financial crisis is found to be statistically significant with a negative effect on economic growth. However, when the first lag of the dummy variable is taken into consideration, it becomes statistically insignificant. This is in line with our prior expectations, as moving one period back for the dummy variable takes us to a period when there was no financial crisis.

**Table 6.** ARDL error correction regression.

| Variable | Coefficient | Std. error | t-statistic | Prob. |
|---|---|---|---|---|
| C | 143.794 | 14.648 | 9.817 | 0.000 |
| D(GR(-1)) | 1.922 | 0.270 | 7.108 | 0.000 |
| D(GR(-2)) | 0.450 | 0.097 | 4.619 | 0.001 |
| D(REM) | -6.810 | 0.839 | -8.118 | 0.000 |
| D(PR(-1)) | 5.021 | 0.857 | 5.858 | 0.000 |
| D(GDS) | 3.183 | 2.684 | 1.186 | 0.263 |
| D(GDS(-1)) | 18.988 | 3.072 | 6.180 | 0.000 |
| D(GDS(-2)) | 19.724 | 3.209 | 6.146 | 0.000 |
| D(DC) | 10.938 | 2.755 | 3.970 | 0.003 |
| D(DC(-1)) | -8.176 | 2.483 | -3.293 | 0.008 |
| D(TFP) | -2.505 | 6.095 | -0.411 | 0.690 |

| Variable | Coefficient | Std. error | t-statistic | Prob. |
|---|---|---|---|---|
| D(TFP(-1)) | 74.454 | 10.845 | 6.865 | 0.000 |
| D(TFP(-2)) | 64.788 | 10.414 | 6.221 | 0.000 |
| D(BM) | -0.502 | 0.081 | -6.212 | 0.000 |
| D(POP) | -6185.783 | 783.870 | -7.891 | 0.000 |
| D(POP(-1)) | 12519.000 | 1624.970 | 7.704 | 0.000 |
| D(POP(-2)) | -10888.690 | 1289.218 | -8.446 | 0.000 |
| D(DV) | -5.197 | 0.937 | -5.546 | 0.000 |
| D(DV(-1)) | -1.302 | 0.865 | -1.506 | 0.163 |
| D(DV(-2)) | -1.512 | 0.883 | -1.712 | 0.118 |
| D(GCF) | 17.349 | 1.733 | 10.013 | 0.000 |
| D(GCF(-1)) | -22.278 | 3.427 | -6.501 | 0.000 |
| D(GCF(-2)) | -5.652 | 1.313 | -4.305 | 0.002 |
| ECM(-1) | -4.459 | 0.454 | -9.829 | 0.000 |
| R-squared | 0.977 | Mean dependent var | | -0.043 |
| Adjusted R-squared | 0.948 | S.D. dependent var | | 2.606 |
| S.E. of regression | 0.596 | Akaike info criterion | | 2.099 |
| Sum squared resid | 6.400 | Schwarz criterion | | 3.092 |
| Log likelihood | -20.087 | Hannan-Quinn criter | | 2.463 |
| F-statistic | 33.260 | Durbin-Watson stat | | 2.219 |
| Prob(F-statistic) | 0.000 | | | |

**Note:** REM = Personal remittances, DS = Gross domestic savings, DC = Domestic credit, TFP = Total factor productivity, BM = Broad money, POP =Population, GCF =Gross capital formation and DV= Dummy variable. .

While the preliminary tests indicated that the employed model is fit for the current analysis, we also conducted two stability tests in the form of the Cusum and Cusum of squares tests to check the reliability of our chosen model. Figure 2 presents the results from the two tests, and it is clear that the plots of stability both lie within the critical bounds at the 5 percent level of significance, hence confirming that the model parameters are efficient.

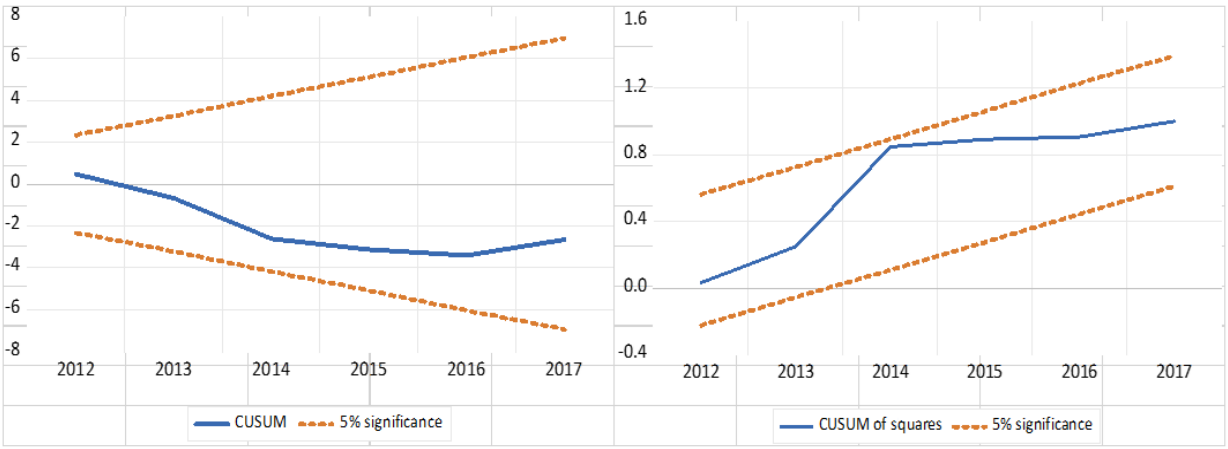


**Figure 2.** CUSUM stability test.

### *4.4. Robustness Check*

To enable satisfaction with the baseline results, which suggested that an increase in remittances will lead to a decline in economic growth, we estimate the same model but use the fully modified least squares technique to assess the consistency of the results. We select the fully modified least squares because it accommodates serial correlation and endogeneity in the presence of co-integration. Table 7 presents the findings from estimating the fully modified least squares, and the results are similar to those obtained by using the ARDL. Remittances are found to be statistically significant with a negative effect on economic growth, albeit with a larger coefficient. All the other factors used as drivers of economic growth that were found to be statistically significant maintain their significance and original signs, including the dummy variable. The only difference is in relation to domestic credit, which was

statistically insignificant when we estimated the ARDL model but is found to be statistically significant when we use the fully modified least squares technique.

**Table 7.** Results obtained from fully modified least squares.

| Variable | Coefficient | Std. error | t-statistic | Prob. |
|---|---|---|---|---|
| REM | -8.446 | 0.042 | -200.431 | 0.000 |
| GDS | -15.179 | 0.217 | -70.024 | 0.000 |
| DC | -11.120 | 0.156 | -71.082 | 0.000 |
| TFP | 46.373 | 0.333 | 139.377 | 0.000 |
| BM | 0.116 | 0.004 | 26.801 | 0.000 |
| POP | -224.182 | 0.936 | -239.494 | 0.000 |
| DV | -19.099 | 0.087 | -220.699 | 0.000 |
| GCF | -6.097 | 0.150 | -40.631 | 0.000 |
| C | 807.549 | 3.800 | 212.489 | 0.000 |
| @TREND | 5.309 | 0.021 | 258.407 | 0.000 |
| R-squared | -3.347 | Mean dependent var | | 2.634 |
| Adjusted R-squared | -4.465 | S.D. dependent var | | 2.075 |
| S.E. of regression | 4.850 | Sum squared resid | | 823.199 |
| Long-run variance | 0.006 | | | |

**Note:** REM = Personal remittances, DS = Gross domestic savings, DC = Domestic credit, TFP = Total factor productivity, BM = Broad money, POP =Population, GCF =Gross capital formation and DV= Dummy variable.

Moreover, we take a look at the impulse response function to analyze how economic growth reacts to shocks in the dependent variables. Figure 2 depicts the results of the impulse response functions.

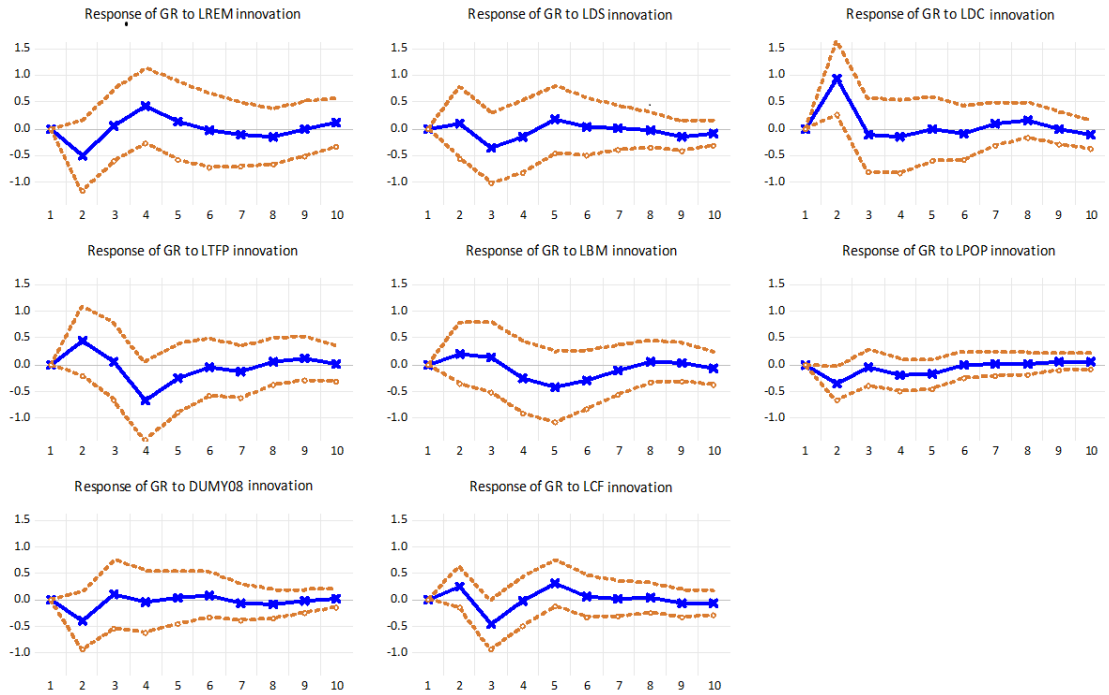


**Figure 3.** Impulse response functions.

Figure 3 shows that a one-standard deviation shock to remittances initially has a negative effect, changing to be positive around the second period and dying out around the fifth period. This finding is in line with the base-line results, which highlight a change in sign for remittances when lags are included. Interestingly, the effect of shock in the dummy variable dies out between the second and third periods, which is much quicker than most of the other dependent variables. This could also be compared to the main results, which show that the effect of the dummy variable becomes insignificant when moment lags are included.

## 5. CONCLUSION

The study examined the effect of remittance inflow on South Africa's economy from 1970 to 2019. The study used the ARDL approach to examine the short-run and long-run effects of remittance inflows on economic growth. The study established a negative relationship between remittance inflow and economic growth in South Africa. In the same vein, the study further established a negative relationship between the broad money supply, domestic savings, and economic growth. The result showed an error correction of about -4.459035 to bring the relationship between remittance inflows and economic growth into equilibrium. The study brings to light the need for South Africa to put measures in place in the area, such as improving its financial systems and removing barriers that inhibit the realization of the positive impact of remittances inflow on its economy.

Future studies should approach the topic from the perspective of net remittance inflows to better explore the relationship between remittance inflows and economic growth.

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**Competing Interests:** The authors declare that they have no competing interests.
**Authors' Contributions:** Conceptualize the study, helped in data gathering and literature review, M.B.; literature review and data analysis, T.U.; methodology, introduction and helped in the discussion, M.M. All authors have read and agreed to the published version of the manuscript.

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## APPENDIX 1.

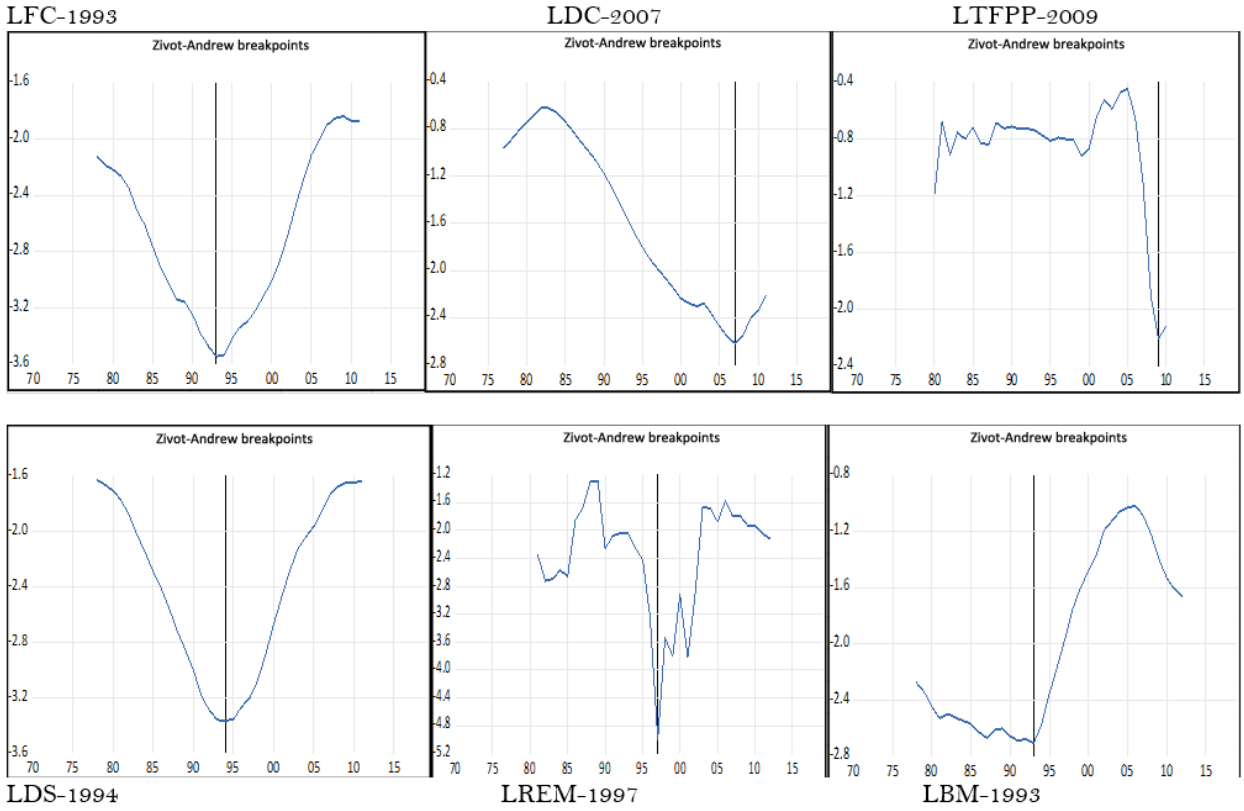


**Figure A1.** Graphical representation of Zivot-Andrews breakpoints in variable.

**Table A1.** Summary stats.

| | GR | REM | CF | POP | DS | DC | BM | TFP |
|---|---|---|---|---|---|---|---|---|
| Mean | 2.431 | 0.154 | 21.988 | 40.090 | 23.183 | 102.147 | 60.242 | 0.752 |
| Standard deviation | 2.212 | 0.088 | 5.066 | 10.292 | 5.401 | 34.302 | 9.796 | 0.095 |
| Kurtosis | -0.676 | -1.767 | -0.530 | -1.280 | -0.546 | -1.655 | -0.941 | 0.005 |
| Skewness | -0.228 | 0.273 | 0.811 | -0.092 | 0.879 | -0.029 | 0.627 | -0.721 |
| Minimum | -2.137 | 0.051 | 15.162 | 22.839 | 17.380 | 53.967 | 45.500 | 0.533 |
| Maximum | 6.621 | 0.291 | 34.115 | 56.717 | 36.190 | 160.125 | 80.800 | 0.900 |

**Notes:** REM = Personal remittances, DS = Gross domestic savings, DC = Domestic credit, TFP = Total factor productivity, BM = Broad money, POP =Population, GCF =Gross capital formation and DV= Dummy variable.