



Amity Journal of Economics

3 (2), (32-50)

©2018 ADMAA

Binding Constraints, Growth Model and Economic Growth: A Case Study of Barbados

Nlandu Mamingi

The University of the West Indies, Cave Hill, Barbados

Nkenge Lawrence

The University of the West Indies, St. Augustine, Trinidad & Tobago

Jason LaCorbinière

United Nations Development Programme, Barbados

Darrin Downes

Central Bank of Barbados, Bridgetown, Barbados

Abstract

In the wake of the 2008/2009 global economic crisis, small open economies including Barbados, faced significant challenges, particularly a considerable slowdown in economic activity. During the years 2008-13, Barbados recorded consecutive years of low or no growth in real GDP, which were accompanied by increasing fiscal deficits and debts. This situation requires critical assessment, with an appropriate strategy to address head-on the critical constraints to economic growth. The present paper utilises a growth diagnostics framework and the results of the 2010 World Bank Enterprise Surveys (WBES) to empirically determine the binding constraints to economic growth of Barbados. In addition, the autoregressive distributed lag (ARDL) approach to cointegration is applied to data spanning the period 1980-2012 with a view to examining whether the binding constraints identified in the WBES are validated in the more formal model of endogenous growth. The results of the growth diagnostics exercise indicate: (i) access to finance, (ii) tax rates, (iii) the cost of telecommunications, (iv) the cost of electricity, and (v) an inadequately educated workforce are the major binding constraints to economic growth in Barbados. Furthermore, the results of the ARDL model confirm the first four major binding constraints of the growth diagnostics exercise. These results have policy implications.

Keywords: Growth Diagnostics, Binding Constraints, Endogenous Growth Model, Autoregressive Distributed Lag Model, Barbados

JEL Classification: C22, O54, O40

Paper Classification: Research Paper

Introduction

The literature on economic growth and development includes various schools of thought ranging from the Classical school to the more recent Growth Diagnostics Approach via the Endogenous Growth School. The endogenous growth theory posits essentially that growth is driven by endogenous factors rather than external ones. In particular, it emphasises the endogeneity of population, the preeminence of the human capital element in capital accumulation, and the greater role for innovation. The growth diagnostics framework initiated by Hausmann *et al.* (2005) is a new approach to economic growth. It is a member of the family of endogenous growth models but provides a different perspective to measuring economic growth. The approach adopts a case study methodology where the focus of the study is on a single country with its binding constraints to economic growth.

With respect to the Caribbean economies, Lewis (1950), Best (1968) and Craigwell (2010) emphasized the importance of implementing approaches to growth and development that are appropriate to the circumstances of small, open economies. Craigwell (2010) endorsed the application of the growth diagnostics methodology and growth accounting framework to study the factors that may influence economic growth in the Caribbean. Downes (2002) examined the key drivers of Barbados' economic growth in the period 1960-2000, finding six explanatory factors, ranging from a favourable international environment to migrant labour, and inflows of foreign investment to the good quality of institutions. Mamingi and Perch (2013) investigated the relationship between population growth and economic growth/development in Barbados in the period 1980-2010. Using an autoregressive distributed lag approach to cointegration in the context of an endogenous growth type of model, they found among others that (i) population growth and its population density each positively and significantly affects economic growth in a positive way, and (ii) economic growth negatively and significantly impacts population growth in a negative manner. Sosa and Cashin (2009) exploited country-specific VAR models with block exogeneity restrictions to examine the drivers of economic fluctuations in the Eastern Caribbean. Here, external shocks including foreign and climatic (natural disasters) account for more than half of fluctuations. Acevedo (2014), using a Panel-VAR framework to study the impacts of natural disasters (hurricanes and storms) on twelve Caribbean countries during the last forty years, found negative effects of natural disasters on economic growth as well as debts. Grenade (2012) found major binding constraints to economic growth in Grenada of poor quality of human capital, high cost of business operations, and low self-discovery. Hausmann and Klinger (2007) used the binding constraints diagnostics framework for Belize and uncovered the following constraints to growth: limited access to finance, cuts in public investment and little access to international finance. Artana *et al.* (2007) applied the growth diagnostics methodology to Trinidad and Tobago and found significant constraining factors to be the underdevelopment of the non-energy tradable sector, a lack of economic diversification, poor infrastructure and rising crime. Kida (2005), studying the growth performance of the Caribbean Small States in the period 1978-2004, indicated that "lack of fiscal discipline, large external public debts, and inappropriate environment for private sector led growth" were impediments to productivity and competitiveness.

The aim of this paper based on Lawrence (2014) and Mamingi *et al.* (2014) is twofold. First, the growth diagnostics methodology is applied to Barbadian data over the period 1980-2012 in order to document and analyse the main constraints to private investment in Barbados, which ultimately impact economic growth. Second, these constraining factors are tested in an endogenous growth model, using the autoregressive distributed lag (ARDL) approach to cointegration. More specifically, the two objectives put together mean that the paper is about identifying and testing for binding constraints to economic growth in Barbados over the sample period.

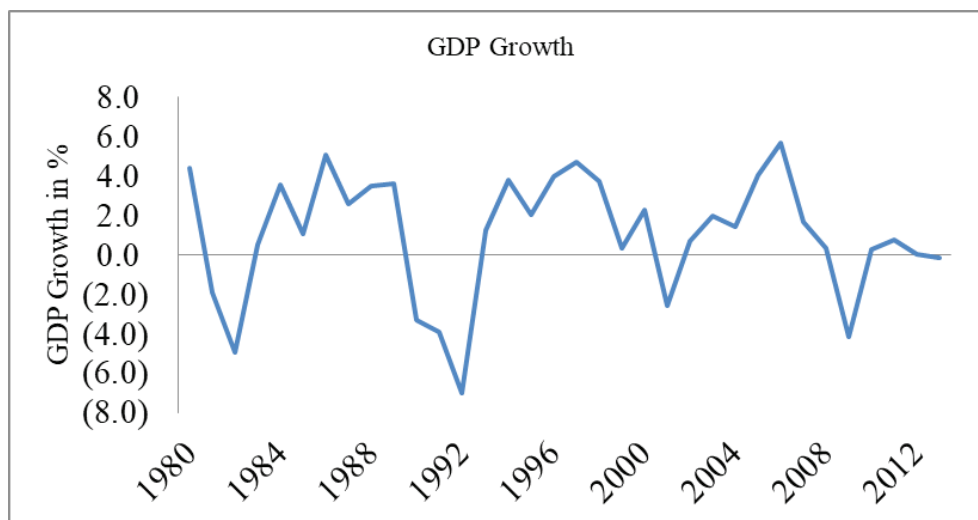
This paper makes two empirical contributions to the literature. First, this is a premiere that applies the growth diagnostics methodology to Barbados. Given that each country is unique, having a study conducted for Barbados is useful for Barbados, particularly at the time where its economic resumption is dearly sought. Second, contrary to many papers of this kind, this paper not only reveals and analyses the binding constraints, but also uses an empirical approach to validate whether or not the binding constraints identified from the surveys are indeed barriers to economic growth.

Barbados: Economic Growth Evolution

Barbados is an independent island country in the Caribbean. Despite its small size, Barbados has consistently been ranked highest among Latin American and Caribbean countries in the Human Development Index (HDI) for the period, 1980-2012. In 2012, Barbados' HDI was 0.825 with a recorded Gross National Income (GNI) per capita (on a purchasing power parity basis, PPP) of \$17,308. The country was ranked amongst the very high human development category positioning at number 38 out of 186 countries.

In this section, the evolution of economic growth in Barbados over the period 1980-2012 is examined as Figure 1 indicates GDP growth in Barbados can be characterized by a number of peaks and troughs. Starting at 4.7% in 1980, GDP declined severely to -5.2% in just a two year period. The fluctuations continued with a growth spurt to 9.4% in 1986 and then another large decline in 1990 to -4.8%. GDP growth peaked to 6.4% in 1997 but has not been as high since falling to 5.7% in 2006. In 2009 on the heels of the global economic crisis, Barbados experienced more declines in GDP growth, reaching a low of -4.1%. Average growth in GDP has since flat-lined to -0.5%, as the economy continues to be challenged by a lack of economic growth stimulation.

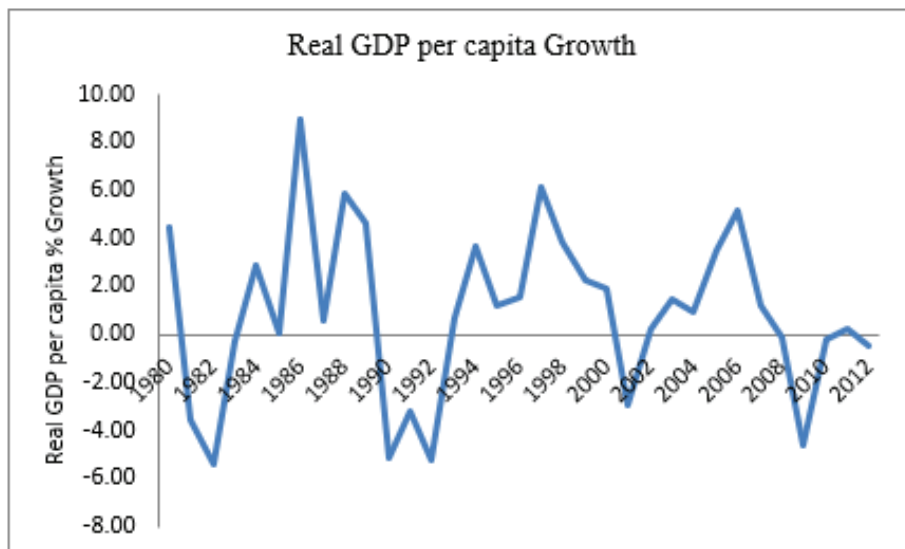
Figure 1: GDP Growth in Barbados, 1980-2012



Source: World Bank (2014b)

Figure 2 shows the evolution of real GDP per capita growth in Barbados mimics the real GDP growth pattern. The few instances of discrepancy between real GDP growth rates and real GDP per capita growth indicates very minor increases in population growth over the sample period. Population on averaged increased by 0.4% annually. During the 1980-1985 period, the tourism and manufacturing sectors of Barbados recorded decline that contributed to economic contraction. In turn, economic growth was also negatively affected in general by decline in export earnings from sugar since the United States trimmed down its quota on sugar from the country (Downes, 2002). The 1990s was also characterized by low levels of real GDP growth and real GDP per capita growth. During this decade, Barbados was forced to request financial assistance from the International Monetary Fund and the World Bank. This action led to a large balance of payments deficits which was accompanied by structural adjustment programs that intended to stimulate aggregate supply and control aggregate demand (Downes, 2002).

Figure 2: Real GDP per capita Growth in Barbados, 1980-2012



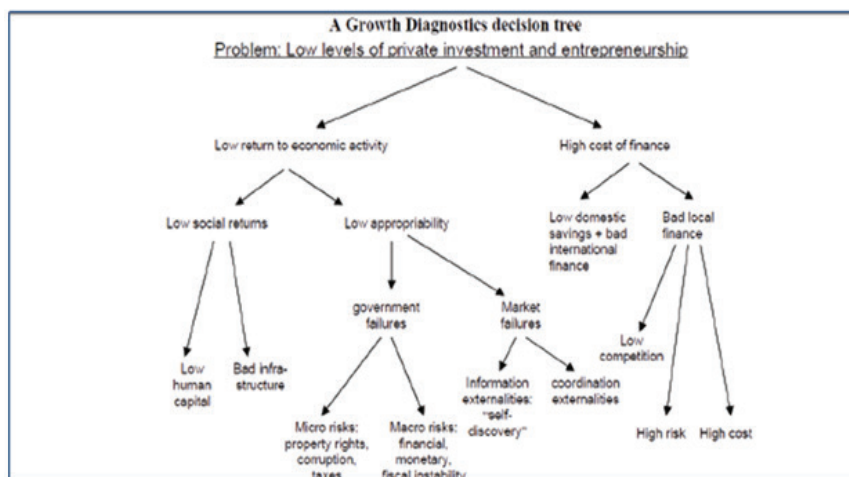
Source: World Bank (2014b)

Modeling Economic Growth in Barbados

Growth Diagnostics Methodology (GDM)

The GDM methodology is based on the premise that higher levels of private investment and incentives to entrepreneurship lead to the stimulation of economic growth. In addition, although there may be many reasons that hinder economic growth, each reason creates a distinctive set of symptoms (Hausmann *et al.*, 2008). The GDM is a top down approach that starts the diagnosis by attempting to address the factors that keep private investment and by extension, economic growth low. Hausmann *et al.* (2008) organised specific policy questions about the potential obstacles to economic growth in a growth diagnostics decision tree (see Fig.3). Each node of the decision tree represents a possible binding constraint to growth and the process of moving down the tree is important for analyzing each limitation and assessing whether or not it can be eliminated in the specific country's context.

Figure 3: A Growth Diagnostics Decision Tree



Source: Hausmann et al. (2008, Fig. 2)

The main benefit of this methodology is that the key constraints to economic growth in Barbados will be identified so that specific policy recommendations useful for the most important reforms to economic growth, can be made.

The World Bank Enterprise Surveys (WBES) were utilized for this exercise. Data were gathered from the most pertinent manufacturing and service sectors of every region of the world to identify the particular factors and to what extent changes in these factors affect the business environment, firm-level productivity and ultimately economic growth using the panel data. The Surveys used standardized survey instruments and a uniform sampling methodology to measurement error and yield data that are comparable across regions (WBES, 2009).

The methodology used to carry out the survey aims to: (i) provide statistically significant investment climate indicators that are comparable across countries, (ii) assess the constraints to private sector growth and job creation and (iii) stimulate dialogue on reform opportunities. To achieve the objectives of the sample methodology, a segment that is representative of the entire non-agricultural private economy in addition to the manufacturing sector is generated and large enough sample sizes are generated for selected industries in order to conduct statistically robust analyses with levels of precision at a minimum 7.5% precision for 90% confidence intervals about (i) estimates of population proportions at the industry level and (ii) estimates of the mean log of sales at the industry level (WBES, 2009).

The population of industries included in the WBES comprises the following categories: the manufacturing sector, construction, services, transport, storage and communications. The surveys were limited to establishments with at least five employees and government owned firms were excluded from the population. The survey was stratified following three criteria: sector of activity, firm size and the geographical location. Firms were stratified according to size where small firms range from (5-19) employees, medium firms (20-99) and large firms (100 or more employees). Stratification by sector of activity depends on the size of the economy which is defined by the country's Gross National Income (GNI) (WBES, 2009). Barbados' economy is defined as very small since its GNI (in 2008) was less than \$15 billion (World Bank, 2014c). The survey for very

small economies such as Barbados is stratified into 2 groups: manufacturing and the rest of the economy and 75 interviews are allocated to each group. Such stratification in the WBES allows an acceptable level of precision for all estimates.

The WBES acknowledges the fact that in many cases the data are representative of those firms willing to participate in the survey and in order to tackle the problem of self-selection, unwilling participants are substituted with willing participants. The non-response rate is measured as a percentage of the total population, so as to accurately distinguish this group from those firms with unknown locations or firms that have been dissolved (World Bank, 2014a). The survey's construction facilitates the re-interviewing of the panel of firms at regular, periodical intervals of time. A survey is conducted every 3-4 years for each region, which provides results that are frequently updated and more precise for analytical purposes in future periods. To achieve this goal, all participating firms are urged to submit detailed contact information which is held confidentially by the World Bank or an approved third party.

Autoregressive Distributed Lag Model (ARDL)

A model that captures factors driving real GDP per capita in the context of an endogenous growth model, including the constraints identified in the growth diagnostics is exercised. The model which possibly represents the long-run relationship among level variables, is specified as follows:

$$\begin{aligned} \text{LRGDPPC}_t = & \beta_1 \text{LPOPSIZE}_t + \beta_2 \text{TE}_t + \beta_3 \text{LTOTEMPL}_t + \beta_4 \text{WGDP}_t \\ & + \beta_5 \text{TAXREV}_t + \beta_6 \text{FL}_t + \beta_7 \text{IR}_t + \beta_8 \text{NATDIS}_t + e_t \end{aligned} \quad (1)$$

where $t = 1, 2, 3, \dots, T$ stands for time index, LRGDPPC_t is the log of real GDP per capita in 2005 BDS\$, LPOPSIZE_t is the log of population size, TE_t is the expenditure share of telecommunications to GDP in %, LTOTEMPL_t is the log of total employed, WGDP_t is the world real GDP per capita growth rate in %, TAXREV_t is total tax revenue as a share of GDP in %, FL_t is fuel and light index as a sub-component of the retail price index (RPI) yearly change using 2001 as the base year, IR_t is the real interest rate, and NATDIS_t is a dummy variable representing the occurrence of natural disasters, more specifically storms or hurricanes that had an adverse effect on the Barbadian economy, and e_t represents the error term.

A constant term and possibly a trend can be added to equation 1. Due to several reasons, ranging from data availability to finding the right proxies, some valid variables were not incorporated in equation 1. That said, at the outset, the expected signs of the variables are given. Population size is expected to have an ambiguous sign, since the literature identifies three main divergent views concerning the impact of population size on economic growth, namely the optimistic, pessimistic or neutral views (Mamingi & Perch, 2013). Total tax revenues as a percentage of GDP are expected to be negatively related to growth, since over one-half of the surveyed firms found that tax rates were prohibitively high and were a constraint to private sector investment. The variables total persons employed and world real GDP per capita growth are both expected to have positive long-run impacts on growth. The impact of global economic recessions such as the 2008 recession is absolutely negative to economic growth in countries such as Barbados because of its dependence on FDI, tourist arrivals, and service exports. The fuel and light index sub-component of the retail price index (RPI) is likely to impact negatively on growth, given almost 60% of the firms surveyed indicated that the cost of electricity and energy was a

limiting factor of private investment. Telecommunications costs may inhibit the growth, which indicates an expected negative effect on growth. Furthermore, with over one-half of surveyed firms indicated that access to finance was a major obstacle to private investment, interest rates are anticipated to negatively impact growth in the long run. Finally, natural disasters are expected to be a drag on the economy.

An autoregressive distributed lag model or precisely an error correction model (ECM) corresponding to equation 1 is of the following type:

$$\Delta y_t = c + \pi_y y_{t-1} + \pi_{yww} W_{t-1} + \sum_{i=1}^{p-1} \beta_i \Delta z_{t-1} + \delta' \Delta W_t + u_t \quad (2)$$

where $y_{t-1} = LRGDPPC_{t-1}$, $\Delta y_t = y_t - y_{t-1}$ is the dependent variable at time t , c is the constant term, W_t is the matrix of explanatory variables as depicted in equation 1, Z_t is (y_t, W_t) , Δ represents the first difference operator, δ' are parameters, k is the number of variables in W_t , and u_t is the error term.

The application of the autoregressive distributed lag approach (ARDL) to cointegration pioneered by Pesaran *et al.* (2001) in the context of an endogenous model most suitably fulfills the purpose of this study. The ARDL offers three important advantages that significantly impact estimation of long-run impacts. Firstly, the main assumption of the ARDL bounds testing procedure is that all variables are endogenous. Secondly, the approach differs from most cointegration techniques because the ARDL model can be applied to regressors that are purely $I(1)$, purely $I(0)$, or mutually cointegrated. Finally, even if the sample size is small, the approach is suitable for cointegration analysis.

Implementing the ARDL bounds testing procedure requires in the first instance estimating an unrestricted error correction model version of equation 1 by OLS. Here the Stepwise Regression is used since it is more efficient in removing those insignificant, lagged short-run variables automatically from the model. This unrestricted error correction model (ECM) suggested by Pesaran *et al.* (2001) adheres to the fundamental principles of the Johansen five error correction multi-variance VAR (see Pesaran *et al.*, 2001; Boamah *et al.*, 2011; Mamingi and Borda, 2015). Here only ECM has been presented. It happens to be equation 2.

In order to test for the existence of a level relationship between y_t and V_t in equation 2, the bounds procedure resorts to the use of the F -test (or Wald test) on the joint null hypothesis that the coefficients of the level variables are jointly zero. According to the theory, the null hypotheses (H_0) are defined as $\pi_y = 0$ and $\pi_{yww} = 0$, and the alternative hypotheses (H_1) are $\pi_y \neq 0$ and $\pi_{yww} \neq 0$. It is crucial to note that the F -statistic referred to in this approach does not follow a standard distribution, therefore the critical values of the regular F -distribution do not apply and the use is made of the two asymptotic critical bounds which were derived from Pesaran *et al.* (2001). These bounds cover the three main categories of the variables that can be estimated using this model: all are $I(0)$, all are $I(1)$ or all the variables are mutually cointegrated. The lower value bounds include those variables that are purely $I(0)$ and the upper value bounds assume that all variables are $I(1)$. A calculated F -statistic that is larger than its corresponding upper value bounds suggests that a long-run relationship between or among variables is present; this allows to conclude that there is cointegration. On the other hand, if the computed F -statistic is smaller than the lower bound, then the null hypothesis of no-cointegration cannot be rejected. Finally, if the F -statistic value falls between the range of both the lower and upper bounds, then the inference about the existence of

cointegration is inconclusive. Pesaran *et al.* (2001) also pointed to the observed t -statistic of the adjustment coefficient to reinforce the conclusion made about cointegration. Again the t -statistic follows a non-standard t distribution. Therefore, if $\pi_y = 0$ and $\pi_{yww} = 0$ are rejected then test $\pi_y = 0$ against $\pi_y < 0$. When testing for the latter hypothesis, the t -statistic must be negative and greater in absolute value than the upper value bound to validate cointegration, see Pesaran *et al.* (2001) for a complete list of the critical values. The presence of cointegration means that the long-run relationship among variables and corresponding error correction model can be estimated.

Note that beside short-run impacts, long-run impacts are also present in the *ECM*. Indeed, in equation 2 π_y is the adjustment coefficient and π_{yww} contains the long-run impact. Precisely, the long-run impact is $LR_{yww} = \pi_{yww} / -\pi_y$ (Mamingi and Borda, 2015, 81). Now equation 2 can be restructured as follows to account for short and long-run parameters:

$$\Delta y_t = c + \pi_y (y_{t-1} - R_{yww} W_{t-1}) + \sum_{i=1}^{p-1} \beta_i \Delta z_{t-1} + \delta' \Delta W_t + u_t \quad (3)$$

where the first relationship in parentheses represents the long-run relationship between Equation 3 is thus another representation of equation 2.

Data

This study utilises annual time series data spanning the period 1980 to 2012, which were collected from the World Bank Development Indicators Database, United Nations Database, Central Bank of Barbados Online Statistics and Annual Statistical Reports, Barbados Statistical Services, and the International Disaster Database. The variables have been defined and justified in the previous section. In addition, as underlined above, the data for the growth diagnostics exercise were procured from the WBES (2010).

Concerning time series data, it is important to know the stationarity properties of all the variables. Using the Augmented Dickey Fuller (*ADF*) test it was concluded that the following variables were integrated of order zero, $I(0)$, at the 10% level of significance: *TE*, *WGDP*, *FL*, *IR* and *NATDIS*. On the contrary, the following variables were found $I(1)$: *LRGDPPC*, *TAXREV*, and *LTOTEMPL*. The log of total population size is inconclusive.

Results and Interpretations

Growth Diagnostics Exercise

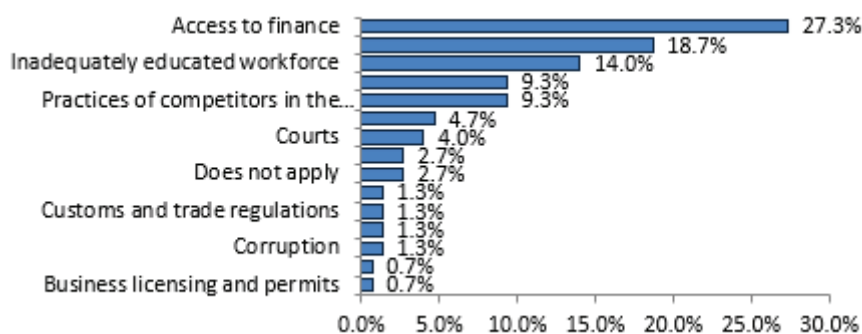
Table 1 presents the major constraints that were identified from the WBES. Survey respondents were asked to classify each factor based on the extent to which it was a concern for their business. All instances in which respondents noted that factors were not issues or only minor obstacles were excluded and only those considered at least to be moderate obstacles were included. Responses of moderate, major and very severe were then aggregated and expressed as a percentage of the total sample of 150 firms. A threshold of 50 percent was used to categorise whether, in general, respondents considered a specific factor to be at least a major obstacle. The results suggest that of the fifteen factors identified, five were considered by more than half of the sample group to be at least moderate obstacles. These were electricity, access to finance, inadequately educated workforce, tax rates and telecommunications.

Table 1: All Binding Constraints to Economic Growth in Barbados

Factor	Moderate obstacle	Major Obstacle	Very severe obstacle	Total	Percentage
Electricity	22	37	28	87	58.0%
Access To Finance	27	39	20	86	57.3%
Inadequately Educated Workforce	42	35	8	85	56.7%
Tax Rates	47	26	9	82	54.7%
Telecommunications	37	24	16	77	51.3%
Customs And Trade Regulations	32	26	6	64	42.7%
Transport	26	20	10	56	37.3%
Practices of comp.in informal sector	28	17	10	55	36.7%
Tax Administrations	34	10	4	48	32.0%
Crime, Theft And Disorder	37	1	2	40	26.7%
Labor Regulations	25	8	3	36	24.0%
Corruption	18	12	2	32	21.3%
Political Instability	22	10		32	21.3%
Business Licensing And Permits	25	1	1	27	18.0%
Courts	12	11	2	25	16.7%

Source: WBES (2010).

Note: Numbers apart from percentage represent individuals. Comp.=competitors

Figure 4: Major Binding Constraints in Barbados Ranked by Sample Firms

Source: WEBS (2010)

Figure 4 illustrates the results obtained from the 150 surveyed firms when asked to rank the biggest obstacles to business activity. The results support the findings depicted in Table 1, which identifies access to finance, electricity, and workforce education as the chief constraints.

Access to Finance

In-depth look at the findings of the survey reveal that 19% of the respondents in the manufacturing industry found that access to finance is a moderate obstacle, while 30% found it a major challenge and 9% believed it is very severe obstacle. In the services industry, 17% of

the firms stated that access to finance is a moderate problem, 22% deemed it a major challenge and 18% of the firms opined that it is very severe obstacle. Of the entire sample a total of 57.3% answered that access to finance was at least a barrier to growth. When asked to rank the biggest binding constraints to growth in order of priority, access to finance ranked at number 1 since 27.3% of all firms chose this challenge as having the most significant impact on business activity. From the results of the survey it was concluded that access to finance is indeed a major binding in the Barbados private sector. The data reveals that 1.33% of firms received credit or loans from non-bank financial institutions (which include micro-finance), 48.66% of all firms received funding from private commercial banks and 3.33% were financed by government agencies. According to the survey, 22.66% of all the firms faced collateral that ranges from \$40,000 to \$30,000,000 for the two industries. When asked to answer why the firms have not applied for new loans or lines of credit, only 7.33% of the total sample expressed that the collateral requirements for loans are too high and 4% said that the interest rates are not very favorable, while 56% of all firms stated that their establishment had sufficient capital and did not need any financing. These percentages are shocking since access to finance ranked as the biggest binding constraints to all firms. Therefore, it will be useful to investigate what else drives financial credit in Barbados.

Electricity

A breakdown of the two broad sectors covered in the survey show that in the manufacturing sector 20% of the firms cited electricity to be a moderate challenge while 17% voiced that it is a major obstacle and a very severe obstacle, respectively. In the services industry, 10% of the respondents stated that electricity is a constraint while 32% expressed that it is a major challenge and 20% revealed that it is very severe obstacle. Of the 150 firms spanning the 2 major sectors 58.0% indicated that electricity is at least a moderate obstacle to growth and when the aggregate sample was asked to rank the obstacles in order of significance, 18.7% of all the firms ranked electricity as the second biggest binding constraint to growth. Concerning power outages, 57.3% of all firms indicated that in the last fiscal year there were several power outages which resulted in losses ranging from \$4,000 to \$20,000 for 6 firms of both industries and as much as \$1,000,000 for 1 of the firms in the manufacturing industry. All in all the cost and quality of electricity pose a challenge to the operations of these firms.

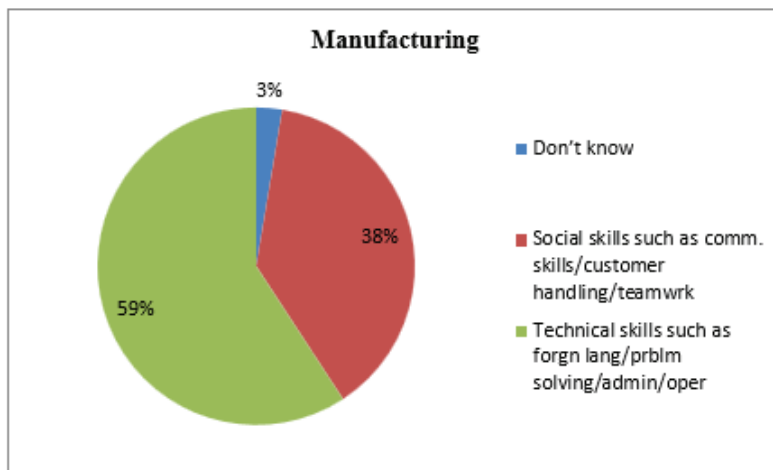
Inadequately Educated Work-Force

A closer view of the results indicate that an inadequately educated workforce is one of the significant binding constraints to growth in Barbados. In fact, although mean schooling years and literacy rates are relatively high in Barbados, the quality of education which is not captured in the data may indicate why an inadequately educated work-force is a binding constraint. When all the firms were asked to categorize the most binding constraints in order of impact, 14.0% of the respondents ranked this variable third out of the 5 major binding constraints identified. Of the entire sample, 56.7% of the firms in both industries expressed that an inadequately educated workforce poses at least a moderate challenge to business. Further decomposition of the data shows that in the manufacturing sector, 26% of the firms said that this is a moderate obstacle, 21% expressed that it is a major obstacle and 7% saw it as a very severe obstacle. In the services sector, 30% said it is a moderate obstacle, 26% deemed it a major challenge and 4% claimed it is a very severe challenge. The data show which human knowledge and skills are the most difficult to find when hiring in the services and manufacturing industry and the demand for the most important skills varies as per what the firms in each industry specialize in. Figures 5 and 6 illustrate this point; however, the WBES did not provide a list of all the firms that were included in the two broad industries. Thus, were unable to match the required skills with a specific business type.

Tax Rates

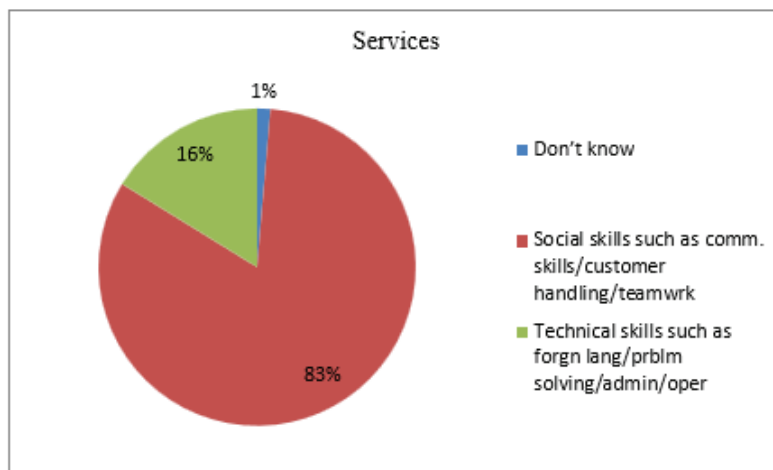
Based on the responses of the survey, 54.7% of the total firms viewed tax rates as at least a moderate binding constraint; however, this challenge ranked as the tenth biggest obstacle to business operations since only 1.3% of the all firms chose tax rates as the most significant barrier to growth. A breakdown of the data, however, shows that for each industry tax rates may be an important factor to operations. For manufacturing, 22% of the firms responded that tax rates are a moderate challenge, 17% said it is a major obstacle, and only 7% thought that tax rates pose a very severe threat to business activity. In the services sector, 40% of the respondents said that tax rates are a moderate obstacle, 18% revealed that it is a major obstacle while only 5% voiced that it is a very severe obstacle.

Figure 5: Most Difficult Skills to Find when Hiring in the Manufacturing Industry



Source: WBES (2010). Note: forgn lang= foreign language; prblm=problem

Figure 6: Most Difficult Skills to Find when Hiring in the Services Industry



Source: WEBS (2010). Note: see Figure 5

Telecommunications

The responses from the survey reveal that 51.3% of all the participating firms confirmed that telecommunications are at least a moderate binding constraint. A further breakdown of the results indicates that in the manufacturing sector, 25% of the firms expressed that telecommunications pose a moderate constraint to operations, 14% said that they are major obstacles to operations and only 7% opined that they pose a very severe obstacle to business activities. For the services sector, 24% claimed they are a moderate obstacle, 18% stated they are a major obstacle and 15% revealed that they are a very severe challenge to business operations.

The analysis of the data gathered from the survey led us to select five constraints deemed to pose the biggest challenge to private business and thus economic growth. Here, are mentioned some of the other issues that firms identified as minor obstacles or not the most pressing binding constraints. That is, these constraints did not pass the 50% threshold of firms identifying that they are at least a moderate obstacle and they are also not ranked as the most pressing binding constraints. The data illustrates that transport was chosen by 37.3% of all the respondents as an obstacle. In fact, 9.3% of the firms indicated transport as the fourth major constraint to business operations. Practices of competitors in the informal sector were chosen by 9.3% of the total population as the fifth biggest obstacle to business. Of the total sample, 24.0% viewed that labour regulations cause a strain on growth, but, 4.7% of all the firms agreed that it is the sixth most binding constraint. Courts and tax administration did not seem to pose major threat to private business operations since only 4.0% and 2.7% of the sample ranked these variables as the seventh and eighth biggest binding constraint. The data shows that 42.7% of the total sample expressed that customs and trade regulations pose a challenge and they were ranked by 1.3% of all firms as the eleventh most serious binding constraint. Crime, theft, and disorder were chosen by 26.7% of all the respondents as a challenge but was ranked as the twelfth biggest constraint by 1.3% of all the firms, this is not an unexpected result since there is little criminal activity per capita in Barbados. With a relatively stable political environment in Barbados, it is not surprising that corruption and political instability ranked thirteenth and fourteenth, respectively, as binding constraints. Finally, the rank of fifteen, business licenses and permits were only chosen by an almost negligible 0.7% of all the respondents as a serious obstacle, which indicates a high degree of efficiency in the process, cost and time spent obtaining licenses and permits.

Hausmann pointed out that binding constraints to private business are quite influential to economic growth and thus the survey aimed to uncover these specific challenges in Barbados. Based on the data collected from the survey, it was determined that the most influential binding constraints to growth in Barbados are cost of and access to finance, cost and quality of electricity, an inadequately educated work-force, telecommunications and tax rates. The task now is to estimate an economic growth for Barbados, using appropriate proxies that incorporate these results in the growth model. This would allow extraction of useful policy implications that address these obstacles directly so that useful policy reform is targeted to these specific obstacles to growth.

Autoregressive Distributed Lag Model Results

This subsection deals with the results of the error correction model obtained from the *ARDL* approach to cointegration. Table 2 provides all the critical values of interest of the bounded *F*-tests and *t*-tests as developed by Pesaran *et al.* (2001). These values are relevant to make inferences about cointegration among the level variables in the context of equations 2 and 3.

Table 2: F and t statistics value bounds for testing the existence of a level growth equation

k	10% level of significance				5% level of significance			
	F(l)	F(u)	t(l)	t(u)	F(l)	F(u)	t(l)	t(u)
3	2.72	3.77	-2.57	-3.46	3.23	4.35	-2.86	-3.87
4	2.45	3.52	-2.57	-3.66	2.86	4.01	-2.86	-3.99
5	2.26	3.35	-2.57	-3.86	2.62	3.79	-2.86	-4.19
6	2.12	3.23	-2.57	-4.04	2.45	3.61	-2.86	-4.38
7	2.03	3.13	-2.57	-4.23	2.32	3.50	-2.86	-4.57
8	1.95	3.06	-2.52	-4.40	2.14	3.30	-2.86	-4.72

Source: Pesaran et al. (2001), Table CI(iii) case III and Table CII(ii).

Note: F is the F -statistic for testing $\pi_{\mathbf{y}} = 0$ and $\pi_{y_{ww}} = 0$ and t is the t -statistic for testing $\pi_{\mathbf{y}} = 0$ in equation 2. (l) Indicates the lower limit and (u) the upper limit. k =number of explanatory level variables.

Table 3 illustrates the results of the Stepwise Regression that was conducted in the context of the ARDL model (see equation 2). A stopping criterion p -value of 0.35 was selected for the Stepwise Regression so that all variables that do not meet this threshold are automatically eliminated from the estimation. This threshold was chosen because a relatively large p -value is required when moving from the general to specific form of the model.

Before interpreting the results per se, it is worth pointing out model 2 passes the basic specification and diagnostic checking tests. Indeed, the CUSUM test for the stability of estimates based on recursive residuals (the figure is available upon request) indicates that at the 5% level of significance the model is stable. The Breusch-Godfrey serial correlation test reveals that no serial correlation exists in the model as implied by the size of the p -value (0.223) of the F -statistic (2.169). The calculated Jarque-Bera test for normality is 1.222 with an associated p -value of 0.543. The latter result indicates that the null hypothesis of normality cannot be rejected at the traditional levels of significance. The Breusch-Pagan-Godfrey heteroscedasticity test with an F -value of 0.456 associated with a p -value of 0.924 points to the absence of heteroscedasticity. Finally, the Ramsey Reset test for model misspecification with an F -value of 0.103 and an associated p -value of 0.904 leads to conclude that there is no misspecification.

Establishing the presence of a level relationship or co-integration between the log of real GDP per capita and the other level variables is determined by the F and t tests. In Table 3, the corresponding $F(9,7) = 11.831$ for $k=8$ is greater than the upper value bounds analogous to the 10% and 5% levels of significance (see Table 2 for $k=8$). The sign of the t -statistic is correct because it is negative and its size (-5.709) is greater in absolute value than the critical values: -4.40 at the 10% level of significance and -4.72 at the 5% level (see Table 2). Thus, both tests confirm the existence of co-integration between the log of real GDP per capita and the level variables. The adjustment coefficient is -0.64 and is statistically significant and negative. It means that 64% of disequilibrium is adjusted per year.

Note that information about long-run parameter estimates from equation 3 is presented in Table 4. Both equivalent results from Table 3 and Table 4 will be commented simultaneously.

The empirical results presented in Table 3 largely confirm the findings of the WBES. Not surprising, the tax-to-GDP ratio was found to negatively impact economic growth in both the short run and the long run at the 10% level of significance. Indeed, assuming a 1% increase in this ratio, real GDP per capita is estimated to fall by slightly less than 1% in the short and long-run time horizons. However, an important caveat may be issued here, since the critical issue is what level of this ratio is harmful or hinders growth. The cost of electricity (proxied by the fuel and light component of the RPI) was also found to have a negative (positive) and significant effect, albeit small, on real GDP per capita in the short (long) run. The results suggest this variable only has in the short run marginally harmful effects on real GDP per capita, which is a critical finding given this cost can contribute to high operating costs of business firms. Reducing the cost of telecommunications in Barbados has been an ongoing and closely monitored issue because of the potentially significant growth-enhancing effects on economic activity, particularly in services-oriented industries. Therefore, the result that 1% increase in this cost is likely to yield in the short run a decrease of 0.0039% in real GDP per capita is not surprising. The variable real interest rate was used to capture the constraint to access to finance that was identified in the growth diagnostics exercise. Indeed, a 1% increase in interest rates yields a 0.014% decrease in real GDP per capita in the long run and a 0.005% decrease in the short run. Total employment as a potential proxy for qualified work force has a positive and significant impact on growth in the long run. Indeed, a 1% increase in employment increases growth (real GDP per capita) by 2.11%. This outcome was expected since higher employment leads to higher output through increase in the levels of productivity. Employment is a long-run determinant of economic growth and furthermore development, therefore growth in employment is a useful indicator of a country's economic progress. Likewise, in the short run, employment significantly and positively affects economic growth. Indeed, a 1% increase in employment in the short run leads to a 0.92 % increase in economic growth. With respect to population size, while a positive impact on economic growth is registered in the long run, a negative effect is recorded in the short run. Indeed, in the long run, assuming the population increases by 1%, real GDP per capita is estimated to rise by 7%. However, in the short run, population size seems to be a drag on the economy, since a positive shock to population growth causes a reduction in real GDP per capita growth. Traditional thinking on this issue is that labour resources and skills add to human capital accumulation, which contributes to enhanced levels of productivity and labour market competitiveness, which are likely to translate into higher growth in real GDP per capita. According to the optimists' view of population growth, increased mass production and specialization improves human capital which facilitates technological expansion, leading to economic development (see, for example, Kuznets, 1973; Darrat & Al-Yousif, 1999). The short-run result is highly consistent with the pessimists' view of population growth. In this regard, population growth may deplete natural and other resources such as land, healthcare, and education. Additionally, population growth caused by net immigration is believed to have an adverse effect on economic growth. This view finds its way among others in Yeboah *et al.* (2001). World GDP per capita growth significantly and positively impacts economic growth in Barbados. This can be explained by the fact that as a highly opened economy Barbados is greatly affected by the evolution of the world economy. The high dependence on tourism sector reinforces the direct impact of the World economy on the Barbadian economy. Finally, natural disasters are an impediment to economic growth in Barbados in the short run as well as in the long run.

Table 3: Error Correction Model of the Growth Equation for Barbados, 1980-2012
Dependent Variable: D(LRGDPPC)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-59.01988	12.35835	-4.775710	0.0020
LRGDPPC(-1)	-0.644281	0.112847	-5.709345	0.0007
TE(-1)	-0.975671	0.483812	-2.016633	0.0835
IR(-1)	-0.009327	0.002628	-3.549603	0.0093
TAXREV(-1)	-0.449720	0.095084	-4.729697	0.0021
FL(-1)	0.003376	0.001548	2.181495	0.0655
LTOTEMPL(-1)	1.360307	0.481909	2.822744	0.0257
WGDP(-1)	0.026870	0.008258	3.253739	0.0140
LPOPSIZE(-1)	4.676603	1.078478	4.336301	0.0034
NATDIS(-1)	-0.035360	0.014498	-2.438934	0.0448
D(WGDP)	0.014883	0.005819	2.557702	0.0377
D(LPOPSIZE(-1))	103.8078	67.85279	1.529897	0.1699
D(TAXREV)	-0.692858	0.093675	-7.396433	0.0001
D(IR)	-0.005144	0.001320	-3.898007	0.0059
D(LTOTEMPL(-1))	-0.237725	0.253721	-0.936953	0.3800
D(TE)	0.416786	0.529119	0.787698	0.4567
D(FL(-1))	-0.002550	0.001090	-2.340147	0.0518
D(NATDIS)	-0.010762	0.009317	-1.155158	0.2859
D(LRGDPPC(-1))	-0.407493	0.237221	-1.717778	0.1295
D(FL(-2))	-0.001330	0.000509	-2.611288	0.0348
D(TAXREV(-1))	-0.231707	0.104189	-2.223911	0.0615
D(LPOPSIZE)	-178.3011	75.00705	-2.377125	0.0491
D(LTOTEMPL)	0.920769	0.402409	2.288146	0.0560
R-squared	0.978698	Akaike I. C.	-5.8411	
F-statistic	14.61840	Schwartz C.	-4.7669	
Prob(F-stat)	0.000654			

Note: All variables are defined as in equation 1. D(LRGDPPC) is the dependent variable, D(...) indicates that the variable has been 1st differenced, LX stands for the natural log of X, k is the number of retained level variables, (-1) and (-2) mean lagged once and twice, respectively.

Table 4: Short-run and Long-run Estimates and the Error Correction Model of the ARDL (equation 3: non-linear form of equation 2), 1980-2012

Dependent Variable: D(LRGDPPC)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-59.01988	12.35835	-4.775710	0.0020
C(2)	-0.644281	0.112847	-5.709345	0.0007
C(3)	-1.514357	0.803269	-1.885242	0.1014
C(4)	-0.014477	0.005673	-2.552074	0.0380
C(5)	-0.698018	0.119377	-5.847161	0.0006
C(6)	0.005241	0.002238	2.341797	0.0517
C(7)	2.111357	0.513493	4.111750	0.0045
C(8)	0.041706	0.017701	2.356064	0.0506
C(9)	7.258642	1.805750	4.019738	0.0051
C(10)	-0.054883	0.027504	-1.995474	0.0862
C(11)	0.014883	0.005819	2.557702	0.0377
C(12)	-178.3011	75.00705	-2.377125	0.0491
C(13)	103.8078	67.85280	1.529897	0.1699
C(14)	-0.692858	0.093675	-7.396433	0.0001
C(15)	-0.231707	0.104189	-2.223911	0.0615
C(16)	-0.005144	0.001320	-3.898007	0.0059
C(17)	0.920769	0.402409	2.288146	0.0560
C(18)	-0.237725	0.253721	-0.936953	0.3800
C(19)	0.416786	0.529119	0.787698	0.4567
C(20)	-0.002550	0.001090	-2.340147	0.0518
C(21)	-0.001330	0.000509	-2.611288	0.0348
C(22)	-0.010762	0.009317	-1.155158	0.2859
C(23)	-0.407493	0.237221	-1.717778	0.1295
R-squared	0.978698	Mean dependent var		0.041140
F-statistic	14.61840	Akaike info criterion		-5.841153
Prob(F-statistic)	0.000654	Schwarz criterion		-4.766902
D(LRGDPPC) = C(1) +C(2)*(LRGDPPC(-1) -C(3)*TE(-1) -C(4)*IR(-1)-C(5)				
*TAXREV(-1)-C(6)*FL(-1)-C(7)*LTOTEMPL(-1)-C(8)*WGDP(-1) -C(9)				
LPOPSIZE(-1) -C(10) NATDIS(-1))+C(11)*D(WGDP)+C(12)				
*D(LPOPSIZE)+C(13)*D(LPOPSIZE(-1))+ C(14)*D(TAXREV)+C(15)				
*D(TAXREV(-1)) +C(16)*D(IR)+C(17)* D(LTOTEMPL)+C(18)				
*D(LTOTEMPL(-1))+ C(19)*D(TE)+C(20)*D(FL(-1))+C(21)*D(FL(-2))				
+C(22)*D(NATDIS)+C(23)*D(LRGDPPC(-1))				

Note: for meaning of variables see note to Table 3

Conclusion and Policy Implications

The paper utilises a growth diagnostics framework and the results of the 2010 WEBS to empirically document the binding constraints to economic growth of Barbados over the period 1980-2012. In addition, the autoregressive distributed lag (*ARDL*) approach to cointegration is estimated to examine the extent to which the binding constraints identified from the WEBS are validated in the formal model of endogenous growth. The methodology used here can be applied to other countries.

The results of the growth diagnostics exercise indicate that access to finance, tax rates, the cost of telecommunications, the cost of electricity, and an inadequately educated workforce are the major binding constraints to economic growth in Barbados. Furthermore, real interest rates have significant and negative impact on economic growth in the short and long run by constraining investment. In particular, employment (a possible proxy for work force) positively impacts economic growth in the short and long run, population size negatively affects economic growth in the short run, but positively in the long run, and natural disasters are an impediment to economic growth. The results according to which an inadequately educated workforce is one of the significant binding constraints to economic growth in Barbados, need further consideration. Indeed, although mean schooling years and literacy rates are relatively high in Barbados, the quality of education which is not captured in the data by the proxy variable may not sufficiently indicate why inadequately educated work-force is a binding constraint.

The major binding constraints from the WEBS are validated by the endogenous growth model used here. The access to finance has been a perennial lament of mainly small and medium-size business firms. While there are currently efforts by Government funded and other agencies to bolster the framework for improving access to finance, it is also important these agencies emphasize ongoing training to owners of small business plans to improve the prospect of securing financing rather than being perceived by banks and other institutions as huge credit risks. There has been some progress in the reduction of the cost of and quality of electricity over the past two years, as more businesses and consumers implement renewable energy products. To repeat, the finding of an inadequately educated force as a binding constraint has to be put into proper context as the proxy used for this constraint has its limitations. Notwithstanding this outcome, re-training and continued development of staff is always important to ensure that the needs of the organisation are met in a rapidly changing business environment. Moreover, employment training programs that aim not only to strengthen technical competences but also work-place skills and other professional tools that bridge the gap between school and work.

Given the importance of affordable, cost effective quality of telecommunications as a critical input into the business operations, it is advised that government monitors more closely the cost of this particular infrastructure offered by the respective service providers. Also, government should enhance legislation that promotes competition and increases the ease of entry into the Barbados market so that a greater number of service providers can gain market share and improve the quality of services and offer more competitive prices to its consumers. Since some firms sited weaknesses in certain services offered by key service providers, efforts should be made to increase the reliability and consistency of these facilities as well as continuously improve the range and coverage of these services. Additionally, the provision of service packages such as internet and telephone plans should be expanded to large enterprises which may have benefits for both parties. On the one hand, large corporations could benefit from economies of scale and telecommunications providers could form marketing partnerships with these corporations. In so doing, good business relationships can be forged among enterprises.

Finally, to address the issue of tax rates, it must be noted that while Barbados maintains a relatively high incidence of corporate taxes when compared to some of its comparators in the tourism and international business sectors, since the WBES were conducted in 2010, there have been a series of tax policy changes designed to improve competitiveness. These include, *inter alia*, reduced tax rates for certain entities in the International Business and Financial Services sector in 2012, and reductions in the applicable Value Added Tax (VAT) from 17.5% to 7.5% on hotel accommodation in 2013. Despite these adjustments, Barbados remains challenged to do more as its tax base has shrunk considerably since the onset of the recession and remains depressed. As a result, further tax changes that substantially reduce revenue could weaken the fiscal position considerably. Reforms should therefore continue to concentrate on measures to rationalize the existing system and improve the efficiency of tax administration.

References

- Acevedo, S., Alleyne, T., Sinclair, T., Joutz, F., Tsibouris, G., Perrelli, R., & Martinez, R. (2014). *Debt, Growth and Natural Disasters: A Caribbean Trilogy Authorized for distribution* (No. W/P 14/125). Washington DC : IMF.
- Artana, D., Auguste, S., Moya, R., Sookram, S., & Watson, P. (2007). Trinidad and Tobago: Economic Growth in a Dual Economy. In M. Agosin, E. Fernandez, & F. Jaramillo (Eds.), *Growing Pains Binding Constraints to Productive Investment in Latin America* (pp. 365-416). Washington DC: Inter - American Development Bank.
- Best, L. A. (1968). Outlines of a Model of Pure Plantation Economy. *Social and Economic Studies*, 17(3), 283–326.
- Boamah, D., Jackman, M., & Mamingi, N. (2011). Credit Growth and the External Current Account in Barbados. *Journal of Eastern Caribbean Studies*, 36(3), 16–39.
- Craigwell, R. (2010). Recent Development in the Growth and Development Theory and Policy with Special Reference to Small Developing Countries. In *In Caribbean Development Bank, Growth and Development Strategies for the Caribbean* (pp. 15–25). St. Michael: Caribbean Development Bank.
- Darrat, A. F., & Al-Yousif, Y. K. (1999). On the Long-Run Relationship between Population and Economic Growth: Some Time Series Evidence for Developing Countries. *Eastern Economic Journal*, 25(3), 301–313.
- Downes, A. S. (2002). *Economic growth in a small developing country: The case of Barbados*. Manuscript. Retrieved from Citeseerx.ist.psu.edu/edu/viewdoc/download?doi=10.1.1.550.37828rep=rep1&type=pdf
- Grenade, K. (2012). On Growth Diagnostics and Grenada - ProQuest. *Journal of Eastern Caribbean Studies*, 37(2), 46–84.
- Hausmann, R., Rodrik, D. & Velasco, A. (2005). *Growth diagnostics*. Retrieved from <http://www.tinyurl.com/kqodran>.
- Hausmann, R. (2007). *Growth Diagnostic: Belize*. Retrieved from <https://www.researchgate.net/publication/242531816>
- Hausmann, R., & Klinger, B. & Wagner, R. (2008). *Doing Growth Diagnostic in Practice : A 'Mindbook' Peru* (No. Working Paper CSI-111, PE-P1074). Peru:CID,Harvard University. Retrieved from <http://siteresources.worldbank.org/INTDEBTDEPT/Resources/468980-1218567884549/mindbook.pdf>
- Kida, P. (2005). *Caribbean Small States-Growth Diagnostics*. Retrieved from <http://siteresources.worldbank.org/INTDEBTDEPT/Resources/468980-1206974166266/4833916-1206989877225/KidaSmallStates.pdf>
- Kuznets, S. (1973). Modern Economic Growth: Findings and Reflections. *The American Economic Review*, 63(3), 247–258.
- Lewis, W. (1950). The industrialisation of the British West Indies. *Caribbean Economic Review*, 2, 1–51.

- Mamingi, N. (2015). The Determinants of Economic Growth in the Countries of the OECS - ProQuest. *Journal of Eastern Caribbean Studies*, 40(2), 63–99.
- Mamingi, N., Lawrence, N., & Lacorbinière, J. (2014). *Modelling the Binding Constraints to Economic Growth in Barbados* (W/P No. 14/3). Barbados :Central Bank of Barbados.
- Mamingi, N., & Perch, J. (2013). Population Growth and Economic Growth/Development: An Empirical Investigation for Barbados. *Journal of Economics and Sustainable Development*, 4(4), 93–105.
- Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16(3), 289–326.
- Sosa, S., & Cashin, P. (2009). *Macroeconomic Fluctuations in the Caribbean: the role of climatic and external shocks*. (W/P No. 09/159). Washington DC: International Monetary Fund.
- WBES (2009). *Enterprise and Indicator's Survey*. Retrieved from https://www.enterprisesurveys.org/~media/FPDKM/EnterpriseSurveys/Documents/Methodology/Sampling_Note.pdf
- WBES (2010). *Enterprise Surveys - What Businesses Experience*. Retrieved from <http://www.enterprisesurveys.org/>
- World Bank. (2014a). *Enterprise Surveys - What Businesses Experience - World Bank Group*. Retrieved from <http://www.enterprisesurveys.org/>
- World Bank. (2014b). *Enterprise Surveys - What Businesses Experience - World Bank Group*. Retrieved from <http://www.enterprisesurveys.org/>
- World Bank. (2014c). World Bank Open Data | Data. Retrieved from <http://documents.worldbank.org/curated/en/25731468331801056/The-financial-sector-assessment-program-addressing-the-needs-or-emerging-markets-and-developing-economies-EMDES>
- Yeboah, D. A., Iyare, S. O., & Mamingi, N. (2001). Economic Growth, Population Growth and Quality of Life in Ghana. *Journal of Global Awareness*, 2(2), 185–197.

Authors' Profile

Nlandu Mamingi is a retired Professor of Economics in the Department of Economics of the University of the West Indies, Cave Hill Campus, Barbados, who has rejoined the same Department as a part-time faculty member. Since July 1, 2018, he has been serving as a Director on the Board of Directors of the Central Bank of Barbados. His research areas cover green economy and sustainable development, valuation of non-marketed goods, budget deficit, public debt and economic growth and econometrics of aggregation over time.

Nkenge Lawrence has been serving as a part-time Macroeconomics Lecturer and a tutor at the University of the West Indies, St. Augustine Campus, Trinidad and Tobago. She has also been a Research Consultant at the HEU, Centre for Health Economics which is a unit out of the Department of Economics at the St. Augustine Campus for over two years where she participated in a number of health and development projects. She is currently Research Assistant to Dr. Althea La Foucade, Head of Department of Economics, St. Augustine Campus. Her research interests include development economics, poverty and health economics.

Jason LaCorbinière is the Planning, Monitoring and Evaluation Analyst with the United Nations Development Programme for Barbados and the OECS. His work centers around sustainable development, renewable energy, climate change finance and impact investment.

Darrin Downes is the Deputy Director (Ag.), Research and Economic Analysis Department of the Central Bank of Barbados and an Attorney-at-law. His current research interests are macroeconomic adjustment policy, economic and financial regulation and competition law in small open economies.