Determinants of Economic Growth: A Panel Data Study of Caribbean countries

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Abstract

Using the Autoregressive Distributed Lag (ARDL) technique to co-integration and an Error Correction Model (ECM) to account for the short and long-run relationships, this paper sheds light on the factors underlying economic growth in nine Caribbean countries for the period 2002-2016. This study focuses on the endogenous growth model, while testing the convergence hypothesis of the neoclassical growth model.

The empirical findings suggest that in the long run, the convergence theory can be accepted. Furthermore, foreign direct investment and fiscal balance positively affect real per capita GDP growth. In the short run, foreign direct investment and fiscal balance maintain their positive impact on growth. Moreover, gross fixed capital formation is positively while population growth is negatively associated with real per capita GDP growth. These findings are in line with studies performed in small and large (groups of) countries and over different periods.

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1. Introduction

Certain countries register uneven, erratic growth trajectories, while others record rapid, sustained growth paths. The vast differences in output levels and growth rates among countries or regions, and across time have led many researchers to examine the determinants of short and long-run economic growth. For a country to reach and maintain a high growth path, policymakers should be aware of these determinants and how their policies might influence them.

To our knowledge, a limited number of studies have examined factors underlying economic growth in small economies and no previous studies included Curaçao as part of the group of selected small countries under investigation. To breach this gap, this paper used panel data consisting of nine Caribbean countries including Curaçao[1] for the period 2002-2016.

The empirical study involves estimating an Autoregressive Distributed Lag (ARDL) approach to co-integration and an Error Correction Model (ECM) to account for the short and long-run relationships between the selected factors and real per capita GDP growth. Based on the results of this dynamic modelling technique, the Centrale Bank van Curaçao en Sint Maarten (CBCS) can provide policy recommendations to foster short and long-run economic growth in the Caribbean, including for the Monetary Union of Curaçao and Sint Maarten.

The remainder of the paper is structured as follows. The second section discusses the most popular theories on long-run economic growth. The third section outlines the data and analytical approach used to identify the main determinants of short and long-run economic growth in our sample of Caribbean countries. The fourth section presents the empirical results, and the fifth section concludes this study.

2. Literature review

Long-run growth research can be classified into two types of models: (1) the neoclassical growth model, which assumes that technological progress is exogenous and addresses the convergence hypothesis and (2) the endogenous growth model, which assumes that technological progress is endogenous and examines the factors underlying economic growth.

[1] Due to a lack of data for Sint Maarten regarding the required variables for this study, we excluded it.

The neoclassical growth model was developed by Solow (1956) and Swan (1956) to explain long-run economic growth and assumes constant returns to scale, diminishing returns to capital, substitution between capital and labor, exogenous technological progress, and that countries employ their resources efficiently (Okafor & Shaibu, 2016). According to the convergence hypothesis, the diminishing returns to capital cause less developed economies (i.e., countries with relatively low initial levels of real GDP per capita) to grow at a faster pace than developed economies (i.e., countries with relatively high initial levels of real GDP per capita) (Barro, 1996).[2] Nonetheless, the convergence is conditional because the steady-state levels of capital and output per worker depend on, among other things, a country's (1) population growth, (2) propensity to save, (3) production function, (4) government consumption, (5) protection of property rights, and (6) shocks in domestic and international markets.

Despite being widely known and commonly used, the neoclassical growth model has been placed under scrutiny by researchers who disagree with the argument that the growth rate of real per capita GDP emerges from exogenous technological progress, as it cannot be explained by the model. Furthermore, instead of converging toward each other, economies tend to diverge from each other due to endogenous factors that vary by country. To solve these shortcomings, the endogenous growth model has been developed (Okafor & Shaibu, 2016).

Applying varying conceptual and methodological approaches, studies in large and small countries have examined factors determining economic growth. Regardless of the ex-ante plausibility of various factors as potential growth determinants, the selection of these factors remains an issue in specifying the model to be used (Okafor & Shaibu, 2016).

2.1 Determinants of economic growth in large countries

Grier and Tullock (1989) show that population growth is positively and significantly linked to a country's economic growth. They used pooled cross-section and time series data for 113 countries in the period 1951-1980. The 113 selected countries were divided into two groups: 24 OECD countries and 89 countries outside of the OECD. They found a negative and significant link between the initial real GDP per capita and economic growth, thereby confirming the convergence hypothesis. In testing for the effect of inflation on economic

[2] Countries with a lower amount of capital per worker relative to the long-run amount have higher rates of return and growth than those with a higher amount of capital per worker relative to the long-run amount.

growth, they found that average inflation has a negative and significant effect on growth rates. The findings of Barro (1996) confirm these results.

Barro (1996) argues that the steady-state output level of a country is determined by political and social factors such as tax rates, the maintenance of the rule of law, and the degree of market distortions. The initial level of output and the steady-state level of output per worker determine the growth rate of a country's economy. In addition, the findings of Chen and Feng (2000) show that given an initial level of output, an increase in the steady-state level of output per worker, because of exogenous labor that increases with technological progress, will lead to positive output growth. They investigated the variations of cross-provincial economic growth in China for the years 1978-1989 and found that higher international trade has a positive impact on economic growth, but higher inflation affects economic growth negatively. Higher expected inflation reduces economic growth because of fewer economic activities such as investments (Stockman, 1981). These findings support the convergence hypothesis because the coastal provinces (with higher initial GDP) tend to grow at a slower pace than the provinces in the inner regions. Also worth mentioning is that a country with low national savings rates and high consumption levels will have a lower steady-state level of output than a country with higher savings rates and investments.

Further studies show that international trade and investment are key factors for economic growth (Barro, 1991; Levine and Renelt, 1992). International trade boosts economic growth by promoting competition and enhancing efficiency, while investment leads to technological progress, thereby fostering economic growth (Barro, 2001). However, without technological progress,[3] the growth rate of real GDP per capita does not continue indefinitely and the economy will eventually stagnate. This line of thought coincides with the works of Malthus (1798) and Ricardo (1817) and is based on diminishing returns to capital in the broad sense.[4]

Borensztein, de Gregorio, and Lee (1998) also analyzed foreign direct investment (FDI) flows from industrial to developing economies for the period 1970-1989 and showed that the contribution of FDI to economic growth is larger than the contribution of domestic investment to growth. The positive effect of FDI on growth may simply reflect that FDI is attracted to

[3] Technological progress implies that new and improved goods & services, upgraded production processes, new managerial skills, and new kinds of business organizations should enable production with fewer resources.
[4] Capital in the broad sense refers to both physical and human capital.

faster growing countries. Makki and Somwaru (2004) pointed out that in the neoclassical model, FDI will only have an impact on long-run economic growth if it affects technology positively and permanently. However, in the endogenous model, FDI affects growth directly with positive returns in production due to spillover effects. Furthermore, FDI improves the inputs and technologies in the production system of a country. Moreover, Petrakos, Arvanitidis, and Pavleas (2007) argued that FDI triggers economic growth because it is one of the main sources of technology transfers.

Contrary to the findings above, Carkovic and Levine (2002) did not find evidence of a robust positive impact of FDI on economic growth. They show that FDI only appears to be significant when the model also includes the following control variables: the initial level of GDP per capita, initial years of schooling, inflation, and government size. Nevertheless, the positive significant link between FDI and economic growth disappears when adding further control variables, such as trade openness and other market indicators. Against the theory of Borensztein et al. (1998)[5], Carkovic and Levine show that the level of human capital does not affect the impact of FDI on GDP growth.

Tolo (2011) studied the determinants of GDP per capita growth using a panel of 23 emerging markets and found significant links between GDP per capita and the initial level of GDP per capita (-), population growth (-), trade openness (+), fiscal balance (+), current account balance (+), and investment (+). The negative relationship between GDP per capita and population growth found in the work of Tolo contradicts the findings of Grier and Tullock (1989). Furthermore, given that the trade balance is usually the largest component of the current account balance (CAB), the positive connection between CAB and GDP per capita can be explained by Esfahani (1991) who states that the expansion in exports contributes positively to economic growth, by relieving import shortages through the provision of foreign exchange for imports. Furthermore, Yanikkaya (2003) suggests that import and export shares in GDP show a positive link with economic growth as economies tend to use their resources more efficiently through the import of goods & services that are cheaper abroad. Aßmann (2008) also analyzed the impact of several crises –in this case current account reversals or deficits– on economic

[5] Borensztein et al. (1998) stated that the impact of FDI on growth is insignificant in countries with low levels of human capital.

growth using different empirical models. He found that, depending on the size of a country and its level of openness, current account reversals have a negative impact on economic growth.

According to Barro (1990), the higher the ratio of government spending to real GDP, the lower the growth rate of an economy. Barro also mentions that additional public infrastructure offsets the negative effects caused by higher tax rates to finance new projects, leading to a positive economic development. Furthermore, Easterly and Rebelo (1993) found that as the neoclassical model is driven by exogenous factors, fiscal policy only affects the steady state growth during the transition period. In addition, the neoclassical growth theory states that differences in tax systems, debt, and spending policies can significantly affect the level of output, but not the growth rate. Also, low levels of government restrictions and bureaucracy prompt new technological developments, which in turn boost productivity and companies' profits, contributing to a nation's wealth creation (Macambira Filho, Da Silva, & Moreira Filho, 2012). Tolo (2011) also found that the fiscal balance is a significant positive contributor to GDP per capita growth, stating that fiscal surpluses are associated with faster economic growth, which could indicate macroeconomic stability. Conversely, Fischer (1993) showed that growth is negatively related to large fiscal deficits, indicating that budget deficits reduce productivity growth.

2.2 Determinants of economic growth in small countries

A limited number of studies have focused on the determinants of economic growth in small countries. For example, Peters (2001) analyzed the determinants of economic growth in 12 small states in the Caribbean region during the period of 1977-1996 using both the neoclassical and the endogenous models. He found that an economy's growth is positively linked to trade openness, human capital accumulation, investment, and life expectancy, but relates negatively with inflation and population growth.

Furthermore, Parry (1988), Read and Driffield (2004), and Jayaraman and Choong (2010) found FDI to be a crucial driver of economic growth in small economies. However, evidence on the causal relation between FDI and economic growth in small economies is scarce because of limited data availability and because these economies tend to have low levels of FDI flows (Read and Driffield, 2004). Moreover, Bertram (2004) found that the GDP growth rate of a small economy depends strongly on the initial level of GDP per capita.

In summary, most variables—the initial level of GDP per capita, investment, FDI, population growth, trade openness, and inflation—that were found to be significant in determining GDP growth in large economies were also found to be significant in explaining long-run growth in small economies.

This paper uses the endogenous growth model, while testing the presence of the convergence hypothesis of the neoclassical growth model. Based on the findings above, the initial real per capita GDP, population growth, and inflation rate are expected to have a negative impact on economic growth, whereas the fiscal balance, domestic private investment, and foreign direct investment are expected to have a positive effect on growth. The impact of the current account balance depends on other determinants included in the model.

3. Data and method

3.1 Data sources

This study covers a panel of nine Caribbean countries for the period 2002-2016.[6] The nine Caribbean countries, namely Antigua & Barbuda, Barbados, Belize, Curaçao, Dominica, Grenada, St. Kitts & Nevis, St. Lucia, and St. Vincent & the Grenadines, were selected based on data availability and comparable economic structures.

For Curaçao, annual time series data on the inflation rate, total population, and gross fixed capital formation were obtained from the Central Bureau of Statistics Curaçao (CBS). GDP in constant 2010 U.S. dollars was computed by adjusting the nominal GDP levels for the Consumer Price Index (CPI) inflation.[7] Data on the current account balance and net inflows of foreign direct investment were derived from the balance of payments data of the Centrale Bank van Curaçao en Sint Maarten (CBCS). Furthermore, data on the fiscal balance were gathered from Annual Financial Statements and the Financial Management Reports (FMR) of the Curaçao government.

For the remaining economies in the Caribbean, data on the inflation rate, total population, net inflows of foreign direct investment to GDP, gross fixed capital formation to GDP, and GDP in constant 2010 U.S. dollars were gathered from the World Development Indicators (WDI) database of the World Bank. Moreover, data on the current account balance to GDP and fiscal

[6] The sample was corrected for data constraints on certain variables.
[7] No GDP deflator was available; therefore, the CPI inflation was used.

balance to GDP were derived from the World Economic Outlook (WEO) database of the International Monetary Fund (IMF).[8]

3.2 Econometric model specification

We used the Autoregressive Distributed Lag (ARDL) or Bounds Testing method proposed by Pesaran and Shin (1999) and Pesaran, Shin, and Smith (2001) in this paper. The primary advantage of this modeling approach lies in its flexibility because it is useful with a variety of variables integrated at zero and first orders, I(0) and I(1), respectively. Still, it is recommended to test the stationarity of the variables under investigation to check whether they are integrated at second orders, I(2), as in that case the ARDL model cannot be used.

The ARDL model can be expressed in the following reduced form:[9]

$$\Delta y_{it} = f(y_{it-1}, FDI_{it}, GFCF_{it}, pop_{it}, FB_{it}, e_{it}) \quad [1]$$

Where Δy is the difference of the natural logarithm of real per capita GDP, y_{t-1} is the natural logarithm of real per capita GDP lagged by one year, representing a proxy for the initial level income, FDI is the ratio of net inflows of foreign direct investment to GDP, pop is the natural logarithm of total population, FB is the ratio of fiscal balance to GDP, $GFCF$ is the ratio of gross fixed capital formation to GDP, e is the error term, t runs from 0 (2002) to 14 (2016), representing the year, and i runs from 1 (Antigua and Barbuda) to 9 (Saint Vincent and the Grenadines), representing a Caribbean country.

The unrestricted Error Correction Model (ECM) can be expressed as follows:

$$\Delta y_{it} = \delta_0 + \sum_{l=1}^{n} \beta_1 \Delta y_{it-l} + \sum_{l=0}^{n} \vartheta_2 \Delta FDI_{it-l} + \sum_{l=0}^{n} \vartheta_3 \Delta GFCF_{it-l} + \sum_{l=0}^{n} \vartheta_4 \Delta pop_{it-l} + \sum_{l=0}^{n} \vartheta_5 \Delta FB_{it-l} + \omega_1 y_{it-1} + \theta_2 FDI_{it-1} + \theta_3 GFCF_{it-1} + \theta_4 pop_{it-1} + \theta_5 FB_{it-1} + \varepsilon_{it} \quad [2]$$

[8] Note that for various years, data on the current account balance to GDP and fiscal balance to GDP were missing in the World Development Indicators (WDI) database of the World Bank. For this reason, these data were obtained from the World Economic Outlook (WEO) database of the International Monetary Fund (IMF).

[9] The inflation rate (INF) and the ratio of current account balance to GDP (CAB) were also included in the original model but were later dropped because they did not significantly contribute to the model.

Where β_1, ϑ_2, ϑ_3, ϑ_4, and ϑ_5 stand for the short-run dynamics, ω_1, θ_2, θ_3, θ_4, and θ_5 represent the long-run relations, ε_{it} is the serially uncorrelated error term across all Caribbean countries i's with zero mean and constant variance-covariance, and Δ is the first-difference operator.

To select the appropriate lag structure of the model, the Akaike Information Criterion or AIC (Akaike, 1978) and the Schwarz Information Criterion or SIC (Schwarz, 1978) are used.

For each independent variable in equation [2], the long-run multiplier is calculated by taking the coefficient of the independent variable (θ_2, θ_3, θ_4, θ_5, or θ_6) and dividing it by minus the coefficient of the lagged dependent variable ($-\omega_1$).

Then the Bounds Test (Pesaran et al., 2001) is performed to confirm whether a long-run relationship or co-integration exists among the variables. This test checks the joint null hypothesis of $\omega_1 = \theta_2 = \theta_3 = \theta_4 = \theta_5 = 0$ in equation [2] of no long-run relationship or co-integration against the alternative hypothesis of $\omega_1 \neq \theta_2 \neq \theta_3 \neq \theta_4 \neq \theta_5 \neq 0$.

The associated F-test has a nonstandard distribution that depends on (1) the order of integration of the selected variables, (2) the number of independent variables, and (3) the presence of an intercept and/or trend in the model (Narayan, Narayan, Prasad, & Prasad, 2010). If the obtained F-statistic is above (below) the appropriate upper (lower) critical value bound reported in Pesaran et al. (2001), the null hypothesis can(not) be rejected and there is (no) co-integration. However, if the F-statistic lies within the appropriate lower and upper critical value bounds, the result is inconclusive.

After the long-run relationship is confirmed, the following long-run model is estimated:

$$y_{it} = \delta_0 + \omega_1 y_{it-1} + \theta_2 FDI_{it-1} + \theta_3 GFCF_{it-1} + \theta_4 pop_{it-1} + \theta_5 FB_{it-1} + \varepsilon_t \quad [3]$$

For the short-run dynamics, the following restricted ECM model is estimated:

$$\Delta y_{it} = \delta_0 + \sum_{l=1}^{n} \beta_1 \Delta y_{it-l} + \sum_{l=0}^{n} \vartheta_2 \Delta FDI_{it-l} + \sum_{l=0}^{n} \vartheta_3 \Delta GFCF_{it-l} + \sum_{l=0}^{n} \vartheta_4 \Delta pop_{it-l} + \sum_{l=0}^{n} \vartheta_5 \Delta FB_{it-l} + \rho_1 ECT_{t-1} + \varepsilon_t \quad [4]$$

Where ECT_{t-1} is the lagged Error Correction Term (ECT) of equation [3], representing the equilibrium adjustment coefficient. To confirm the co-integration relationship among the variables, this term must be negative and statistically significant (Altaee, Al-Jafari, & Khalid, 2016).

3.3 Extreme values and multicollinearity

To avoid bias in the models' coefficient estimates, the impact of extreme values (outliers) must be limited. The method conventionally used to detect outliers is the mean plus or minus three times the standard deviation of the univariate data (Howell, 1998). This method, however, has three limitations: (1) the distribution of the data is assumed to be normal, (2) the mean and standard deviation are considerably affected by extreme values, and (3) often extreme values cannot be detected in small sample sizes (Cousineau & Chartier, 2010; Leys, Ley, Klein, Bernard, & Licata, 2013; Miller, 1991).

To overcome these limitations, we used the modified z-score test as it is minimally affected by extreme values (see Iglewicz & Hoaglin, 1993, for further details on this method). For this method, first a robust measure of central tendency and dispersion known as the Median Absolute Deviation (MAD) was computed. Because the MAD is insensitive to the presence of outliers and to the sample size, Huber (1981, p. 107) describes it as the "single most useful ancillary estimate of scale".

The MAD is calculated as follows:

$$MAD = Median(|x_i - x_m|) \quad [5]$$

Where x_i is the observation of Caribbean country i per year and x_m is the sample median.

Subsequently, the modified z-score test is calculated:

$$z_i = 0.6745 * \frac{x_i - x_m}{MAD} \quad [6]$$

Where x_i is the observation of Caribbean country i per year, x_m is the sample median, MAD is the median absolute deviation, and 0.6745 is the constant.

The threshold for extreme values is then:

$$|z_i| > 3.5 \quad [7]$$

To prevent potential weakening of the statistical power of our models, we also checked for the presence of multicollinearity among the independent variables. All pairwise Pearson's correlation coefficients were below the common cutoff of .8 (Simon Fraser University, 2020). This finding is confirmed by the Variance Inflation Factors (VIF) below the typical cutoffs of 5 or 10. Hence, no multicollinearity problems were identified and, therefore, we proceeded with the previously selected independent variables.

4. Empirical results

4.1 *Panel unit root test*

To allow for different Autoregressive (AR) coefficients in each time series in the panel, the Fisher-type of Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests were used (Phillips & Perron, 1988; Choi, 2001; Maddala & Wu, 1999). Both tests examine the joint null hypothesis that all series in the panel are non-stationary (with a unit root) against the alternative hypothesis that some series are stationary (without a unit root) (see Table 1).

The unit root test results suggest that y_{t-1}, FDI_t, and FB_t exhibit unit roots, but become stationary in first differences, while pop_t and $GFCF_t$ are stationary at levels. Furthermore, y_t is stationary in first differences or at levels depending on the type of test (ADF/PP).

Table 1: Panel unit root test results [a)]

	Intercept and trend (ADF)		Intercept and trend (PP)		Integration
Variable	I(0)	I(1)	I(0)	I(1)	
y_t	13.98	53.17***	28.64*	--	I(1)/I(0)
y_{t-1}	15.43	47.11***	21.79	53.07***	I(1)
FDI_t	22.67	84.17***	23.46	103.56***	I(1)
pop_t	40.58***	--	34.76**	--	I(0)
$GFCF_t$	28.89**	--	33.31**	--	I(0)
FB_t	20.85	70.32***	20.87	87.09***	I(1)

Source: Authors' calculations based on Asteriou's (2007) approach.

[a)] ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively.

4.2 Bounds test

The calculated F-statistic for y (4.05) exceeds the upper 95% critical value bounds (see Table 2). Accordingly, there appears to be evidence of a long-run relationship or co-integration among the variables when y is considered as the dependent variable in the model. This result applies at the 5% significance level or greater.

Table 2: ARDL co-integration test results [a) b)]

Dependent variable	F-statistic	90% critical value bounds ($k = 4$)		95% critical value bounds ($k = 4$)		99% critical value bounds ($k = 4$)		Co-integration
		I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	
$F_{y(y\|FDI,GFCF,pop,FB)}$	4.05**	2.45	3.52	2.86	4.01	3.74	5.06	Yes
$F_{FDI(FDI\|y,GFCF,pop,FB)}$	0.38	2.45	3.52	2.86	4.01	3.74	5.06	No
$F_{GFCF(GFCF\|y,FDI,pop,FB)}$	1.85	2.45	3.52	2.86	4.01	3.74	5.06	No
$F_{pop(pop\|y,FDI,GFCF,FB)}$	3.26	2.45	3.52	2.86	4.01	3.74	5.06	Inconclusive
$F_{FB(FB\|y,FDI,GFCF,pop)}$	0.61	2.45	3.52	2.86	4.01	3.74	5.06	No

Source: Authors' calculations and Pesaran et al. (2001) for the critical value bonds (see Appendix 1).

[a)] *** and * indicate significance at 1% and 10% level, respectively.

[b)] Intercept was included in both models (not reported).

4.3 Long-run and short-run estimates

Table 3 reports the long-run empirical results. Both the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) select an ARDL (1,0,0,0,0) model, consisting of one lag for the dependent variable (y) and zero lags for the independent variables (FDI, $GFCF$, FB, and pop).

Table 3: Long-run estimates based on the unrestricted ECM [a) b) c) d)]

Dependent variable Δy_t	
Independent variable	Model [2]
y_{t-1}	-0.00824*
	(0.00459)
FDI_t	0.00179***
	{0.21715}
	(0.00063)
$GFCF_t$	-0.00056
	{-0.06757}
	(0.00044)
FB_t	0.00140**
	{0.16936}
	(0.00061)
pop_t	0.00331
	{0.40143}
	(0.00484)
R-squared	0.55
Adjusted R-squared	0.44
Observations	129
F-statistic	5.20***

Source: Authors' calculations

[a)] ***, **, and * indicate significance at 1%, 5%, and 10% level, respectively.

[b)] Standard errors are shown in round () brackets.

[c)] Long-run multipliers are shown in curly {} brackets.

[d)] Intercept was included in both models (not reported).

As shown in Table 3, almost all long-run coefficient estimates are significant, except $GFCF_t$ and pop. Moreover, their signs are broadly in line with the growth literature as discussed in section 2.

The negative coefficient of y_{t-1} suggests the existence of convergence in our sample, implying that Caribbean economies with a lower initial income level seem to grow at a faster pace than those with a higher initial income level. Specifically, an increase of 1% in the initial real GDP per capita seems to reduce real per capita GDP growth by 0.8% in the long run. This negative link between the initial level of GDP and economic growth coincides with the findings of Solow (1956) and Tolo (2011).

Results for the remaining independent variables suggest that in the long run, FDI_t and FB_t will contribute positively to real per capita GDP growth. Specifically, an increase of 1% in foreign direct investment in percent of GDP or in fiscal balance in percent of GDP is associated with an increase of 0.2% in real per capita GDP growth. These results corroborate earlier studies. The positive link between FDI and GDP per capita growth concurs with Makki & Somwaru (2004) and Petrakos, Arvanitidis, & Pavleas (2007), who find FDI to be a crucial determinant of economic growth. Furthermore, the positive relation between fiscal balance and economic growth per capita is supported by Tolo (2011) who states that a fiscal surplus could be an indicator for macroeconomic stability.

Looking at the short-run results in Table 4 reveals some differences with the long-run results as discussed above.

Table 4: Short-run estimates based on the restricted ECM [a) b) c)]

Dependent variable Δy_t	
Independent variable	Model [4]
Δy_{t-1}	0.47352**
	(0.20455)
ΔFDI_t	0.00122**
	(0.00057)
$\Delta GFCF_t$	0.00218***
	(0.00071)
ΔFB_t	0.00110**
	(0.00051)
Δpop_t	-0.53954*
	(0.29816)
ECT_{t-1}	-0.48532**
	(0.22211)
R-squared	0.49
Adjusted R-squared	0.40
Observations	119
F-statistic	5.08***

Source: Authors' calculations

a) ***, **, and * indicate significance at 1%, 5%, and 10% level, respectively.

b) Standard errors are shown in round brackets.

c) Intercept was included in both models (not reported).

The previous year's real per capita GDP growth (Δy_{t-1}) is a significant positive contributor to the current real per capita GDP growth in the short run. Specifically, a 1% increase in real per capita GDP growth in the previous year is associated with a 0.47% increase in real per capita GDP growth in the current year.

Contrary to the non-significant long-run results, population (Δpop_t) was a significant negative predictor of real per capita GDP growth in the short run. Particularly, a 1% increase in population growth is related to a 0.5% decrease in real per capita GDP growth. This finding is in line with other studies (Garza-Rodriguez, Andrade-Velasco, Martinez-Silva, Renteria-Rodriguez, & Vallejo-Castillo, 2016; Peters, 2001) and can be explained by small countries like those in the Caribbean having insufficient capacity in the short run to accommodate a growing population.

Similarly, the impact of gross fixed capital formation in percent of GDP ($\Delta GFCF_t$) on real per capita GDP growth is significant in the short run but not in the long run, coinciding with the findings of other studies, such as Barro (1991) and Levine and Renelt (1992). In the short run, a 1% rise in the gross fixed capital formation in percent of GDP is related to an increase of 0.002% in real per capita GDP growth. This short-run positive relation, however, shows minor economic impact.

Based on the definitions of the World Bank and CBS Curaçao, gross fixed capital formation includes land improvements; plant, machinery, & equipment purchases; and the construction of roads, dwellings, buildings, & other structures. Gross fixed capital formation could impact economic growth directly by increasing physical capital stock (Plossner, 1992) or indirectly by stimulating technological advances (Levine & Renelt, 1992). Nevertheless, these private investments do not necessarily impact GDP growth in the long-run due to short-term increases in economic activity. Take, for example, the purchase of machines & equipment; these serve their purpose for a limited period and require replacement after aging. Another example specifically for Curaçao is the large tourism-related investment projects that took place in the period 2006-2008. Particularly these investment projects caused Curaçao's real GDP to grow by more than 1% per year during that period. Unfortunately, in the years thereafter in which no significant investment projects took place, the country recorded relatively low real GDP growth rates, in some years even negative growth rates. In the period 2009-2016, the country recorded on average a real GDP growth rate of -0.3% per year.

Like the long-run results, the influence of foreign direct investment in percent of GDP (ΔFDI_t) and fiscal balance in percent of GDP (ΔFB_t) remains positive and significant in the short run, but their impact is much smaller (0.0012% and 0.0011%, respectively). These results suggest that the impact of foreign direct investment and fiscal balance could increase real per capita GDP growth in both the short and long run. These variables seem to be complementary to each other. Fiscal balance could be a proxy for fiscal discipline but also for political or macroeconomic stability as argued by Tolo (2011), because it provides a fiscal buffer that is required to respond to unanticipated macroeconomic shocks. In turn, macroeconomic stability could be viewed as the foundation for investor confidence that is required for foreign direct investments, but also gross fixed capital formation or domestic private investments to take place.

Foreign direct investments enable a company or individual to exercise control over a foreign business in which the company or individual acquired business interests. The ability of a country to attract foreign direct investments depends, among other things, on its national policies and investment climate (OECD, 2002). A key characteristic of foreign direct investments is that these typically involve resource transfers in terms of capital, technology, know-how, skills, and expertise as well as the ability to manage the innovation process and to tap into global supply chains. Due to these spillover effects as described by Makki and Somwaru (2004), foreign direct investments can affect economic growth directly in the short run, as well as in the long run. Nonetheless, given the long-run implications of the two main factors underlying economic growth (fiscal balance and foreign direct investments), it becomes clear that it takes time for them to positively impact economic growth, hence explaining the greater long-run impact compared to the short-run impact.

As expected, the Error Correction Term (ECT_{t-1}) is negative and significant, thereby confirming the presence of a long-run relationship or co-integration among the variables. The size of the ECT suggests a moderate speed of adjustment to long-run equilibrium; 49% of any disequilibrium between y and the other variables is corrected within one year.

4.4 Diagnostic tests

To check whether the unrestricted and restricted ECMs are stable and properly specified, standard diagnostic tests are performed. Table 5 reports the diagnostic test results of the estimated models.

According to the Durbin-Watson test results, no evidence is found of autocorrelation in the models and the Breusch-Pagan LM test results indicate that no heteroscedasticity is present. Furthermore, as shown by the Jarque-Bera test results, the error term proves to be normally distributed.

Table 5: Diagnostic test results [a) b)]

The null hypothesis is zero autocorrelation	
Unrestricted ECM	D-W statistic=2.06
Restricted ECM	D-W statistic=1.95
The null hypothesis is homoscedasticity	
Unrestricted ECM	Breusch-Pagan LM statistic=37.10 (0.418)
Restricted ECM	Breusch-Pagan LM statistic=37.08 (0.419)
The null hypothesis is normally distributed errors	
Unrestricted ECM	J-B statistic=1.69 (0.429)
Restricted ECM	J-B statistic=0.72 (0.698)

Source: Authors' calculations

[a)] P-values are shown in brackets.

[b)] D-W stands for Durbin-Watson, LM stands for Lagrange Multiplier, and J-B stands for Jarque-Bera.

Regarding the dynamic stability of the models, the inverse roots (see Appendix 2), within-sample fit of the models (see Appendix 3), and (accumulated) impulse responses are checked (see Appendix 4).

An impulse response function shows the response to a shock (in this case of one standard deviation) in the error term, while the accumulated impulse response function indicates the accumulated sum of the impulse responses (Lau Chi-Keung, To Kin-Man, and Zhang Zhi, 2008). As all roots lie inside the unit circle and the (accumulated) impulse responses converge to (their long-run value) zero, the estimated models seem to be dynamically stable or stationary. Given that the models passed all diagnostic tests, the models appear to be stable and validated.

5. Conclusion

Academic literature on long-run economic growth theory distinguishes between two growth models: (1) the neoclassical growth model and (2) the endogenous growth model. This paper focuses on the endogenous model, while testing the existence of the convergence hypothesis of the neoclassical model. The sample covers nine Caribbean countries for the period 2002-2016. The ARDL technique to co-integration and the ECM to account for short and long-run dynamics are used, where two models are developed for comparison purposes. The following potential growth determinants are selected in our models: (1) the initial income level, (2) population growth, (3) foreign direct investment, (4) fiscal balance, and (5) gross fixed capital formation.

The long-run empirical results confirm the convergence theory by showing a negative relationship between the initial level of per capita GDP and real per capita GDP growth. Furthermore, the factors foreign direct investment and fiscal balance are significantly and positively related to real per capita GDP growth in the long run. In the short run, the impact of foreign direct investment and the fiscal balance remains positive and significant, while that of population growth is significant but negative. The influence of gross fixed capital formation also becomes significant and is positively associated with real per capita GDP growth. These findings broadly coincide with other studies performed in both small and large economies.

Fiscal balance could be a proxy for fiscal discipline and macroeconomic stability as mentioned by Tolo (2011), which is a key foundation for investments—foreign direct investments and domestic private investments (estimated by the gross fixed capital formation)—to take place. Given the positive spillover effects of foreign direct investments as argued by Makki and Somwaru (2004), these can impact economic growth directly and in the long run.

The above discussion has several implications. First, to promote long-run economic growth, it is recommended that Caribbean countries, including Curaçao, maintain fiscal discipline and improve their investment climate to attract foreign direct investment. In addition, the negative relation between population growth and short-run GDP growth may be related to the fact that the countries included in our sample are tourism dependent. While the tourism sector is a common focus of small Caribbean countries, it should be noted that average income in this sector is relatively low. Therefore, it is well advised to attract high-end tourists as these visitors spend considerably more during their stay, thereby generating more foreign exchange revenues. Furthermore, if the countries can achieve population growth through attracting people with new/advanced knowledge and skills, it may benefit their overall economic progress[10] in the medium to long run. It would be interesting for future research to investigate the latter further.

[10] Economic progress covers aspects, such as human capital development, that are not included in the GDP measure of the current study (see e.g., Costanza, Hart, Posner, & Talberth, 2009 and Henriquez, 2019, for further details).

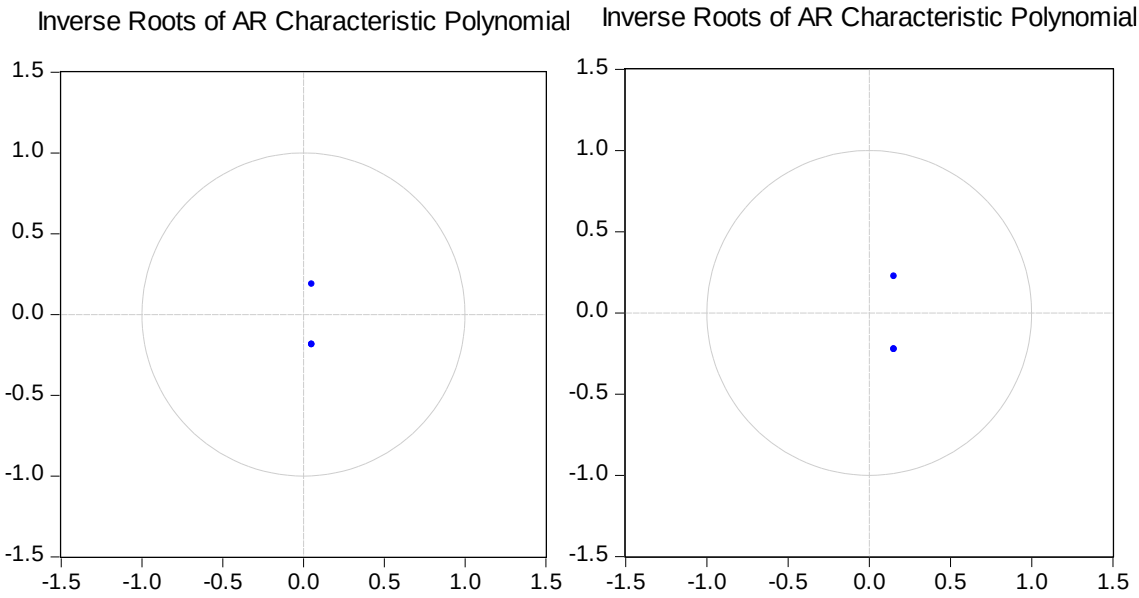
Appendices

Appendix 1: Table CI (iii) Case III: unrestricted intercept and no trend

k	0.100		0.050		0.025		0.010		Mean		Variance	
	I (0)	*I* (1)	*I* (0)	*I* (1)	*I* (0)	*I* (1)	*I* (0)	*I* (1)	*I* (0)	*I* (1)	*I* (0)	*I* (1)
0	6.58	6.58	8.21	8.21	9.80	9.80	11.79	11.79	3.05	3.05	7.07	7.07
1	4.04	4.78	4.94	5.73	5.77	6.68	6.84	7.84	2.03	2.52	2.28	2.89
2	3.17	4.14	3.79	4.85	4.41	5.52	5.15	6.36	1.69	2.35	1.23	1.77
3	2.72	3.77	3.23	4.35	3.69	4.89	4.29	5.61	1.51	2.26	0.82	1.27
4	2.45	3.52	2.86	4.01	3.25	4.49	3.74	5.06	1.41	2.21	0.60	0.98
5	2.26	3.35	2.62	3.79	2.96	4.18	3.41	4.68	1.34	2.17	0.48	0.79
6	2.12	3.23	2.45	3.61	2.75	3.99	3.15	4.43	1.29	2.14	0.39	0.66
7	2.03	3.13	2.32	3.50	2.60	3.84	2.96	4.26	1.26	2.13	0.33	0.58
8	1.95	3.06	2.22	3.39	2.48	3.70	2.79	4.10	1.23	2.12	0.29	0.51
9	1.88	2.99	2.14	3.30	2.37	3.60	2.65	3.97	1.21	2.10	0.25	0.45
10	1.83	2.94	2.06	3.24	2.28	3.50	2.54	3.86	1.19	2.09	0.23	0.41

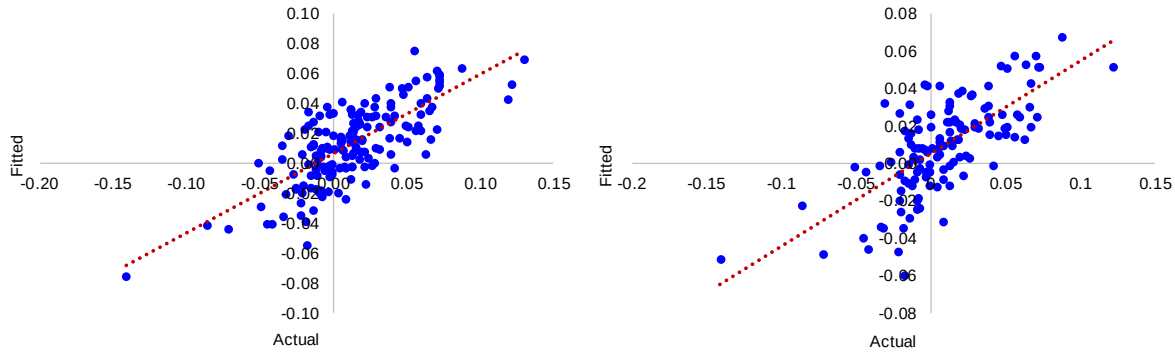
Source: Pesaran et al. (2001), page 300

Appendix 2: Roots of the associated characteristic equation of the unrestricted (left) and restricted (right) ECMs



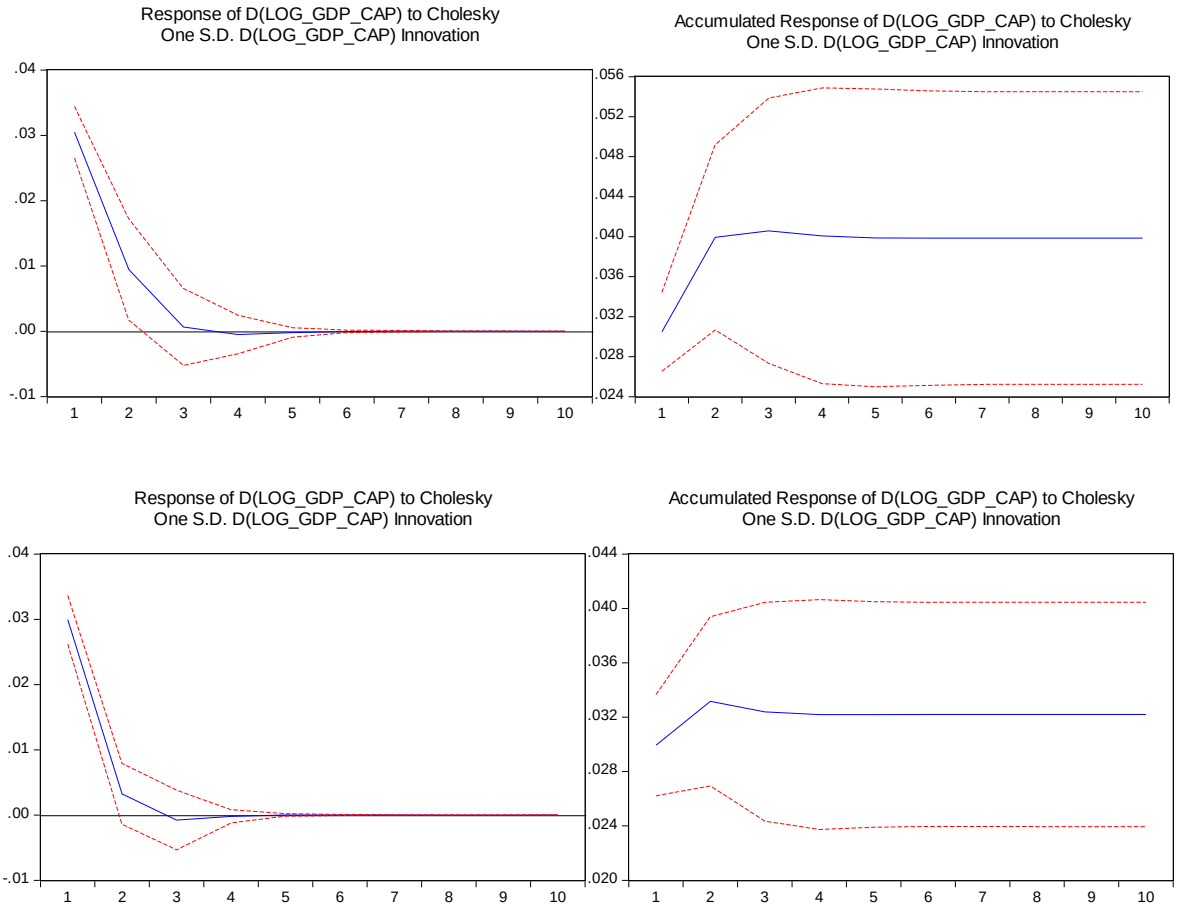
Source: Authors' calculations

Appendix 3: Within-sample fit of the unrestricted (left) and restricted (right) ECMs



Source: Authors' calculations

Appendix 4: Impulse responses (left) and accumulated impulse responses (right) of the unrestricted ECMs and the restricted ECMs



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