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THE DYNAMIC CAUSAL RELATIONSHIP BETWEEN REMITTANCES, FERTILITY AND UNEMPLOYMENT IN SOUTH AFRICA

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DO REMITTANCES INFLUENCE FERTILITY AND UNEMPLOYMENT IN SOUTH AFRICA?

Mercy T. Musakwa ¹

Abstract

In this study, the causal relationship between remittances, fertility and unemployment in South Africa is re-examined using annual data from 1990 to 2020. The study was motivated by the need to reconsider the nature of this relationship after a sharp increase in remittance inflows into the country. The findings from this study would inform fertility policies in South Africa. The question that this study seeks to answer is: Can remittances play a role in the lowering of fertility and unemployment levels in South Africa? The study used total fertility as a measure of fertility; remittances as a percentage of gross domestic product (GDP); and the strict definition of unemployment to examine the nature of the relationship between the three variables. Employing an autoregressive distributed lag (ARDL) approach to cointegration and the error correction model (ECM)-based causality model, the study found that there is a unidirectional causal flow from unemployment to fertility in the short run, and bidirectional causality between remittances and unemployment in both the short run and the long run. Bidirectional causality between fertility and remittances in the short run, and a unidirectional causal flow from fertility to remittances in the long run were also confirmed by the study. It can be concluded that South Africa may continue to formulate and implement policies that support remittance inflows in the battle against unemployment and high fertility rates. Policy implications are also discussed.

Key Words: South Africa, fertility, unemployment, autoregressive distributed lag, remittances

JEL Classification: I1, O15, O5

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1. Introduction

A sharp rise in remittances has sparked researchers' interest in this resource and how it could be promoted and harnessed, at national level, to support the economic development agenda. The United Nations supports remittances as a source of external development finance, this is also captured by Sustainable Development Goal (SDGs) 11 (IOM Global Migration Data Analysis Centre, 2022a). The importance of migration in the development agenda, as well as the safety of and fair conditions for migrants, has given rise to the Global Compact for Migration, an inter-governmental agreement on common goals for the management of international migration. It contains 23 objectives and was concluded under the leadership of the United Nations (IOM Global Migration Data Analysis Centre, 2022a). The objectives include minimising adverse drivers, information provision, skills development and recognition, migrant and diaspora contribution, remittances, consular protection, and legal identification and documentation. The objective relating to remittances covers safer, cheaper and faster remittances through policy interventions and better regulatory frameworks (IOM Global Migration Data Analysis Centre, 2022a). In addition to the Global Compact for Migration, which is an international agreement, African countries have also entered into agreements under the African Charter on Human and People's Rights, which was adopted in 1986; and the African Common Position on Migration and Development (ACPM) and Migration Policy Framework for Africa (MPFA), which were adopted in 2006 (IOM Global Migration Data Analysis Centre, 2022b). The trends in remittance inflows, which are supported by policy, have not disappointed. Since 2016, remittances have been a large source of finance in low- and middle-income countries.

Remittance inflows to low- and middle-income countries are expected to increase by 4,9% to \$626 billion in 2022. The expected increase is premised on the opening of economies and

expanded income opportunities for migrants. According to the Migration and Development Brief 37, the average cost of sending money to low- and middle-income countries in 2022 was at 6%, twice the target rate of 3% in the SDGs (World Bank and KNOMAD, 2022). South Africa is no exception when it comes to high remitting costs, although groundwork is being done to ensure that migrants have numerous formal remittance channels at their disposal. The main objective of this study is to investigate the causal relationship between remittances, fertility and unemployment, with the view of establishing which factor influence the other. This is important in informing policy related to fertility, remittances and unemployment that remain high. Can remittances inflows be a panacea to high unemployment levels and lowering fertility rate in South Africa?

Numerous researchers have investigated the impact of remittances on fertility, yet little attention has been paid to the causal flow between remittances and fertility on the one hand, and remittances and unemployment on the other. The COVID-19 pandemic resulted in a surge in unemployment in South Africa as many companies closed, retrenched employees or could only pay their employees reduced salaries. As a result, there has been an increase in unemployment in South Africa by all unemployment measures. Unemployment in South Africa is currently hovering around 40%, while the youth unemployment rate is more than 60% (World Bank, 2022). According to Palamuleni, Kalule-Sabiti and Makiwane (2007), unemployment among women has a negative effect on fertility rates (i.e., they cause fertility rates to increase). The closure of firms and lay-offs had a negative impact on employment, and hence also on fertility levels. Despite the negative effects of COVID-19 on the livelihoods of most South Africans, remittances remained robust during and after the pandemic. There is a close connection between fertility, unemployment and remittances, and this study seeks to establish the causal relationships between these three variables. Knowledge of the relationship

would indicate to policymakers which of these variables should be supported first to get the desired results.

The study used total fertility; remittances as a percentage of GDP; and unemployment measured according to the strict definition of the term. An autoregressive distributed lag (ARDL) bounds approach to cointegration, and error correction model (ECM)-based causality were used to examine the causality between the variables. The ARDL approach was selected because of its numerous advantages, such as its robustness in small samples. Another advantage is that the results of the study would be applicable to both the short-term and the long-term timeframes, and therefore can give the precise insights that policymakers required when time is of essence. The results from this study provides more light on the influence of remittance on fertility and unemployment in the short and long run time frames.

Although South Africa has recorded a decline in the fertility rate over the decades, variations are still reported across population groups and age groups. Palamuleni *et al.* (2007) studied the determinants of fertility, including both its direct and indirect determinants for South Africa. However, their analysis failed to consider factors other than internal reproductive health programmes that might have a direct influence on fertility, for example migration and remittances. South Africa still faces challenges when it comes to unemployment and lowering the fertility rate, especially among teenagers. The gradual rise in the number of emigrants could influence the current fertility rate to even lower levels, while at the same time it might reduce unemployment. Thus, apart from providing development finance, remittances can also speed up the decline in fertility rate in South Africa. To the best knowledge of the researcher, several studies have been done on the impact of remittances on fertility (Atta, Kasmaoui, and Mughal, 2021; Anwar and Mughal, 2014; Davis and Lopez-Carr, 2010), but no study has explored the

causal relationship between remittances and fertility. The same can be said of studies examining the relationship between remittances and unemployment (Asad, Hashmi and Yousaf, 2016). Given the increase in remittance inflows into low- and middle-income countries, including African countries, the question is: Can remittances lead to decreases in current fertility and high unemployment rates? South Africa is an interesting case study given its policies and programmes on family planning and the recent increase in unemployment, on the one hand, and the increase in remittance inflows into the country, on the other hand.

The rest of the study is structured as follows: Section 2 contains a literature review; Section 3 sets out the estimation techniques used; and Section 4 presents and discusses empirical results. Section 5 concludes the study.

2. Literature Review

2.1 The Dynamics of Remittances, Fertility and Unemployment in South Africa

Remittances

South Africa is one of the signatories to the UN's sustainable development goals (SDGs), which identify remittances as a source of external finance. The advantages of remittances over other sources of finance are that they do not come with conditions and are interest-free. South Africa is generally regarded a destination for African migrants, yet in the recent past the number of South Africans leaving the country in search of greener pastures has increased (Moyo, 2021). The importance of migration, and consequently of remittances inflows, is also encapsulated in the Global Compact for Safe, Orderly and Regular Migration (GCM), which has come into effect in 2018. The participation of South Africa in this agreement, which was spearheaded by the United Nations to address migration, shows that South Africa is prepared to play a leading role in the migration agenda. South Africa is a middle-income country with a

comparatively industrialised economy that tends to attract more immigrants than it loses emigrants.

Major migrant destinations for South Africans are Britain, Australia, the United States of America, New Zealand, Canada and Germany. Among African countries, Mozambique, Zimbabwe and Eswatini are some of the countries that South Africans migrate to (Statista, 2022). According to Statista (2022), 915 000 South Africans emigrated in 2020, a negligible figure when compared to the number of immigrants in the country, which is estimated at 2.9 million or close to 5% of the country's total population (Moyo, 2021). Although the number of emigrants from South Africa is relatively small, there has been a gradual increase in South African emigrants in recent times. Despite this, remittance flows to South Africa remained depressed over the study period in comparison to other African countries. This could be attributed to migration due to non-economic reasons, such as joining family. From 1991 to 2000, remittances averaged 0.1% of GDP and this average changed slightly to 0.2% between 2001 and 2020 (World Bank, 2022). Remittance inflows of above 0.2% of GDP were recorded from 2005; this percentage stayed the same until 2020 (World Bank, 2022).

Fertility

Prior to 1994, government policies had already aimed at reducing fertility rates in all population groups (Chimere-Dan, 1993). State-sponsored family planning programmes were officially rolled out in 1974, and all South African women had access to these programmes (Kaufman, 1997). The end of apartheid saw the government emphasising that sex education and family planning should be included in a newly formulated national health programme. South Africa drafted the White Paper on Population Policy from 1994 to 1996. This White Paper provided a comprehensive framework for addressing population issues related to sustainable socio-

economic development (Ministry for Welfare and Population Development, 1998). Twenty-four strategies focusing on ten broad areas consistent with integrating population and development were formulated. One of the focus areas was health, mortality and fertility (Ministry for Welfare and Population Development, 1998). Although it is undeniable that South Africa has made huge strides in reducing total fertility at a national level, variations in total fertility rates are still recorded across provinces and population groups (Palamuleni, *et al.*, 2007; StatsSA, 2011). This implies that more effort is still required to reduce fertility in the country.

Total fertility between 1962 and 1979, which was well before the end of apartheid, was 5.6 children per woman. A decline to 4.3 children per woman was registered between 1980 and 1984 (Chimere-Dan, 1993). Government programmes to reduce fertility yielded positive results, as evidenced by the trend in the total fertility rate, even during the study period. In 1990, the fertility rate was 4 children per woman, but thereafter a steady decline was recorded year after year. By 2010, the fertility rate was 2.5 children per woman (World Bank, 2022). This decline continued throughout the study period and by 2020, the rate was 2.3 children per woman (World Bank, 2022). At an aggregate level, the reductions in the fertility rate were impressive based on the standard for an emerging country. However, more still needs to be done across population groups - not reflected in total fertility figures at an aggregate level. According to StatsSA (2011), fertility among black and coloured women remains high compared to other population groups. The same variation was recorded across provinces, with Limpopo and Mpumalanga high fertility rates, while the Western Cape and Gauteng were among the provinces with low fertility rates. Whether remittances would be a panacea in reducing fertility rates across all population groups is a critical question.

Unemployment

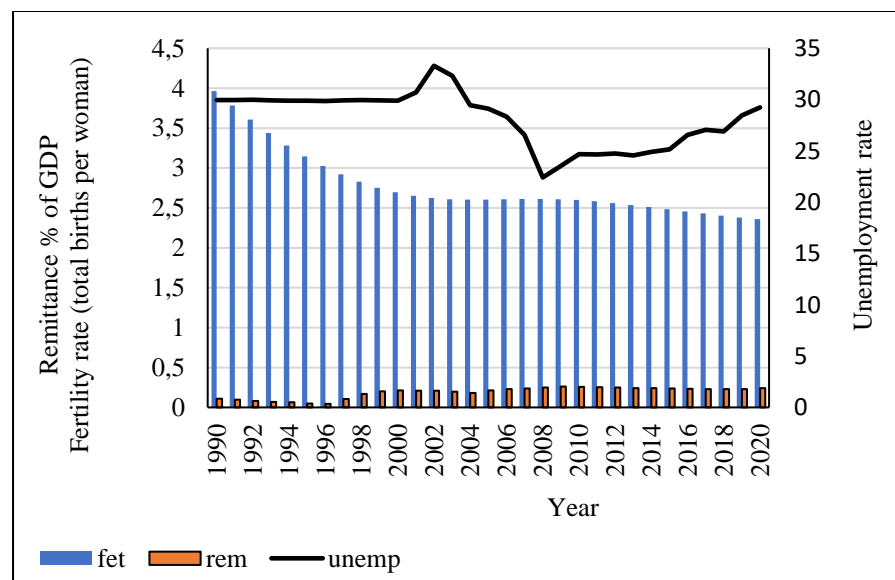
The Constitution of South Africa includes a Bill of Rights that spells out, among other things, the labour rights afforded to citizens. The Bill of Rights stipulates that everyone has the right to fair labour practices; the right to form and join a trade union; and the right to participate in the trade union activities. It also states that every trade union or employers' union has the right to engage in collective bargaining. In addition to the rights entrenched in the Constitution, the South African government has also rolled out policies to advance previously disadvantaged groups. South Africa's labour market exhibits low labour force participation. It is also characterised by affirmative action, the payment of minimum wage in certain sectors, employment equity goals and youth employment incentive². The minimum wage is governed by the National Minimum Wage Act, which determines the minimum wage per hour and sub-minimum wages for agricultural and domestic workers. The purpose of employment equity is to promote equal opportunity, eliminate discrimination and implement affirmative action to redress the disadvantages that designated groups suffered in the past³. In addition to policies that affect the employment of older persons, youth employment programmes have also been rolled out. South Africa struggles with high youth unemployment – very recently the youth unemployment rate was 46.5% (StatsSA, 2022). Support programmes that have been implemented to change this include the Youth Empowerment Outreach and Global Business Services (GBS) (DTIC, 2022a; DTIC, 2022b). Despite concerted efforts to increase the employment rate in South Africa, it has only gradually increased over the years. COVID-19 restrictions and a slowdown in economic growth worsened the unemployment rate as measured

²Employment Equity Act 55 of 1998. Available from <https://www.labour.gov.za/DocumentCenter/Acts/Employment%20Equity/Act%20-%20Employment%20Equity%201998.pdf>. [Accessed 7 December 2022].

³ Employment Equity Act 55 of 1998.

according to the strict definition of the term and other metrics, like labour force participation ratio (World Bank, 2022). The unemployment rate remained at an average of 30% during the period from 1990 to 2006 (World Bank, 2022). A decline of 4% was registered between 2006 and 2007 (World Bank, 2022). This was a feat that South Africa has not yet managed to repeat (World Bank, 2022). From 2007 onwards, the country enjoyed lower unemployment levels, with an average of 25% (World Bank, 2022). However, in 2020, the unemployment rate took an upward trajectory, returning to the 1990 unemployment figures of 29% (World Bank, 2022). According to the Quarterly Labour Force Survey for the second quarter of 2022, unemployment decreased from 34.5% in the first quarter of 2022 to 33.9% in the second quarter of 2022 (StatsSA, 2022). The trends in fertility, unemployment and remittance inflows are reported in Figure 1.

Figure 1 - Trends in Fertility, remittances and Unemployment 1990-2020



Source: World Bank (2022)

Figure 1 reports the trends in fertility, remittances, and unemployment during the study period. Remittances and fertility rate have a negative relationship, according to the data presented in the figure. Thus, as remittances increase from the 90s, fertility rate also took a downward trend,

suggesting remittance lead to a decrease in fertility rate. However, the same can not be said about unemployment, low remittance inflows between 1990 and 1997 coincided with marginal changes in unemployment. Unemployment rate decreased from 2003 to 2008 a time when remittances were picking momentum. This positive trend reversed from 2008 where unemployment started an upward trend, despite remittances growing stronger. The trend in these two variables suggest that other macroeconomic variables playing an important role in the level of unemployment apart from remittance inflows.

2.2 Empirical Literature

The relationship between remittances and fertility is divided into substitution effect and the income effect. When the income received by migrants helps to alleviate economic constraints to fulfilling reproductive desires, families grow bigger (Anwar, and Mughal, 2014; Stark, 1981). Substitution effects are witnessed when remittances mean that parents can stop relying on children to provide security in their old age and therefore no longer desire many children. Instead, households can access better medical care and contraceptives, and to invest in the development of their children. As a direct result of this, fertility rates decrease. In other words, the substitution effect is seen when the fertility rate decreases because there has been an increase in the opportunity costs of producing and raising children; the focus is then no longer on the quantity of children in a family, but on the quality of children, which increases because they have better access to education. Remittances are not only financial remittances that have income and substitution effects – they also include social remittances, which can affect for example fertility rates in migrants’ home country. When migrants learn about better reproductive practises during their stay in a host country and transmits this information to their home country, social remittance is made (Beine, Docquier and Schiff, 2008).

There is a dearth of literature on the causal relationship between fertility, remittances and unemployment. This study reviews studies that examined the impact of remittances on fertility and employment. Although it is acknowledged that impact studies cannot be equated to causality studies, impact studies reviewed in this section will shed some light on the dynamic relationship between remittances, unemployment and fertility. Studies that investigated the impact of remittances on fertility found overwhelming evidence of a negative relationship between the two (see, McFarlane, Brown and Das, 2023; Atta, Kasmaoui, and Mughal (2021; Paul, Soomro and Arif (2019). Studies that examined the impact of remittances on unemployment are divided into three; those studies that found remittances to reduce unemployment (Okeke, 2021; Asiedu and Chimbar, 2020); studies that found remittances to increase unemployment (see, for example, Pal, Villanthenkodath, Patel and Mahalik, 2022); and studies that found no causal relationship between the two (see, Sevenscan, 2021).

Remittances and Fertility

McFarlane, Brown and Das (2023) investigated the impact of remittances on fertility for Jamaica using annual data from 1976 to 2019. Using the autoregressive distributed lag approach, the study found a 1% increase in remittances to reduce fertility by 0.024%. Atta, Kasmaoui, and Mughal (2021) examined the impact of remittances on fertility decline in Morocco using annual data from 1975 to 2018. Employing autoregressive distributed lag approach, their study found a negative relationship between remittances and fertility. The relationship was found to be stronger in the long run than in the short run. Paul, Soomro and Arif (2019) examined the impact of remittances on fertility rate in Pakistan using data from 1975 to 2015 using the ARDL and ECM procedures. The study found a negative relationship between remittances and fertility in the short run and the long run. A 1% increase in remittances

result in a 0.08% decrease in fertility in the long run and 0.02% in the short run. In the same vein, Anwar and Mughal (2014) investigated the role played by remittances in developing countries' fertility transition using unbalanced panel data for South Asian countries. The study found remittances to be significantly associated with low fertility rates. A 1% increase in remittances is associated with a 1.5% decrease in the fertility rate of the migrant-sending country. The study also found the substitution effect to be stronger than the income effect. However, little evidence of social remittances was found in the case of South Asian migrants.

Davis and Lopez-Carr (2010) examined the impact of remittances on consumption patterns. They also studied the effects of such changes in consumption patterns on fertility following the exposure of members of two highland Guatemalan communities to low-fertility cultures. Using ethnographic case studies, the study found that an increase in consumption was not counterbalanced by a decrease in household fertility. They argue that the environmental cost of consumption could be mitigated by diffusing family planning methods to affect fertility negatively. Naufal and Vargas-Silva (2009) analysed the relationship between remittances and fertility for remittance receiving countries. Using panel data from several countries, their study found that there was a negative relationship between remittances and fertility in Latin American and African countries. The study found that the female labour participation ratio, GDP per capita and the percentage of the population living in rural areas were closely related to fertility. Marchiori, Pieretti and Zou (2008) developed an overlapping generations model to account for endogenous fertility and education. Only high-skilled individuals migrate with a higher probability of remitting to their parents. If the migrant-receiving countries relax their immigration restrictions, an increase in migrants leads to a reduction in fertility and promotes human capital accumulation in the home country as migrants move in large numbers. These

findings are consistent with the findings of separate studies by Atta, Kasmaoui, and Mughal (2021) and Anwar and Mughal (2014).

Remittances and Unemployment

Pal, Villanthenkodath, Patel and Mahalik (2022) studied the impact of remittances on economic growth, unemployment and income inequality in low-, middle- and high-income countries using data from 1991 to 2020. The study used random, fixed effects and fully modified ordinary least squares estimation. It was found that remittances lead to an increase in unemployment in high-income countries but reduce unemployment in low- and middle-income countries. Okeke (2021) conducted a similar study to examine the impact of remittances on unemployment in Nigeria using two-stage least squares (2SLS). The study found that remittances have a negative impact on unemployment. It also found that there was a unidirectional causality from remittances to unemployment. Sevenscan (2021) analysed the relationship between remittances, unemployment, economic growth and human development in a set of separate panel data of 23 low-income, 42 lower-middle-income and 48 upper-income countries from 1990 to 2019. Using the Fully Modified Ordinary Least Squares (FMOLS) and the Dynamic Ordinary Least Squares (DOLS) estimation, the study did not find significant empirical evidence of the effect of unemployment rates on remittances.

Asiedu and Chimbar (2020) studied how remittances affect labour market activities in Ghana. Using the instrumental variable estimation techniques, the study found a strong negative association between household remittance-receiving individuals and labour supply decisions. The negative effect on labour supply was found to be much stronger in rural areas, while the effect in urban areas was small. Tsaurai (2020) investigated the nexus between unemployment, remittances and income inequality in emerging markets using data from 2003 to 2016. The

emerging market countries included were Turkey, Greece, Argentina, Thailand, Brazil, China, Russia, Portugal, Colombia, Czech Republic, Poland, Peru, Indonesia and Mexico. Using the generalised method of moments (GMM) approach, remittances and unemployment were found to complement each other in reducing income inequality. Heliati (2019) conducted a similar study of the relationship between remittances, GDP, investment, population and unemployment in Indonesia using data from 1984 to 2016. Using Ordinary Least Squares (OLS) estimation, remittances were found to have a positive effect on unemployment. A 1% increase in remittances was found to increase unemployment by 0.003%. Asad *et al.* (2016) investigated the relationship between remittances and unemployment in Pakistan using data from 1975 to 2010. The study found that there was a link between remittances and unemployment in the long run. Using OLS estimation, the study further found unidirectional causality from remittances to unemployment.

The above-mentioned studies on the relationship between remittances and fertility provide overwhelming evidence that remittances lead to a reduction in fertility rates. However, the same cannot be said of unemployment: the empirical evidence is largely inconclusive. Some studies confirmed that remittances have unemployment-reducing effects (Pal, Villanthenkodath, Patel and Mahalik, 2022; Asad *et al.*, 2016), while others found that remittances lead to an increase in unemployment rates (Pal *et al.*, 2022; Chimbar, 2020; Heliati, 2019). A third group of studies found that remittances had no impact on unemployment (Sevencan, 2021). Studies of the causality between remittances, unemployment and fertility are limited, highlighting a gap in the literature on studies exploring the causality links between these three variables.

Estimation Techniques

This study uses the autoregressive distributed lag (ARDL) approach to cointegration and ECM-based causality to investigate the causal relationships between remittance, fertility and unemployment in South Africa. The ARDL approach was selected based on its advantages, for example its robustness in small samples (Solarin and Shahbaz, 2013) and that it allows estimation of variables with a mixed order of integration (i.e., variables integrated order one and order zero (Pesaran, Shin and Smith *et al.*, 2001). If variables are integrated of a higher order than one, the approach falls away. Also, the results from the study can be separated into short-run and long-run results, which provides more insight into policymaking where timeframes are important.

Variable Definition

The main variables of interest are fertility (FET), measured by total birth per woman; remittances (REM), captured by remittance inflows as a percentage of GDP; and unemployment (UNEMP) measured according to the strict definition of the term. The strict definition only captures the category of unemployed people who are actively looking for employment. Education (EDU) measured by gross primary school enrolment was added as an intermittent variable to form a multivariate causality framework because of its influence on remittances and fertility. Education was added as an intermittent variable because it influences other variables of interest in the model – remittance, fertility and unemployment. The higher the education level, the more receptive women are to family planning methods, while emigrants with a higher level of education could also secure better paying jobs, which would increase their ability to send more remittances home. Education also increases the chances of individual securing employment or better paying jobs according to extant literature. Thus, education plays an important role on fertility, remittance inflows and unemployment.

Model Specification

The ARDL model specification for the multicausality model is given in Equations 1 to 4.

Cointegration Model (FET, REM, UNEMP, EDU).

Cointegration test for long-run relationships between the variables in the model:

$$\begin{aligned} \Delta FET_t = & \delta_0 + \sum_{i=1}^n \delta_{1i} \Delta FET_{t-i} + \sum_{i=0}^n \delta_{2i} \Delta REM_{t-i} + \sum_{i=0}^n \delta_{3i} \Delta UNEMP_{t-i} \\ & + \sum_{i=0}^n \delta_{4i} \Delta EDU_{t-i} + \beta_1 FET_{t-1} + \beta_2 REM_{t-1} + \beta_3 UNEMP_{t-1} \\ & + \beta_4 EDU_{t-1} + \mu_{1t} \dots \dots \dots (1) \end{aligned}$$

$$\begin{aligned} \Delta REM_t = & \delta_0 + \sum_{i=0}^n \delta_{1i} \Delta FET_{t-i} + \sum_{i=1}^n \delta_{2i} \Delta REM_{t-i} + \sum_{i=0}^n \delta_{3i} \Delta UNEMP_{t-i} \\ & + \sum_{i=0}^n \delta_{4i} \Delta EDU_{t-i} + \beta_1 FET_{t-1} + \beta_2 REM_{t-1} + \beta_3 UNEMP_{t-1} \\ & + \beta_4 EDU_{t-1} + \mu_{2t} \dots \dots \dots (2) \end{aligned}$$

$$\begin{aligned} \Delta UNEMP_t = & \delta_0 + \sum_{i=0}^n \delta_{1i} \Delta FET_{t-i} + \sum_{i=0}^n \delta_{2i} \Delta REM_{t-i} + \sum_{i=1}^n \delta_{3i} \Delta UNEMP_{t-i} \\ & + \sum_{i=0}^n \delta_{4i} \Delta EDU_{t-i} + \beta_1 FET_{t-1} + \beta_2 REM_{t-1} + \beta_3 UNEMP_{t-1} \\ & + \beta_4 EDU_{t-1} + \mu_{3t} \dots \dots \dots (3) \end{aligned}$$

$$\begin{aligned} \Delta EDU_t = & \delta_0 + \sum_{i=0}^n \delta_{1i} \Delta FET_{t-i} + \sum_{i=0}^n \delta_{2i} \Delta REM_{t-i} + \sum_{i=0}^n \delta_{3i} \Delta UNEMP_{t-i} \\ & + \sum_{i=1}^n \delta_{4i} \Delta EDU_{t-i} + \beta_1 FET_{t-1} + \beta_2 REM_{t-1} + \beta_3 UNEMP_{t-1} \\ & + \beta_4 EDU_{t-1} + \mu_{4t} \dots \dots \dots (4) \end{aligned}$$

Where: FET = total birth per woman; REM = remittance inflows as percentage of GDP;

UNEMP = unemployment; EDU = education measured by gross primary school enrolment.

δ_0 is a constant; $\delta_1 - \delta_4$ and $\beta_1 - \beta_4$ are short-run and long-run coefficients, respectively.

$\mu_1 - \mu_4$ are error terms.

Stationarity Test

The ARDL approach does not require unit root tests. However, to ensure that the variables used in the model are stationary in levels and first difference, the Augmented Dickey–Fuller (ADF) unit root test and the Phillips–Perron (PP) test were carried out. The Phillip-Perron test is a non-parametric test on the nuisance parameters (Phillip and Perron, 1988), while the Augmented Dickey-Fuller test controls serial correlation and heteroscedasticity in the error term. The test provides three variations depending on the inclusion of an intercept or trend. Variables are stationary when the mean, variances and autocorrelation do not change over time. Regressing non-stationary variables result in a spurious regression. The next step will be a test for a long run relationship among the variables in the study.

Cointegration Tests

The null hypothesis of no cointegration H_0 is tested against the alternative hypothesis H_1 of the presence of cointegration H_1

$$H_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$$

$$H_1 \neq \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq 0$$

The calculated F-statistic is compared to critical values developed by Pesaran *et al.* (2021). The critical values have upper and lower bounds. If the F-statistics are above the upper bound, cointegration is confirmed, the null hypothesis of no cointegration is rejected and the alternative hypothesis is accepted. If the F-statistics are below the lower bound critical value, no cointegration is confirmed, resulting in the acceptance of the null hypothesis; and if the F-statistic falls between the upper and the lower bound, the results are inconclusive.

The Granger-causality models for Equations 1 to 4 are specified in Equations 5 to 8.

$$\Delta FET_t = \delta_0 + \sum_{i=1}^n \delta_{1i} \Delta FET_{t-i} + \sum_{i=1}^n \delta_{2i} \Delta REM_{t-i} + \sum_{i=1}^n \delta_{3i} \Delta UNEMP_{t-i} + \sum_{i=1}^n \delta_{4i} \Delta EDU_{t-i} + \vartheta_1 ECM_{t-1} + \mu_{1t} \dots \dots \dots (5)$$

$$\Delta REM_t = \delta_0 + \sum_{i=1}^n \delta_{1i} \Delta FET_{t-i} + \sum_{i=1}^n \delta_{2i} \Delta REM_{t-i} + \sum_{i=1}^n \delta_{3i} \Delta UNEMP_{t-i} + \sum_{i=1}^n \delta_{4i} \Delta EDU_{t-i} + \vartheta_2 ECM_{t-1} + \mu_{2t} \dots \dots \dots (6)$$

$$\Delta UNEMP_t = \delta_0 + \sum_{i=1}^n \delta_{1i} \Delta FET_{t-i} + \sum_{i=1}^n \delta_{2i} \Delta REM_{t-i} + \sum_{i=1}^n \delta_{3i} \Delta UNEMP_{t-i} + \sum_{i=1}^n \delta_{4i} \Delta EDU_{t-i} + \vartheta_3 ECM_{t-1} + \mu_{3t} \dots \dots \dots (7)$$

$$\Delta EDU_t = \delta_0 + \sum_{i=1}^n \delta_{1i} \Delta FET_{t-i} + \sum_{i=1}^n \delta_{2i} \Delta REM_{t-i} + \sum_{i=1}^n \delta_{3i} \Delta UNEMP_{t-i} + \sum_{i=1}^n \delta_{4i} \Delta EDU_{t-i} + \vartheta_4 ECM_{t-1} + \mu_{4t} \dots \dots \dots (8)$$

ECM = error correction term

$\vartheta_5 - \vartheta_4$ are the error correction term coefficients.

The rest of the variables remain the same as specified in equation 1-4.

Data Sources

This study examined the causal relationship between remittances, fertility and unemployment for South Africa using annual time series data from 1990 to 2020. Fertility rates (FET), remittances (REM), unemployment (UNEMP) and education (EDU) were extracted from the World Bank Development Indicators.

2 Empirical Results

The stationarity test of the variables included in the model was done to ensure that only variables integrated of orders zero and one are included in the model. This is also important according to the ARDL approach as the approach falls away in the case of variables that are integrated of a higher order than one. The study used the Augmented Dickey–Fuller (ADL) and Phillips–Perron (PP) test. The results of the unit root test are presented in Table 1.

Table 1: Unit Root Test

Augmented Dickey–Fuller Unit Root Test				
Variable	Stationarity of all variables in levels		Stationarity of all variables in first difference	
	Without Trend	With Trend	Without Trend	With Trend
FET	-1.722	-1.963	-6.233***	-5.353***
REM	-1.878	-2.859	-2.665*	-3.498*
UNEMP	-1.306	-1.634	-4.021**	-4.028**
EDU	-0.273	-1.826	-4.170***	-4.798***
Phillips–Perron Test				
Variable	Stationarity of all variables in levels		Stationarity of all variables in first difference	
	Without Trend	With Trend	Without Trend	With Trend
FET	-2.019	-2.087	-4.113**	-4.206**
REM	-1.207	-1.714	-2.697*	-3,505**
UNEMP	-1.481	-1.376	-3.936**	-3.936**
EDU	-1.547	-2.209	-4.862***	-4.853***

Note: *, ** and *** denote stationarity at 10%, 5% and 1% significance levels, respectively.

The results reported in Table 1 confirm that all variables included in the model are integrated of order 1. To proceed with the analysis, a test of a long-run relation among the functions in the model was done. The results of the long-run relation are presented in Table 2.

Table 2: Cointegration Results

Dependent Variable	Function	F-Statistic	Cointegration Status			
FET	F(FET REM, UNEMP, EDU)	1.381	Not Cointegrated			
REM	F(REM FET, UNEMP, EDU)	4.788**	Cointegrated			
UNEMP	F(UNEMP REM, FET, EDU)	4.177*	Cointegrated			
EDU	F(EDU REM, UNEMP, FET)	4.969**	Cointegrated			
Asymptotic Critical Values (unrestricted intercept and no trend)						
Critical Values Pesaran <i>et al.</i> (2001), p. 300 Table CI (iii) Case III	1%		5%		10%	
	I (0)	I (1)	I (0)	I (1)	I (0)	I (1)
	4.29	5.61	3.23	4.35	2.72	3.77

Note: *, ** and *** denote stationarity at 10%, 5% and 1% significance levels, respectively.

Results reported in Table 2 confirm cointegration in three of the four functions in the model. For those functions where cointegration was confirmed, causality is estimated for the long-run and the short-run timeframes, while for the FET function, only short-run causality is analysed and reported. The causality results are reported in Table 3.

4.3 Analysis and Discussion of Results

Table 3: Causality Results

	ECM				ECT_{t-1} [t-statistics]
	Δ FET	Δ REM	Δ UNEMP	Δ EDU	
Δ FET	-	9.497***	5.257**	7.865***	-

		[0.001]	[0.013]	[0.004]	
Δ REM	9.133*** [0.002]	-	4.888** [0.038]	2.681 [0.117]	-0.380*** [-4.465]
Δ UNEMP	2.713 [0.114]	3.188* [0.089]	-	1.877 [0.171]	-0.429* [-2.444]
Δ EDU	2.465* [0.089]	6.340** [0.020]	1.416 [0.247]	-	-0.410*** [-3.694]

Note: *, ** and *** denote stationarity at 10%, 5% and 1% significance levels, respectively.

Results reported in Table 3, row one (Δ FET) and row two (Δ REM), confirm bidirectional causality between remittances and fertility in the short run, and a unidirectional causal flow from fertility to remittances in the long run. Family members that travel abroad are likely to bring back knowledge of family planning, thus driving fertility down. This finding confirmed the dominance of the substitution effect in South Africa, where remittances lead to a reduction in fertility. Atta *et al.* (2021) and Anwar and Mughal (2014) found the same results in studies on Morocco and South Asian countries, respectively. The study also found a unidirectional causal flow from unemployment to fertility in the short run. Thus, a high unemployment rate is associated with a high fertility rate. A bidirectional causality between remittances and unemployment was confirmed in the short run and in the long run - results presented in row two (Δ REM) and roll three (Δ UNEMP) in Table 3. The findings of this study confirm the notion that migrants who come from poor families are likely to remit more to assist their struggling families. On the other hand, families that receive remittances may not experience high pressure to secure employment as the remittances are used to meet their needs. Remittances used for investment, for example, to start small businesses, contribute to the generation of extra income and reduce the pressure to secure formal employment. This finding is consistent with findings by Pal *et al.* (2022).

Other results reported in Table 3 confirm a bidirectional causality between fertility and education in the short run, and a unidirectional causal flow from fertility to education in the long run. Fertility and education have a mutually beneficial link. The study also found a unidirectional causal flow from unemployment to education in both the short run and the long run. This confirms the negative effect of unemployment on the ability of South African families to send their children to school, resulting in high unemployment levels as the less educated children become less competitive in the labour market. No causality was found between education and remittances in South Africa. The functions in the model passed all diagnostic test. The results are presented in Annex 1.

5. Conclusion

The causal relationships between fertility, remittances and unemployment in South Africa were investigated using data from 1990 to 2020. The study was motivated by the need to establish whether remittances influence fertility levels and unemployment in South Africa. As South Africa forges ways of reducing unemployment, the study provides insight into the role that remittances can play in reducing fertility and unemployment rates. To fully specify the model, education was added as an intermittent variable. Using the ARDL approach, the study found bidirectional causality between fertility and remittances in the short run, and a unidirectional causal flow from fertility to remittances in the long run. The study also found a unidirectional causal flow from unemployment to fertility in the short run, and bidirectional causality between remittances and unemployment in both the short run and the long run. The findings of this study point to the importance of remittances in influencing fertility and unemployment in South Africa. It can be concluded that policymakers in South Africa can leverage remittances as part of the solution to the problem of prevailing high unemployment levels. Policy makers need to take cognisance of the role that remittances play in increasing the accessibility and application

of family planning methods. Based on the findings of the study, it is recommended that policymakers in South Africa continue to support remittances as solution to the problems of development finance, unemployment and fertility rates.

The study focused on the causal relationship between fertility, remittances and unemployment using data from 1990 to 2020, the use of updated data can provide different causal relationship, given the interruption of COVID-19 in 2020. Further, only one measure of unemployment was employed, limiting the results to general unemployment levels in South Africa. A focus on other metrics like Youth unemployment may provide a different outcome.

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Annex 1

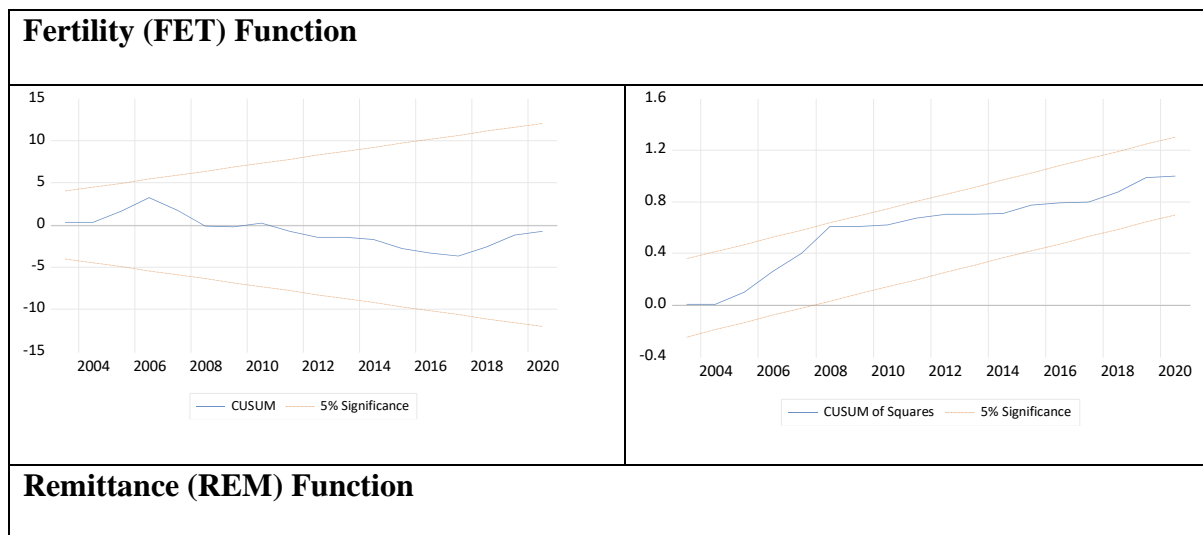
Table 5: Diagnostics results

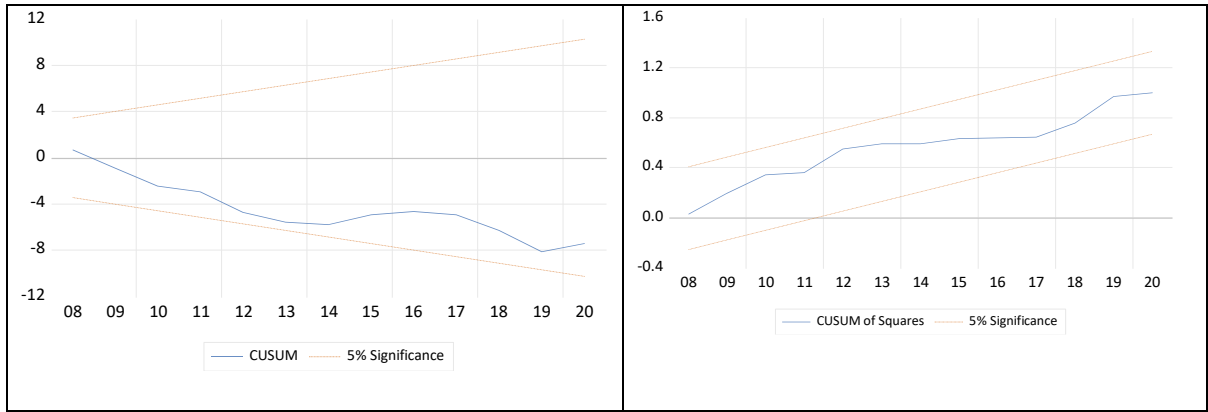
LM Test Statistic	Results
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	FET Function	REM Function	UNEMP Function	EDU Function
Serial correlation	0.4754 [0.7884]	0.2310 [0.9198]	0.3987 [0.8965]	0.4513 [0.6432]
Functional form	1.8709 [0.1892]	1.7253 [0.1898]	0.3919 [0.5396]	0.3034 [0.5875]
Heteroscedasticity	0.4114 [0.9233]	0.4232 [0.9143]	0.5388 [0.8406]	0.7431 [0.6210]
Normality test	0.4687 [0.2697]	1.2158 [0.5445]	0.4877 [0.2538]	0.5795 [0.7484]

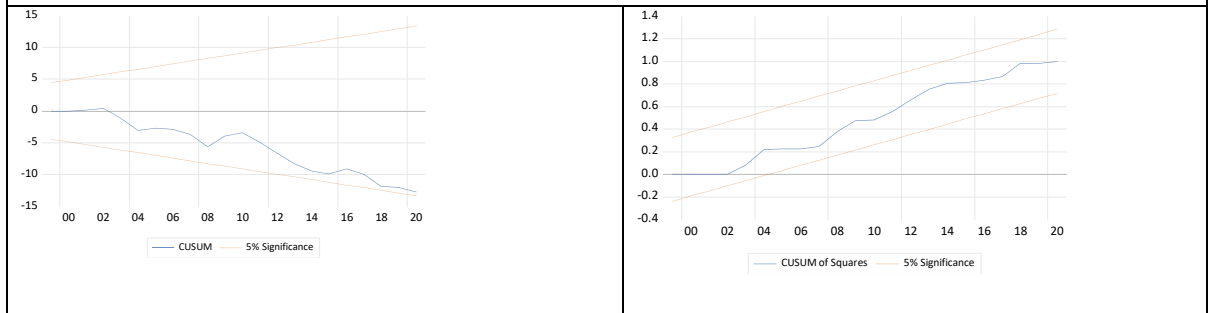
All the functions in the model passed normality test, serial correlation, functional form and heteroscedasticity. Stability tests are presented in Figure 3. The functions passed all the stability test – CUSM and CUSUMQ- at 5% level of significance.

Figure 3: Stability test results

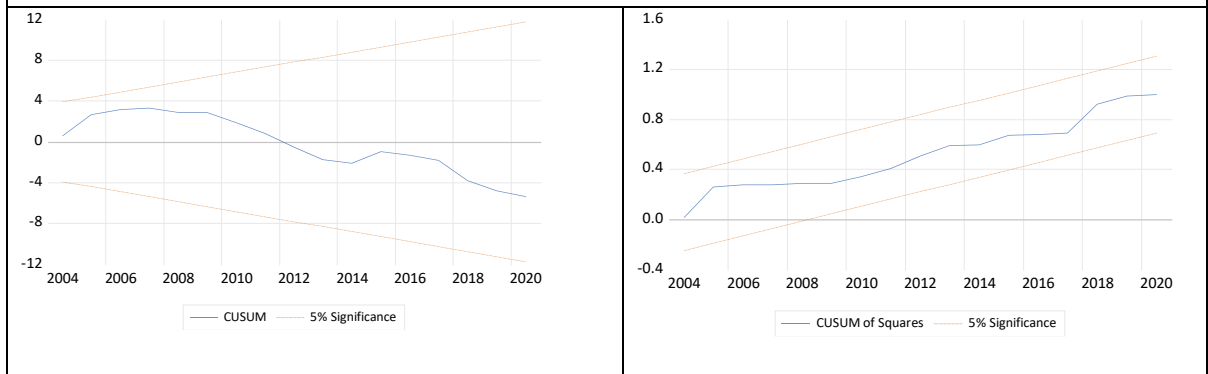




Unemployment (EMPL) Function



Education (EDU) Function



Note: 5% level of significance.