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Productivity growth in the Caribbean and Latin America under trade liberalization

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Abstract

Using the Malmquist productivity index as a measure of productivity, productivity was found to be greater in the Caribbean compared with Latin America, with the variation in the index being greater in the Caribbean. Technological change accounted for a greater proportion of productivity growth in Latin America, and technical efficiency played a greater role in the Caribbean. Compared to the pre- and post- covid years [Covid year = 2019], productivity growth decreased in Latin America, whereas productivity growth increased in the Caribbean, over that period.

In terms of the relative impact of variables impacting productivity growth, using obtained from using regression analysis indicates that policies to improve the literacy rate, making credit available to the private sector and increasing access to electricity will give this region an advantage, as the correlation between productivity growth and these variables were more favorable in this region. Also, expanding the manufacturing sector in the Caribbean is likely to have a greater positive impact in the Caribbean than in Latin America. Latin America has the advantage of a greater positive impact on productivity in market size and decreasing the exchange rate.

Keywords: Caribbean; Latin America; Productivity Growth; Technical Efficiency; Technological Change

1. Introduction

Free trade is a constant reminder to countries that upgrading their productivity and productive efficiency and competing in the international markets cannot be overlooked. Many papers have pointed to labor productivity as a key metric in the ongoing competition; not only must the human capital in labor be given attention to, but the technology they use to increase productivity must be adequate. Productivity analysis provided the kind of caliper needed to benchmark productivity and reset the stage to improve productivity gain. It is within this context that this analysis is undertaken with regard to Caribbean countries.

Economic growth in the Caribbean has always been modest and just prior to the covid outbreak it measured less than 2 % [World Bank, 2023]. Perhaps this is still the effects of being stuck in the post-independence inflexible economic system of monoculture production and a system of trade in which agriculture goods, minerals, or oil, were exchange for capital and technology, or it is the result of capital being diverted away by frequent economic shocks derived from their natural predisposition in the hurricane belt [Mercer-Blackman and Seerattan, 2014]. But many Caribbean countries have not managed to develop a competitive or/and sufficiently flexible economic base to meet the international markets.

Heavy dependence on foreign assistance and tariff revenue, though unavoidable, has partly contributed to this predicament, even these sources of capital, with the quick development in modern free trade, are gradually being withdrawn, and whatever still remains in effect is being rationed between the Caribbean and Latin America.

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Many regard the plight of the Caribbean as being due to the low productivity in the region, but others see it as being caught in a low productivity trap [ECLAC, 2023], in which the low productivity begets low productivity as a result of low expenditure on capital

As the need to complete intensifies, many have turned to direct foreign investment [DFI], making the tradeoff between resource exploitation and repatriation of revenue for capital, technology, and manpower development.

Economic integration promises many opportunities to Caribbean countries, especially as it relates to the benefits of economies of scale, to which Caribbean countries have had limited access, on account of their small sizes and geographically dispersed nature. But the process has been slow.

ECLAC [2023] recommends that Caribbean, and Latin American, countries alike foster more innovation and develop a more diversified economic base that is based on a wider range of technology. But productivity growth is also a function of good policies and institutions [Perelman, 1995], which must also be looked into.

This paper aims, from the standpoint of benchmarking and advising policies, to determine productivity growth in the Caribbean and Latin American and compare the impacts of specific economic strategies on the economy of each region.

2. Background

The Caribbean and Latin America have aways had to compete for international markets, both preferential and non-preferential and foreign investment, both direct and indirect, and foreign aid. In such a way that gains to one means a loss to the other.

Over the past decade, overall economic growth in both regions has continued to be low. The pre-pandemic levels have been about 1.8 to 2.5 % [ECLAC, 2023], which is considered to be much lower than that of other middle- and low-income countries.

In most Caribbean economies, production has been focused less on manufacturing, and more on service, and tourism. Mining and Agriculture have been fairly constant and remain fairly stable in the new international markets.

But, within the new markets, the Caribbean is still regarded as a primary product producer. Of the refined products used within this region, the production of the bulk of them as finished products are being led from outside of the region. And in many cases, the raw resources utilized to produce these products are the raw material produced and exported from the Caribbean. In effect, Caribbean countries are still trading cheap primary products for more expensive refined products [Turnbull [2021].

ECLAC [2023] recommends that Caribbean, and Latin American, countries foster more innovation and develop a more diversified economic base that is based on a wider range of technology.

ECLAC [2023] and World Bank [2023] further recommend improving data collection and its availability and further developing the telecommunication systems withing the region. For any meaningful innovation to take place, data is necessary. This is also true for improving production efficiency. One must not only know the terrain one is operating in, but must also know the players, their abilities and their performances. And the key to achieving this is information. This is where infrastructure like the internet becomes useful. Data must be made available, not only in quarterly or annual reports or at annual conferences, but must be available at all times, to all interested parties, especially those at the firm level.

Also, more communication and discussion must be fostered, as these are the kinds of conditions under which ideas can easily grow into innovations. Countries that have moved along in this respect are those with data and easy ways to access this data.

But, for the Caribbean, to innovate comes with its own problems. First, there is the question of appropriate intellectual rights protection that would allow the innovator to reap the gain from innovation before that innovation becomes public goods. And second, there are already other major players operating in the market, with large market shares, which

Caribbean countries must compete against, and on account of whom, the scope for innovation has become very limited.

But more importantly, for these Caribbean countries, sustained innovation calls into question the need for research and development, and after an innovation, there is the question of seeing that innovation through to the point where there are benefits from it become available to be reaped. This process requires capital, the provision of which, for the Caribbean, is not an easy task. But the region must go ahead in the direction of preparing to compete.

And finally, recommendations have also been made along the line of promoting policies to further engage the private sector in the integration process, and to coordinate policies and harmonize regulations within each region, so that countries have a clear vision of the goals, and strategies to get to them [ECLAC 2023; World Bank, 2023]. Often, within trading blocs, problems related to country level asymmetry and disharmony in policy implementation emerge among countries. Such problems have implications for each county in the bloc. The objective is to minimize such problems through careful coordination and avoid delays in moving ahead toward meeting set goals.

In concluding this section, it is important to point out that empirical evidence [Makki and Somwaru, 2004] shows that cross-border diffusion of ideas, technology, and managerial skills that occurs through international trade and foreign investment can significantly improve productivity within a trading country. This being so suggests that the rate of development in any bloc could be increased, the more involved and tactical countries are in international trade and foreign investment.

3. Analytical Framework

In the context of a production frontier, technological change represents technological innovation, and it measures the extent to which the frontier moves outwards [Färe et.al., 1994,].

Technical efficiency, on the other hand, measures how far relative to the production frontier a country's technology is. Technical efficiency change provides evidence of growth catching up. Technical efficiency and changes in technical efficiency are affected directly by policies and institutions to promote diffusion of technology and knowledge [Färe et. al, 1994, Perelman, 1995] from developed countries, and internal policies to promote education, training, other “learning by doing” and managerial skills. Other factors, such as access to police protection, health care or credit and electric power, have an indirect effect on technical efficiency and technical efficiency change. This aspect of productivity is particularly important to developing countries [Olson, 1996], where the cost of technology development is often prohibitive.

A measure of technological change provides an indicator of innovation within a country. Technological change requires high levels of expenditure on R&D [Perelman, 1995] and thus, is generally both a function of, and a major determinant of growth and development in countries [Olson, 1996]. New technological innovations that occur in developed countries usually create a new “world” production frontier. However, these innovations filter down to developing countries through foreign investment, trade, and other direct and indirect educational processes, thereby nudging them towards the new production frontier.

Productivity change is the product of both technical efficiency change and technological change. It provides an overall measure of the extent to which a country is able to exploit available knowledge and technology, and its own endogenous creativity or innovation.

4. Methodology

The methodology used is the non-parametric Malmquist Productivity Index. The Malmquist Productivity Index can be transformed such that the components of productivity, the index technical efficiency change, and the index technology change could be derived. In the productivity change analysis that follows, these technical efficiencies change, and technology change indexes are used.

For the derivation of the Malmquist, see Fare et. al [1994]. The Malmquist Productivity Growth Index, as defined by Fare et. al [1994] is as in Equation 1:

$$M = \frac{D^t o(x^{t+1}, Y^{t+1})}{D^t o\ (x^t, yt)} \quad \ldots\ldots \quad (1)$$

where: $D^t o(x^t, y^t)$ and $D^t o\ (x^{t+1}, y^{t+1})$ are distance functions defined with respect to the transformation function S^t [Figure 1], where $\{S^t = (x^t, y^t)$: x^t can produce $y^t\}$, where $x^t \in R^n{}_+$, $y^t \in R^m{}_+$, and the technology consists of the set of all feasible input/output vectors. S^t is assumed to satisfy certain axioms that allow the definition of meaningful output distance functions, and R represents the set of real numbers.

In order to avoid choosing an arbitrary benchmark, Fare et. al [1994] modified the Malmquist productivity index as follows, Equation 2:

$$\text{Mo}\ (x^{t+1},\ y^{t+1}, x^t, y^t) = \left[D^t o \frac{x^{t+1},y^{t+1}}{D^t o(x^t,yt)}\right] \left[\frac{D^{t+1}o(x^{t+1},y^{t+1})}{D^{t+1}o(x^t,y^t)}\right] ½ \quad …….. \quad (2)$$

where: the distance function $D^t o(x^{t+1},y^{t+1})/D^t o(x^t,y^t)$ represents observed production relative to the transformation function S^t, and $D^{t+1}o(x^{t+1},y^{t+1})/D^{t+1}o(x^t,y^t)$ represents observed production relative to the transformation function S^{t+1}, such that (x^{t+1},y^{t+1}) and (x^t,y^t) are both feasible in relation to the technology at t+1 [Figure 1].

The decomposition of the Malmquist Productivity Index [Fare et. al., 1994] into the indexes of Technical Efficiency Change and Technology change is as shown in Equation 3.

$$\text{Mo}\ (x^{t+1}, y^{t+1}, x^t, y^t) = \left[\frac{D^{t+1}o(x^{t+1},y^{t+1})}{D^t o(x^t,y^t)}\right] \left[\frac{D^t o(x^{t+1},y^{t+1})}{D^{t+1}o(x^{t+1},y^{t+1})}\right] \left[\frac{D^t o(x^t,y^t)}{D^{t+1}o(x^t,y^t)}\right] \quad ……. \quad (3)$$

where: $D^{t+1}o(x^{t+1},y^{t+1})/D^t o(x^t,y^t)$ measures the change in relative efficiency (i.e., the change in how far observed production is from maximum potential production) between t and t+1 and $D^t o(x^{t+1},y^{t+1})/D^{t+1}o(x^{t+1},y^{t+1}) * D^t o(x^t,y^t)/D^{t+1}o(x^t,y^t)$ ½ captures the shift in technology between the two periods evaluated at x^t and x^{t+1}.

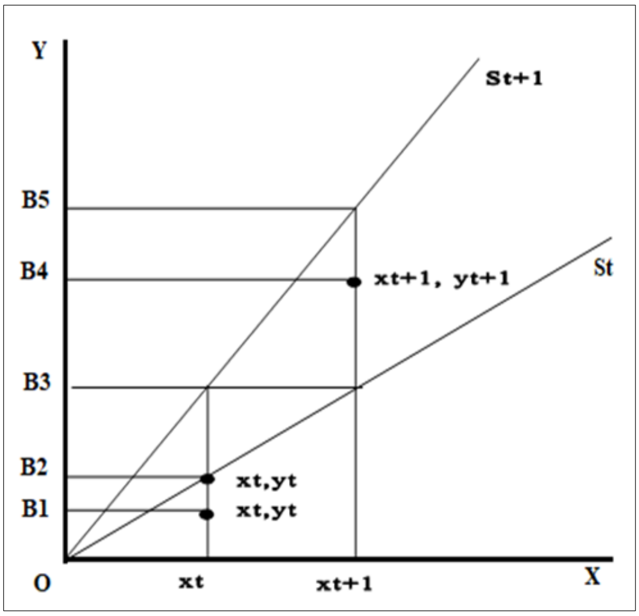

Figure 1 Distance function used to construct the productivity index

Thus, technical efficiency change (EC) is expressed as shown in Equation4:

$$EC = [D^{t+1}(x^{t+1}, y^{t+1})/D^t o\ (x^t,\ y^t)] \quad ………… (4)$$

And technological change (TC) as shown in Equation 5:

$$TC = [D^t o\ (x^{t+1},\ y^{t+1})/D^{t+1}o\ (x^{t+1},\ y^{t+1})\ [D^t o\ (x^t,\ y^t)/D^{t+1}o\ (x^t, y^t)]½ \quad …… \quad (5)$$

To quickly review the idea presented above, the Malmquist productivity index for constant returns to scale technology can be written as [Figure 1, Fare et. al., 1994]:

$$Mo\,(x^{t+1}, y^{t+1}, x^{t}, y^{t}) = [(0B4/0B5)(0B2/0B1)] * [0B4/0B3)/(0B4/0B5) * (0B1/0B2)/(0B1/0B3)]½ = (0B4/0B5)\,(0B2/0B1) * [(0B5/0B3)\,(0B3/0B2)]\,½ \quad \ldots\ldots\ldots\ (6)$$

where: Technical efficiency change = (0B4/0B5)(0B2/0B1).

Technological change = [(0B5/0B3) (0B3/0B2)] ½

Thus, technological change is measured as the geometric means of two shifts: technological change relative to t and technological change relative to t+1. Technical efficiency change between t and t+1 captures changes in relative efficiency over time.

Improvement in productivity yields a Malmquist index greater than 1. Deterioration in productivity over time yields a Malmquist index of less than 1. Similarly, technical efficiency changes and technological change indexes greater than 1 represent improvement in the respective measures, whereas values less than 1 represent deterioration in the measures.

Although the product of the technical efficiency changes and technological change components must, by definition, equal the Malmquist index, these components may be moving in opposite directions. For example, if the Malmquist index = 1, but the measures of technical efficiency change, and technological change are not necessarily equal to 1.

In this study, linear programming (LP) was used to compute the distance functions. In order to calculate the productivity change of country k between t and t+1, linear-programming problems for $D^{t}o(x^{t},y^{t})$, $D^{t+1}o(x^{t},y^{t})$, $D^{t}o(x^{t+1}, y^{t+1})$ and $D^{t+1}o(x^{t+1}, y^{t+1})$ were solved.

$(D^{t}o\ (x^{k,t}, y^{k,t})) - 1\ =\ max\ \theta k\ subject\ to$

$$\sum_{k=1}^{K} Z^{k,t}\, y_{m}^{k,t} \geq \theta\, y_{m}^{k,t} \qquad m = 1,\ldots, M;$$

$$\sum_{k=1}^{K} Z^{k,t}\, x_{n}^{k,t} \leq x_{n}^{k,t} \qquad n = 1,\ldots,N;$$

$$Z^{k,t} \geq 0 \qquad k = 1,\ldots,K; \qquad \ldots\ldots\ldots\ldots(7)$$

where: k=1..., K countries using n=1....N inputs ($x_{n}^{k,t}$) at each time period t=1...,T to produce m=1...,M outputs ($y_{m}^{k,t}$). The intensity variable (Z) measures the intensity with which the input(s) x is used to produce output(s) y. Each Z is at least equal to zero, and each country has observations for each year. The technology assumes constant returns to scale and strong disposability of inputs and outputs (Färe et.al., 1994).

The computation of $D^{t+1}o\ (x^{t+1}, y^{t+1})^{-1}$ is exactly like that in Equation (7), but t+1 is substituted for t.

In order to calculate $D^{t}o\ (x^{t}, y^{t})^{-1}$ for each of the k = 1…K countries, the following LP shown in Equation 7 was solved:

To calculate the distance functions $D^{t+1}o\ (x^{t}, yt)^{-1}$ and $D^{t}o\ (x^{t+1}, y^{t+1})^{-1}$, information for two periods is required. For $D^{t}o\ (x^{t+1}, y^{t+1})^{-1}$, the LP solved is as follows:

$D^{t}o\ (x^{k,t+1}, y^{k,t+1}) - 1\ =\ max\ \theta k\ \ subject\ to$:

$$\sum_{k=1}^{K} Z^{k,t}\, y_{m}^{k,t} \geq \theta\, y_{m}^{k,t+1} \qquad m = 1,\ldots, M;$$

$$\sum_{k=1}^{K} Z^{k,t}\, x_{n}^{k,t} \leq x_{n}^{k,t+1} \qquad n = 1,\ldots, N;$$

$$Z^{kt} \leq 0 \qquad k = 1,\ldots,K; \qquad \ldots\ldots\ldots\ldots\ldots \quad (8)$$

Equation (8) involves observations for both period t and period t+1. The reference technology relative to which ($x^{k,t+1}$, $y^{k,t+1}$) is evaluated is constructed from the observation at t. In Equation (7), $D^t o$ ($x^{k,t} y^{k,t}$) ∈ S^t and, therefore, is less than 1. However, in Equation (8), ($D^t o$ ($x^{k,t+1}$, $y^{k,t+1}$) may take values greater than 1.

The linear programming problem for $D^{t+1} o$ (x^{t+1}, y^{t+1}) is solved similarly to Equation (8), but the t and t+1 superscripts are transposed.

Regression analysis. Ordinary least squares were used to examine the relationships between productivity change and specific independent policy variables. This methodology readily accommodated the dependent variable, whose value was continuous and positive. Each parameter estimate was interpreted as the percentage change in productivity growth for a one percent change in the respective independent variable

$$lPRD_{ij} = \alpha_0 + \alpha_1 lGDP_{ij} + \alpha_2 lEDU_{ij} + \alpha_3 lCR + \alpha_4 lK_{ij} + \alpha_5 lELEC_{ij} + \alpha_6 lINF_{ij} + \alpha_7 TAX_{ij} + \alpha_8 lEXR_{ij} + \alpha_9 lTTr_{ij} + \alpha_{10} lAGRI_i + \alpha_{11} lMAN_{ij} + \alpha_{12} LSERV_{ij} + e_{ij} \qquad (9)$$

where: i and j are the country and year, respectively; $lPRD_{ij}$ is the variable representing the productivity index of each country in each year. The other variables are as defined in Table 1; and $e_{ij,}$ represents unexplained random errors. The countries involved in this study are as shown in Table 2. Each coefficient to be expressed in percent terms since the model is estimated in its log form indicated by the letter '*l*' in front of each variable

5. The Data

This study involved observations on the outputs and inputs for 9 Caribbean Countries and 12 Latin American Countries over the period 2008 to 2022. Caribbean countries are defined as all Caribbean islands and countries in South and Central Americas that are members of the Caribbean Common Market [CARICOM], Table 1.

The measures of output were calculated as the GDP (measured as Constant 2015 US Dollars) divided by the real price. The real price was obtained by dividing the constant GDP by the current GDP and standardized by the price index. Input included labor and capital. Labor was measured as the number in the Labor Force. Capital was calculated from the gross fixed capital formation expressed in percentage of real GDP divided by the price index, expressed in real terms.

The data used in this study were obtained from the World Bank [2024]. Because of inconsistencies observed in the World Bank data set with respect to some countries in the Caribbean and Latin America, these countries were omitted from the study.

Also, in determining the relationship between productivity change and specific policy variables, several observations for some countries [Paraguay and Guatemala] were not available, so these countries were also not included in the regression analysis. Table 1 shows the average annual changes in output and input for the countries involved in this study over the period 2008-2022. The countries are divided into groups based on whether they are CARICOM members or not.

GDP growth rate was similar in the Caribbean and Latin America over the 2009-2022 period [0.034 & 0.035], with the Honduras showing the highest growth rate in Latin America [0.099] and Guyana showing the highest growth rate in the Caribbean [0.134]. No country in either region showed a negative growth rate in GDP. However, the growth rate of Capital and labor were higher in Latin America that in the Caribbean with Honduras showing the highest growth rate in both capital and labor [0.076 and 0.033] in Latin America. In the Caribbean, Guyana showed the highest growth rate in capital [0.181], while Belize shown the highest growth rate in labor [0.034].

6. Productivity variables

Many economic factors affect productivity growth. In this study, twelve variables that proxy for six groups are considered. Table 2 shows the expected correlation between each variable and the productivity variable.

Market-related variables. In this group, market size, measured as the GDP of a country [GDP], is considered. The larger the market size, the more likely it would be for investors to invest in productivity improving ventures, such as training and other factors that are related to human capital building, tools acquisition or construction, and organization for productivity growth. [Lina and Wengb] (2019) and Ferraro et. al. [2020] showed a positive relationship between market scale [size] and productivity. In this study, a positive relationship is also expected.

6.1. Human capital/private sector related variables.

In this group, two variables are investigated, the literacy rate [LIT], proxied for by the amount of the GDP expended on education, and domestic credit per capita {CR], available to the private sector.

With regard to the literacy rate, the more literate a population is [i.e., the ability to read instructions and blueprints, and operate machinery, and computerized systems, etc.] the more productive they are likely to be. Khan et. al [1991] has documented a positive relationship between literacy and labor productivity. Oladimeji et. al. [2024] showed a direct relationship between digital literacy and productivit**y.** This positive relationship between literacy and productivity is likely to show up in this analysis.

Table 1 Interannual change in Capital, Labor and GDP in countries studied [2008-2022]

Countries	Capital [K]	Labor	GDP
Colombia	0.065	0.019	0.046
Costa Rica	0.039	0.015	0.033
Brazil	0.013	0.011	0.009
Honduras	0.076	0.033	0.099
Nicaragua	0.053	0.024	0.048
Ecuador	0.009	0.023	0.016
Argentina	0.029	0.013	0.008
Chile	0.043	0.016	0.041
Bolivia	0.055	0.018	0.027
Mexico	0.011	0.018	0.026
Paraguay	0.034	0.021	0.031
Uruguay	0.050	0.005	0.032
Mean	0.040	0.018	0.035
Bahamas, The.	0.013	0.014	0.016
Dominican Republic	0.033	0.025	0.042
Guyana	0.181	0.003	0.134
St. Vincent and the Grenadines	0.051	0.000	0.009
Barbados	0.000	-0.002	0.006
Jamaica	-0.070	0.017	0.028
St. Lucia	-0.025	0.015	0.042
Trinidad and Tobago	-0.054	-0.002	0.003
Belize	0.021	0.034	0.022
Mean	0.017	0.011	0.034

With regards to credit per capita, the greater the availability of domestic credit to the private sector [CR], the more likely it is that innovation will be spurred in this sector. Cases where capital is the limitation to innovation or the expansion of innovation will more likely be improved, and productivity in the private sector will increase. On the other hand, the availability of domestic credit might just come in handy for other domestic uses, such as home building and repairs, and would not have any significant effect on productivity. Cecchetti and Kharroubi, 2018, found a negative relationship between lower levels of credit and productivity growth. Manaresi and Pierri, [2019] for that a reduction in credit supply is directly related to total factor productivity.

In this paper it is likely that in the Caribbean and Latin America available credit might go into domestic use as the income [GDP/Capita] is usually very low in these regions compared with elsewhere. But there is still the possibility that some will be put to productive use. A positive correlation is expected between this variable and productivity growth.

Infrastructure related variables. In this group, two variables are studied, Gross fixed capital formation [K], derived from the amount GDP spent of gross fixed capital formation, and the percentage of the population with access to electricity [ELEC].

Productivity has always been modelled as a function of K and L [Labor]. With an increase in K, labor productivity increases. Overall, it is expected that in the Caribbean and Latin America productivity is likely to increase. This is so because neither region is classified as a high technology region, but regions faced with challenges to acquire capital. Nourzad. F. [1995], found a positive correlation between public fixed capital formation and productivity growth. Trpeski, and Marijana, 2019, also found the same result in their study of productivity in Southeastern Europe.

Table 2 Variables, acronyms, hypothesized relationships with productivity index and rationales

Variables	Description	Acronym	Ho	Rationale
Market Related Variables				
Market size		GDP(M)	+	Greater the market size, greater the potential to increase productivity
Private sector Related Variables				
Literacy [Edu. Exp/Capita]		LIT	+	Higher education means higher productivity.
Credit /Capita [Private Sector]		CRED	+	Higher credit to private sectors, more investment in capital. Increased productivity
Infrastructure Related Variables				
Fixed capital formation		K [M]	+	Greater capital formation means greater productive infrastructure.
Access to electricity [% of Pop.].		ELEC	+	Access to electricity means access to power. Increased productivity.
Monetary/Fiscal Policy Related Variables				
Inflation Rate		INF	-	The impact, negative at least in SR.
Tax on Income, profit & capital gain [Value],		TAX	-	Higher tax means less investment, less productive capital
Trade Policy Variable				
Tax on trade [% of Rev.]		TT	-	Higher taxes [higher cost] on trade, trade restrictions, less benefit from market size
Exchange Rate		EXR	-	Lower ER, increased foreign demand, increased potential to increase productivity.
Productive sectors				
Agriculture [% GDP]		AGRI	+	Expected to be greater than OTHER.
Manufacturing [% GDP]		MAN	+	Expected to be greater than OTHER.
Service [% GDP]		SERV	+	Expected to be greater than OTHER.

Other [Mining, Construction] [% GDP]	OTHER	Ref.	

Since increased capital formation increases the productive base in the regions in question, it is likely that the correlation between fixed capital formation and productivity will be positive.

With regards to ELEC, it is likely that while most of this electricity will go into domestic use, some will go into commercial production, and will tend to have a positive effect on technology use and thus on production capacity and productivity. Alam e. al [2018] verified this relationship between access to electricity and productivity in developing countries. This result is likely to hold true in this study

Monetary/Fiscal Policy related variables. The inflation rate [INF] and tax on income, profit and capital gains [TAX] are the variables studied to represent this group.

Inflation is likely to devalue money, and make investment, including investment in productive assets, more costly, at least in the short run. This is likely to have a negative impact on productivity, again, in the short run. In the long run, however, on the basis of the argument that money has no effect in the long run, INF is likely to have no effect. Piper et. al,.2020, in their studies of the Brazilian economy found an inverse relationship between inflation and productivity. Araujo et. al. in their 2018 investigation of inflations in Brazil found similar results. The result in this study is expected to be similar

Taxes, on income, on profit or on capital gains are likely to decrease, spendable income, and in particular, income spent on productive assets. Thus, TAX is likely to have a negative impact on productivity. Vartia [2008] found that taxes have a depressing effect on investment and productivity. This finding is supported by Ferraro, et. al. [2020] in their study of tax policies on innovation and productivity growth. This negative relationship between TAX and productivity growth is also predicted in this study.

Trade policy variables. Two variables, Tax on trade [TT] and exchange rate [EXR] are studied in this group. TT is calculated as a percentage of a country's revenue and the coefficient is interpreted in percentage terms.

Tax on trade increased the prices of goods and thus decreased demand and in so doing effectively reduced the market size. Consequently, TAX reduces the capacity to take advantage of large-scale markets and thus stifles innovation and productivity gain strategies. A larger trading market provided more opportunities to exploit innovation to the fullest. Taxes on trade are likely to stifle this effort, and therefore there is likely to be a negative impact of TT on productivity growth. Furceri, et. al. (2019), in their analysis of the macroeconomic consequences of tariffs, observed a negative relation between tariffs and productivity. Kilumelume, et. al. (2021) made the same observation. Taxes on trade are likely to have the same effect in this study.

The exchange rate [EXR] has a mixed effect on productivity, depending on whether one's currency has a low value or a high value. If a country has a low exchange rate, this is likely to increase the demand for goods from that country, and this is likely to incentivize innovation and productivity to meet that demand. If on the other hand, a country has a high exchange rate, the effect on innovation and productivity will be the opposite. This is assuming that the inputs used in the production process are not imported, otherwise the exchange rate of the input supplying country will have to be considered.

Cravino [2014], noted that exchange rate does have an effect on productivity. McLeod and Mileva, 2011) noted that weaker exchange rates tend to be correlated with increased total factor productivity.

Productive Sector Variables. It is important to determine which productive sector of the economy is correlated with more productivity growth. Four sectors are examined, the agriculture sector [AGR], the manufacturing sector [MAN], the service sector [SERV] and an aggregate of the rest which includes mining and drilling, and construction, the other sector [OTHER]. Because the raw data is expressed in percentage of GDP and sums to 100%, in order to avoid estimation problems, OTHER is dropped, each coefficient in the regression is expressed with reference to OTHER. There is no priori expectation on the impact of any sector on productivity in either region.

7. Results and discussion

7.1. Result and discussion: Productivity indexes

The results for the productivity, the Malmquist index, are shown in Table 3. The results are divided into two periods, 2009-2018, 2021-2022, followed by the sum for the entire 2009-2022 period. The period affected by the 2019 Covid productivity shock is removed to show the results without that specific period affecting it. The results for the technical efficiency change index and technology change index are also shown in this table.

Based on the results, the mean for productivity growth [the Malmquist index] in the entire period studied [2009-2022] was greater for the Caribbean compared with that of Latin America [1.036 vs 1.008]. In the Caribbean, productivity growth was greatest in St Lucia followed by Trinidad and Tobago [1.083 & 1.072]. In Latin America, Honduras leads with an index of 1.034. All other countries in the Caribbean and In Latin America except two showed growths in productivity.

Productivity growth in general could be described as modest. No country showed accelerated growth. Prior to the Covid shock [2019] all the Caribbean countries, except Guyana showed indexes greater than 1, but none exceeded 10 percent growth in productivity. In Latin America, the results were similar. Following the Covid shock, several countries showed accelerate growth, of which the leading countries were St. Lucia, Trinidad and Tobago, Jamaica, and Guyana with at least 20 percent growth.

The recovery in technological change, especially in the Caribbean, following Covid could simply be a slow recoil because of scarcity of capital, or again simply restrictive policies. But in Latin America, the recovery was encouraging.

In countries with slow recovery, notably Caribbean countries, DFI could help provide the capital, technology, or developmental strategies needed for quick recovery, but it is up to specific countries to decide whether there is a real gain from taking that approach or not

Table 3 Efficiency change, their technological change, and the Malmquist productivity index

Countries	Technical Efficiency Change			Technological Change			Malmquist Productivity Index		
	2009-2018	**2021-2022**	**2009-2022**	**2009-2018**	**2021-2022**	**2009-2022**	**2009-2018**	**2021-2022**	**2009-2022**
Colombia	0.978	0.852	0.974	1.017	1.270	1.055	0.987	0.993	1.004
Costa Rica	1.003	0.863	0.982	1.013	1.193	1.042	1.004	1.004	1.007
Brazil	0.994	0.848	0.968	1.028	1.231	1.060	1.007	0.993	1.005
Honduras	1.056	0.688	1.022	0.987	1.621	1.073	1.035	0.931	1.034
Nicaragua	1.035	0.681	0.997	0.984	1.746	1.090	1.015	0.967	1.019
Argentina	0.993	0.809	0.968	1.015	1.190	1.044	0.992	0.942	0.993
Chile	1.007	0.943	0.997	1.003	1.109	1.021	1.003	1.039	1.009
Bolivia	0.979	0.723	0.973	0.997	1.736	1.097	0.970	0.988	0.998
Ecuador	1.001	0.839	0.971	1.022	1.393	1.080	1.008	1.010	1.008
Paraguay	1.001	0.801	0.969	1.019	1.311	1.061	1.015	0.945	1.002
Uruguay	1.009	0.862	0.981	1.010	1.146	1.032	1.010	0.980	1.002
Guatemala	1.023	0.761	0.987	1.000	1.617	1.082	1.020	1.003	1.012
Mexico	1.017	0.846	0.992	1.013	1.188	1.041	1.015	0.986	1.014
Mean	1.007	0.809	0.983	1.008	1.365	1.060	1.006	0.983	1.008
Std. Deviation.	0.022	0.077	0.016	0.013	0.232	0.023	0.016	0.030	0.010
Bahamas, the	1.005	0.973	1.005	1.002	1.112	1.017	1.007	1.081	1.021

Belize	0.991	0.858	0.966	1.018	1.353	1.065	1.007	1.009	1.001
Dominican Republic	1.002	0.876	0.983	1.012	1.209	1.045	1.006	1.037	1.013
Guyana	0.989	1.102	1.020	1.004	1.090	1.019	0.990	1.200	1.038
St. Vincent and the Grenadines	1.049	0.888	0.993	1.016	1.254	1.049	1.059	1.136	1.035
Barbados	1.027	0.926	0.990	1.012	1.165	1.037	1.020	1.064	1.009
Jamaica	1.001	1.507	1.063	1.020	0.886	0.999	1.017	1.336	1.050
St. Lucia	1.016	1.110	1.018	1.020	1.347	1.069	1.025	1.492	1.083
Trinidad and Tobago	0.997	1.000	1.001	1.012	1.375	1.070	1.009	1.375	1.072
Mean	1.008	1.027	1.004	1.013	1.199	1.041	1.015	1.192	1.036
Std. Deviation.	0.019	0.202	0.028	0.006	0.157	0.026	0.019	0.171	0.028

7.2. Result and discussion: Regression analysis

The results for Latin America and the Caribbean are shown in Table 4

Table 4 The productivity index and variables studied and their coefficient

	Caribbean				Latin America		
Variables		*Coefficients*	*P-value*		*Coefficients*	*P-value*	
Market Related variables							
Market size	MARKET	0.1417	0.0021	***	0.2087	0.0053	***
Human capital/ Private sector related variables							
Literacy rate	LIT	0.0904	0.0128	**	-0.0221	0.0163	**
Credit/Capita	CR	0.0264	0.0370	**	0.0178	0.0743	*
Infrastructure Variables							
Capital formation	K	0.2101	0.0200	**	0.2447	0.0012	***
Electricity	ELEC	0.0185	0.0283	**	0.0184	0.0150	
Monetary/Fiscal Policy Variables							
Inflation Rate [INF]	INF	-0.0104	0.9886		-0.0208	0.2008	
Tax [TAX]	TAX	-0.0129	0.0398	**	-0.0670	0.0142	**
Trade Policy Variable							
Tax on trade [TT]	TT	-0.0855	0.3946		-0.0297	0.2084	
Exchange Rate [EXR]	EXR	-0.0464	0.0023	**	-0.0030	0.0324	**
Productive sector Variables							
Agriculture [% GDP]	AGR	-0.0464	0.0010	***	0.0327	0.0655	
Manufacturing [%GDP]	MAN	0.0756	0.0418	**	0.1505	0.0010	***
Service [% GDP]	SERV	-0.0160	0.0588		-0.1662	0.0288	**
Constant	Intercept	-0.204	0.0000	***	-0.23863	0.029	***
R Square		0.671			0.584		

** & *** means significance at the 95 % and 99 % CI levels.

In the Caribbean, eight variables were found to be significant in five groups, the market related, the human capital/private sector, infrastructure, the trade policy, and the productive sector groups, were significant. No variable was significant in the monetary/fiscal policy

groups. Based on the R square [0.671], the variables considered explain only 67.1 percent of the variation of productivity growth in the region In Latin America, seven of the variables in all six groups were significant and these groups include the market related, the human capital/private sector, infrastructure, the monetary/fiscal policy, the trade policy, and the productive sector groups. The variables studied explained 58.4 percent [R square = 0.584] of the variability in productivity growth.

With regards to the significant variables, the market size variable [MARKET] showed that productivity is likely to increase in both regions with an increase in market size. In particular for the Caribbean, a percent increase in market size is likely to result in an increase in productivity by 0.1417 percent. In Latin America, the increase is likely to be greater [0.2087 %]. This relationship followed those of Lina and Wengb (2019) and Ferraro et. al [2020] and suggest that as countries in the Caribbean and Latin America engage more external markets, there would be more incentives for firms to invest more to increase their productivity.

In the Human Capital/Private Sector group, in the Caribbean, both variables, the literacy rate [LIT] and credit per capita [CR] in the private sector, were significant and both had the expected positive signs [0.090 and 0.026 %] indicating that productivity is likely to increase as these variables increase. Some countries, including Guyana have expanded on their policies to advance both the literacy rate and credit made available to the private sector. In Latin America, only LIT was significant and this indicates that an improvement in literacy will have a significant impact on productivity growth in the region.

In the infrastructure group, K was significant in both regions and had the expected positive sign, as was also found in their studies by Nourzad. F. (995) and Trpeski, and Marijana (2019). The coefficient was similar in both regions [0.2101 and 0.244] suggesting that increased expenditure in fixed capital formation is likely to bring about increased productivity in both regions.

In terms of ELEC, the variable was significant only in the Caribbean, suggesting that an increase in access to electricity is likely to bring about an increase in productivity in the regions, quite possibly as a result of the private sector becoming more able to participate in commercial productions activities.

In the Monetary/Fiscal policy group, INF was not significant in the Caribbean. TAX was significant with the expected negative sign [-0.0129] suggesting that increases in tax on income, profit and capital gain is likely to be correlated with a reduction in productivity growth, as increases in tax reduces the capital available to invest in measures to improve productivity, as suggested by Cecchetti and Kharroubi [2018] and Manaresi and Pierri, [2019]. TAX was also significant in Latin America [-0.067].

The exchange rate [EXR], in the Trade Policy group, is the only significant variable and has the expected negative sign, in both regions, but the impact is greater in Latin America compared with the Caribbean [-0.0464 and -0.003]. These results suggest that, as suggested by Cravino [2014] and McLeod and Mileva [2011], as the exchange rate decreases, productivity is likely to increase, as a result of an increasing market size as more foreign buyers seek to take advantage of the low exchange rate.

In the productive sector group, in the Caribbean, AGR and MAN were significant. AGR was negative, suggesting that this sector has a lesser impact on productivity growth than the OTHER sector. MAN was positive [0.076] suggesting that a one percent increase in MAN is likely to have a 0.76 percentage in overall productivity in this region. In Latin America, MAN and SERV were significant. MAN was positive indicating that it impacted more on productivity in the region than the OTHER sector, mining and drilling included. SERV was negative [-0.166] indicating that the service sector has a lower impact on productivity than the OTHER sector

8. Conclusion

Productivity Indexes. Using the Malmquist productivity index as a measure of productivity, productivity was found to be greater in the Caribbean compared with Latin America, with the variation in the index being greater in the Caribbean. Technological change accounted for a greater proportion of productivity growth in Latin America, and technical efficiency played a greater role in the Caribbean. Compared to the pre- and post- covid years [covid year = 2019], productivity growth decreased in Latin America, whereas productivity growth increased in the Caribbean, over that period.

Regression. In terms of the economic variables that significantly impact productivity in the Caribbean, an increase in the market size, the literacy rate, and the availability of credit to the private sector, infrastructure building and a reduction in the exchange rate, are likely to have a positive impact on productivity. The agriculture and manufacturing sectors outperform the other sector [which includes mining and drilling] in bringing about an increase in productivity in the region.

In Latin America, the same variables were significant and had a similar impact on productivity growth. Exceptions were access to electricity, which was not significant, and taxes on income, profit, and capital gains, which was significant and had a negative impact on productivity growth. Also, the agricultural sector has a less strong impact on productivity growth than the other sector, which includes mining and drilling.

In terms of competitive policies to improve productivity in the Caribbean compared with Latin America, improving the literacy rate, making credit available to the private sector and increasing access to electricity will give this region an advantage, as the correlation between productivity growth and these variables were more favorable in this region. Also, expanding the manufacturing sector in the Caribbean is likely to have a greater positive impact in the Caribbean than in Latin America. Latin America has the advantage of a greater positive impact on productivity in market size and decreasing the exchange rate.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Alam, M. S., M. D. Miah, and A. K. Tiwari. The nexus between access to electricity and labor productivity in developing countries. 2018. https://doi.org/10.1016/j.enpol. 2018.08.009

[2] Araujo, E., Ferrari Filho, F., & Araujo, E. Macroeconomic Performance in Brazil under the Inflation Targeting Regime. Investigación Económica, 2018. 77, 72-101.

[3] Cecchetti, S. G. and E. Kharroubi. WHY DOES CREDIT GROWTH CROWD OUT REAL ECONOMIC GROWTH? 2018. Working Paper 25079 http://www.nber.org/papers/w25079.

[4] Chavas, J, and M. Aliber, 1993. An Analysis of Economic Efficiency in Agriculture: a non-parametric Approach, Journal of Agriculture and Resource Economics. 1993. July, 18(1),1-16.

[5] Cravino, J. Exchange Rates, Aggregate Productivity, and the Currency of Invoicing of International Trade. 2014.file:///C:/Users/User/Downloads/sem_2014_06_02 _cravino.n.pdf

[6] ECLAC [ed.]. Economic Survey of Latin America and the Caribbean 2023. Financing a sustainable transition: investment for growth and climate change action. 2023. https://www.cepal. org/en/ publications/67990-economic-survey-latin-america-and-caribbean-2023-financing-sustainable-transition.

[7] Fare, R., S. Grosskopf, M, Norris and Z. Zang. Productivity growth, technical progress and efficiency change in industrialized countries. 1994. American Economic Review, 1994, vol. 84, issue 1, 66-83

[8] Ferraro D, S Ghazi P. F. Peretto. Labor Taxes, Market Size, and Productivity Growth. 2020. https://public.econ .duke.edu/ ~peretto/FGP%20tax%20 reform% 202020.pdf

[9] Furceri, D., S. A. Hannan, J. D. Ostry, and A. K. Rose. Macroeconomic Consequences of Tariffs. IMF Working Paper. 2019. http://faculty.haas. berkeley.edu/arose.

[10] Khan, R., W. D. Shaw, and F. Hussain. Causality between literacy and labor productivity in Pakistan. Economics of Education Review, 1991. 10 (3): 245-251

[11] Kilumelume, M., B. Morando, C. Newman and J Rand, John. Tariffs, productivity, and resource misallocation. 2021. https://hdl.handle.net/ 10419/249480

[12] Lina, S and Y Wengb. Market size, productivity, and product quality regarding firm heterogeneity. Economic research – ekonomska Istrazivanja 2019, VOL. 32, NO. 1, 2924–2940 https://doi.org/10.1080/1331677X.2019.1653781.

[13] Makki, S. S., and A. Somwaru. Impact of Foreign Direct Investment and Trade on Economic Growth: Evidence from Developing Countries. American Journal of Agricultural Economics, 2004. 86(3). 795-801.

[14] Manaresi, F. and N. Pierri. Credit Supply and Productivity Growth. IMF working paper. 2019. file:///C:/Users/User/Downloads/WPIEA2019107.pdf.

[15] McLeod, D., and E Mileva. Real Exchange Rates and Productivity Growth. Discussion Paper. 2011. No: 2011-04. https://ideas.repec.org/p/frd/wpaper/dp2011-04.html

[16] Nourzad. F. Public capital formation and productivity growth.1995. https://link. springer.com/ article/ 10.1007/BF01073521

[17] Oladimeji, K. A, A. K. Abdulkareem and A, Adejumo. From Tech Skills to Performance Gains: How Digital Literacy Drives Productivity Improvements in the Public Sector. 2024. https://doi.org/10.54201/iajas.v4i1.93.

[18] Olson, Jr., M. Big Bills on the Sidewalk: Why Some Nations are Rich, and other Poor. 1996. Journal of Economic Perspectives, 10(2), 3-34.

[19] Perelman, S. R & D, Technical Progress and Efficiency Change in industrial activities. 1995. https://onlinelibrary.wiley.com; https://doi.org/10.1111/j.1475-4991.1995.tb00124.x

[20] Piper, D., F. Ferrari-Filho and M. T. Lélis. The Relationship between Productivity and Inflation: An Empirical Analysis of the Brazilian Economy. 2020. Theoretical Economics Letters, 10 (3): 563-578.

[21] Turnbull, D. Food security in the Caribbean. 2021. https://blog.iica.int/ en/blog/ food-security-caribbean.

[22] Trpeski, P. and C. Marijana. GROSS FIXED CAPITAL FORMATION AND productivity in southeastern Europe. 2019. Proceedings of FEB Zagreb International Odyssey Conference of Economics and Business. Zagreb, 1 (1): 277-288

[23] Valerie Mercer-Blackman Dave Seerattan. To Cut or Not to Cut Does the Caribbean Follow the Advice of Multilaterals? Inter-American Development Bank Country Department Caribbean Group POLICY BRIEF No. IDB-PB-214. 2014. File:///C:/Users/User/Downloads/ To-Cut-or-Not-To-Cut-Does-the-Caribbean-Follow-the-Advice-of-Multilaterals.pdf.

[24] Vartia, L.. How do Taxes Affect Investment and Productivity? 2008. https://www.oecd-ilibrary.org/economics/how-do-taxes-affect-investment-and-productivity_230022721067.

[25] World Bank. Economic review, Latin America, and the Caribbean. 2023. https://www. worldbank.org.

[26] World Bank. World Bank Group online data. 2024. https://data.worldbank.org.

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