Best and The Engines of Caribbean Growth and Development: Theory and Evidence

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Abstract

This paper revisits the central hypothesis of Best (1968) that the main engine of growth with industrial restructuring of a Caribbean economy is the 'residentiary' sector, which accumulates capital on the domestic account. We develop the hypothesis in an updated theoretical framework which assumes that the marginal product of capital depends on the rate of growth two broad industrial clusters, classified according to how they accumulate capital. One cluster, which embodies Best's residentiary sector, primarily produces and uses domestic capital to generate output and exports. The other primarily imports its capital to do the same. We test the hypothesis with annual data on Barbados, Jamaica and Trinidad and Tobago from 1970 to 2016, using OLS and a recursive SVAR. We find that the hypothesis is supported by the historical evidence. The finding implies that Caribbean countries need a concerted effort to develop the output and export capacity of their capital-producing sectors relative to their traditional exports.

1. Introduction

One of the key insights contributed to economic thought by Caribbean thinkers like Lewis (1950; 1954) and Best (1968; 1971; 1980) is that economic development is characterised by the success an economy achieves in combining economic growth, industrial restructuring and falling dependence on foreign capital over time. Given the initial distribution of assets in the economy, proactive asset redistribution policy is decisive in fostering industrial restructuring to generate growth. This paper revisits the central hypothesis of Best (1968) that the main engine of growth with industrial restructuring of a Caribbean economy is the 'residentiary' sector, which accumulates capital on the domestic account, and which he later came to describe as the 'inshore' sector. Best (1980) revisited the hypothesis for the case of Trinidad and Tobago and sought without success to provide empirical underpinnings using open-economy national accounting and Keynesian dynamic simultaneous-equations econometrics in the tradition of the Cowles Commission. As with mainstream supply-side models, Keynesian effective demand models are not designed to distinguish the effects of the supplying sectors on economy-wide growth. Moreover, a long enough time series was not available at the time to provide reliable parameter estimates. Here, we develop an alternative test of the effects of sector growth on economy-wide growth within the aggregate national accounting framework. We build on its specification of the roles of domestic and foreign savings in support of investment to model the economy-wide rate of growth in terms of the rates of growth of the sectors of the economy, suitably disaggregated. For this, we rely on the assumption that the marginal product of labour satisfies a distributive law of capital accumulation and employment. That is, the marginal product of labour depends on how capital accumulation is distributed among the sectors of the economy as they grow their marginal products of labour and contribute to employment growth. Accordingly, sectors of the economy are appropriately clustered according to how they accumulate capital, and specifically whether they mainly produce and use domestic capital or whether they mainly rely on imported capital. Sectors that mainly produce and/**or** use domestic capital incorporate the inshore sector identified by Best (1968).

We apply the minimum standards set by Kaldor (1966): to be a growth engine, a cluster's growth must stimulate economic growth through productivity growth and must stimulate significant growth in the other sectors of the economy. Thus, to develop the empirical measures, a reasonable first step is to use available historical evidence to determine if the underlying assumption is valid. On this basis, the contemporaneous relationships among the cluster growth rates and the economy-wide growth rate could be reliably specified. Applicable econometric methods needed to test the growth engine hypothesis using historical data within a small macroeconomic modelling framework were only developed after 1979. Among these are the two methods used in this paper: (i) estimation of forecast error variance decompositions (FEVDs) generated using low-dimension structural vector autoregressions (SVARs) introduced by Sims (1980); and (ii) in the case where model variables are nonstationary and cointegrated, estimation of the parameters of the cointegrating relationship estimated with the dynamic ordinary least squares (DOLS) approach introduced by Stock and Watson (1993). Fifty (50) years have passed since Best's hypothesis was first proposed as an alternative to Lewis' (1950; 1954) hypothesis proposing the manufacturing sector as the engine of Caribbean growth, and significant structural change has occurred in these economies in that time. Sufficient data are now available to apply the two methods identified above with acceptable reliability.

The paper makes several key contributions. First, it derives an applicable indicator of dependence in the sense intended by Best and formulates a theory of the relationship between dependence, economy-wide growth and industrial restructuring. Second, it updates Best's multisectoral hypothesis on the economy-wide rate of growth by relying on the assumption that the marginal product of labour satisfies a distributive law of accumulation and employment as described above. Third, it provides historical evidence to support this underlying assumption about determination of the marginal product of labour. Fourth, it provides historical evidence for Best's hypothesis about the central Caribbean growth engine using data on three economies from 1970 to 2016: Barbados, Jamaica and Trinidad and Tobago.

The rest of the paper is organised as follows. **Section 2** revisits the aggregate accounting framework and formulates the relationship between growth and dependence in the sense intended by Best. **Section 3** then uses the relationship between investment and savings from domestic and foreign sources to formulate the relationship between the economy-wide rate of growth and the growth of the industrial clusters of the economy, defined to encompass Best's 'inshore' sector. **Section 4** provides evidence to support the underlying assumption that the marginal product of labour satisfies the distributive law of accumulation and employment. **Section 5** uses OLS and the FEVDs to determine the clusters that serve as the growth drivers and thus identify the main engines of growth in Barbados, Jamaica and Trinidad and Tobago. **Section 6** summarises the findings and considers the implications for policy.

2. Growth and Dependence

We start from the characteristic relationship between output and the financing of expenditure, which embraces the domestic and foreign transactions of the open economy. Let Y be output, C private consumption, G government spending, dK the net accumulation of capital, T taxes, dA the net accumulation of foreign assets, and r_f the rate of return on foreign assets. Then:

1. $Y - T + r_f A = C + dK + G - T + dA$

The conventional interpretation of equation (1) is that it is the result of discretionary choices by individuals, domestic firms and public institutions regarding consumption, investment and public spending. If the economy is closed, then $A = 0$ and the accumulation of assets (dK) to determine the scale and structure of output is wholly constrained by the value of domestic production and savings (public and private). The economy cannot borrow and excess demand shows up as price increases. If the economy is open and its private and public spending exceeds the value of its domestic output, it has the option to borrow abroad, so $A < 0$ and it incurs interest payments, $r_f A$. If the value of its output exceeds its aggregate demand, it can lend abroad in pursuit of better risk-adjusted returns than is available at home, so $A > 0$ and $r_f A$ represents foreign earnings. The term dA describes the increased net liability resulting from these domestic decisions and it plays a complementary role in determining the nature, creativity, and scale of production and exports.

However, in a Caribbean economy matters are different. The conscious and voluntary decisions by domestic individuals, firms and public institutions regarding consumption, investment, technology, organisation, and public spending, and hence domestic savings, play only a minor role in the evolution of production and exports. The increased net liability dA is primarily the result of penetration by foreign direct investment, bringing technologies and organisation to organise production of a narrow range of exports designed to generate $r_f A$.

Compared to domestic savings, it dominates the accumulation of assets and the technology and organisation that produce output and exports. The level of dependence on foreign assets, $\rho = \frac{A}{Y}$, tends to be high and growing, continually increasing payments $r_f A$. This makes the reduction of ρ while growing and restructuring output the central concern of national economic, sociological and political development. That is, the central social concern is reduction of the relative importance of foreign capital inflows, with associated reduction in reliance on the foreign knowledge stock to support the accumulation of capital over time. Central to the achievement of such reduction is the growth of the domestic knowledge stock, in particular, the scientific, engineering and organisational knowledge of entrepreneurs and workers involved in production, backed by supporting public policies.

The path of ρ and its relationship to growth can be addressed using the country's balance of international payments. The income generated when producing the country's output can be spent on domestic output net of its exports ($Y - \frac{\varepsilon p_x}{p} X$) or on imports ($\frac{\varepsilon p_j}{p} J$), where ε is the domestic price of foreign currency, p_x is the foreign price of exports, p_j is the foreign price of imports, and p is the GDP deflator. That is:

2. $$C + dK + G = \left(Y - \frac{\varepsilon p_x}{p} X\right) + \frac{\varepsilon p_j}{p} J$$

Since the economy is designed primarily to produce exports, it is also highly dependent on imports as inputs into production, including distribution to households. Equation (2) is the national accounting identity. If taxes are added to account for government's primary budget balance, it indicates that the trade balance is**:**

3. $$\frac{\varepsilon p_x}{p} X - \frac{\varepsilon p_j}{p} J = Y - T - C - dK + T - G$$

Substituting equation (3) into equation (1) and reorganising gives the country's balance of international payments as:

4. $$\frac{\varepsilon p_x}{p} X - \frac{\varepsilon p_j}{p} J + r_f A = dA$$

The left-hand side of equation (4) is the *current account balance*, i.e., the sum of the balance of trade and net income receipts or payments on foreign assets current account. The right-hand side of the equation is the *capital account balance*, which is the net of (i) *capital outflows* to change the stock of foreign assets held by domestic firms and households, and (ii) *capital inflows* to change the stock of domestic assets held by foreign firms and households. Further, equation (4) indicates that movements on the current account must be matched by identical movements on the capital account.

For a Caribbean economy, we assume that initially $A < 0$ and $dA < 0$. To study the evolution of ρ, we multiply equation (4) by -1, divide through by Y and use the identity $\frac{dA}{Y} = \frac{d}{dt}(\frac{A}{Y}) + \frac{A}{Y}\frac{dY}{Y}$ to get the evolution of ρ as the linear order 1 differential equation:

5. $$\frac{d\rho}{dt} = \left(r_f - g\right)\rho(t) + g\frac{\frac{\varepsilon p_j}{p}J - \frac{\varepsilon p_x}{p}X}{dY}, \rho(t) > 0$$

Equation (5) indicates that $g\frac{\frac{\varepsilon p_j}{p}J - \frac{\varepsilon p_x}{p}X}{dY}$ is a forcing function determining the level of dependence. Once capacity has been established, the investment must be validated and sustained by production and trade performance, and causation runs from the current account to the capital account. Equation (5) indicates that if industrial restructuring can cause exports to grow relative to imports and if $g > r_f$, there will be a tendency for $\rho(t)$ to fall and the economy becomes less dependent over time.

Equation (5) can be further generalised to take account of two sets of tendencies: (i) the tendency for government's revenues to depend heavily on the performance of the specialised export sector developed by foreign capital inflows, and for the current account balance to drive the budget balance; and (ii) the tendency for government to use seigniorage from an expanding money supply (dM^s) as well as domestic borrowing to help finance its budget deficit and support expansion of domestic development credit to restructure the economy. In that case, we write the fundamental differential equation of development (FDED) for a Caribbean economy as:

6. $$\frac{d\rho}{dt} = \left(r_t - g\right)\rho(t) + H(t), \rho(0) > 0$$

where $H(t) = g\frac{\frac{\varepsilon p_j}{p}J - \frac{\varepsilon p_x}{p}X + G - T - dM^s}{dY}$ and $r_t = i_t\alpha + \varepsilon_t r_f \beta(1 + \varphi)$ is the weighted average of the rates of return on domestic liabilities (i_t) and foreign liabilities (r_f) with weights α and β, the respective shares of government domestic borrowing and foreign capital inflows in total national liabilities and with φ representing government's share of the foreign liabilities. If $H(t) = 0$, the FDED takes the classical form with $\frac{d\rho}{dt} = F\left(\rho, t\right)$. Equation (6) indicates that dependence grows when the liabilities produce combined trade deficits, budget deficits and returns that overwhelm the effects on real growth and seigniorage. On the other hand, if liabilities are used in such a way that the right-hand-side tends to be negative, so $(r_t - g)\rho(t) + H(t) < 0$, then dependence falls. This is because the liabilities produce real growth and seigniorage that either overwhelm any associated trade deficits, budget deficits and returns on liabilities or cause trade and budget surpluses.

There are some advantages to solving the DE, including determination of what drives ρ at any time and the necessary and sufficient long-run conditions for development. Assuming that $(\mathrm{r}_t - g)$ is constant, the integrating factor that makes the DE exact is $e^{-\int(\mathrm{r}_t - g)dt} = e^{-(\mathrm{r}_t - g)t}$. It applies even if $H(t)$ is zero. Thus,

7. $$\rho e^{-(\mathrm{r}_t - g)t} = H(t)\int e^{-(\mathrm{r}_t - g)t}dt$$

Or,

8. $$\rho(\mathrm{t}) = H(t)[\frac{1}{(g - \mathrm{r}_t)} + ce^{(\mathrm{r}_t - g)t}]$$

where c is a constant of integration. For the steady-state value of ρ, we find $\lim_{t\to\infty}\rho(t)$. There are three interesting basic economic cases associated with (8).

In **case 1**, the value of exports generated is low relative to imports. This can be the result of low export prices relative to import prices as the terms of trade tends to move against exports in the sense intended by Prebisch (1950). It can also be the result of negative demand shocks associated with the business cycles of the foreign economy or unattractive characteristics of the exports. In such situations, the economy runs a trade deficit with $\frac{\varepsilon p_j}{p}J > \frac{\varepsilon p_x}{p}X$. The associated current shortage of foreign exchange reduces domestic effective demand and slows growth of imports and reduces government revenues, causing the rate of growth to fall below the rate of return on foreign assets. If $\mathrm{r}_t > g$, then whatever the contribution of the term $\frac{H(t)}{(g - \mathrm{r}_t)}$, as $\mathrm{t} \to \infty$ the second term in (8), $H(t)ce^{(\mathrm{r}_t - g)t}$, becomes infinitely large causing $\rho(t)$ to rise explosively and the economy to become increasingly dependent in the long run. This is the basic logic of the process that produces persistent stagnation and explosive dependence, described by Best (1968) as “gall and wormwood”. Generally, the trade deficits cause budget deficits that align with returns and overwhelm the effects of real growth and seigniorage. In practice, the economy cannot afford the cost of restructuring and becomes more dependent on foreign discretion, capital, technologies and organisation to develop the specialist export sector so A grows, making dA and A larger negative numbers.

In **case 2**, the value of exports is high relative to imports and the economy runs a trade surplus but output and exports do not restructure. This can occur because rising demand and favourable supply characteristics cause the terms of trade moves in favour of exports, jointly causing $\frac{\varepsilon p_x}{p}X > \frac{\varepsilon p_j}{p}J$. The associated abundance of foreign exchange enables growth of effective demand that fosters high growth sufficient to equal or exceed the rate of return on foreign assets. If $g > r_t$, $\rho(t)$ falls to a finite value determined by $\frac{H(t)}{(g - \mathrm{r}_t)}$, since as t $\rightarrow \infty$ the second term in (8), $H(t)ce^{(\mathrm{r}_t - g)t} \rightarrow 0$. This is the case corresponding to what Best (1968) described as a "golden age". Generally, the foreign liabilities create assets that produce real growth and seigniorage that either overwhelm any associated trade deficits, budget deficits and returns on liabilities or cause trade and budget surpluses. The economy becomes less dependent on foreign capital, but exports remain highly concentrated on the traditional export sector that relies on foreign technologies and organisation. Demand for industrial restructuring is not a social imperative. In practice, if the trade surplus is sufficiently large it enables the economy to fund payments due to foreign direct investors and to claim and invest the net proceeds abroad, building up foreign reserves, so it also runs a current account surplus and alters the net flow of foreign assets. Specifically, the surplus eventually leads to $A > 0$ and $dA > 0$, with $\frac{\varepsilon p_x}{p}X > \frac{\varepsilon p_j}{p}J$. This occurs even as foreign direct investment remains focused on the original export sectors of interest. This is growth with falling dependence but without development.

In **case 3**, policy interventions address the risk of negative price and demand shocks and the tendency to current account deficits associated with case 1 by redirecting domestic and foreign investment and supporting resources to sectors that can develop new ideas, diversify and grow output and exports and create supporting demand. The financial outcomes of case 2 are replicated with key structural differences. The foreign liabilities combine with domestic investment to create assets that produce real growth and seigniorage that either overwhelm any associated trade deficits, budget deficits and returns on liabilities or cause trade and budget surpluses. The original net flow of international assets is reversed, eventually causing $A > 0$, and $dA > 0$, with $\frac{\varepsilon p_x}{p}X > \frac{\varepsilon p_j}{p}J$. However, in this case, as the rate of growth rises above the rate of return to foreign assets, and $\rho(t)$ falls, the economy also becomes less dependent on foreign ideas, capital, technologies and organisation. Even if economic conditions were to change and cause the economy to run a current account deficit, emerging sectors could innovate and restore balance or create a surplus in response. This is growth with development. This case raises the empirical question: which sector of the economy had the largest impact on the rate of growth in the pursuit of development since 1968?

3. Growth and Industrial Restructuring

Using equation (3), we assume for simplicity that private savings comes from unspent profit income at a rate s_k, with profit generated on the growing capital stock as $\left(r + K\frac{dr}{dK}\right)K$. Also use-depreciation and obsolescence occur at a constant rate δ_k. Since workers do not save, the taxes that affect the savings rate are taxes on profits at a rate t_p. In the Caribbean economy, net savings must be adjusted to allow for capital flight when depressed economic conditions exist or when confidence in the economy falls. Capital flight takes two forms. One is an outflow of financial savings, which reduces the flow of unspent income to the economy. The other is human capital flight, at a rate δ_h, which has the effect of further lowering the net household savings rate. Thus, in equilibrium, we write:

9. $$dK = T - G \pm dA + \left(s_k(r + K\frac{dr}{dK})(1 - t_p) - \delta_k - \delta_h\right)K$$

If we divide through equation (9) by K, the rate of growth of the capital stock is:

10. $$\frac{dK}{K} = \frac{T-G}{K} \pm \frac{dA}{K} + s_k(r + K\frac{dr}{dK})(1 - t_p) - \delta_k - \delta_h$$

Thus, the rate of accumulation of capital in the economy depends on how net foreign capital inflows enter the process. We assume a current account deficit and use $\frac{dA}{K} = \frac{dK}{K}\frac{A}{K} + \frac{d}{dt}\frac{A}{K}$ to get:

11. $$\frac{dK}{K}(1 - \frac{A}{K}) = \frac{T-G}{K} \pm \frac{d}{dt}\frac{A}{K} + s_k(r + K\frac{dr}{dK})(1 - t_p) - \delta_k - \delta_h$$

where $\frac{A}{K}$ is the ratio of net foreign assets to the capital stock. Next, we assume that the capital stock created by the economy depends on the output it seeks to produce. Following Lewis (1954), some of the capital stock might be produced and some imported. Then, for the relationship between K and Y we assert that there always exists some power v, $0 < v \leq 1$, and some proportionality factor $\lambda > 1$ such that:

12. $K = \lambda Y^{v}$

Thus,

13. $$\frac{dK}{K} = \nu \frac{dY}{Y}$$

If $\nu < 1$, there are increasing returns to capital accumulation, consistent with Lewis (1954) and later Kaldor (1966). If $\nu = 1$, there are constant returns, consistent with Harrod (1939) and Domar (1946). Substituting from (13) into (11) gives the rate of growth as:

14. $$\frac{dY}{Y} = m[\frac{T-G}{K} \pm \frac{d}{dt}\frac{A}{K} + s_k(r + K\frac{dr}{dK})(1-t_p) - \delta_k - \delta_h]$$

where $m = \dfrac{1}{v(1-\frac{A}{K})}$.

To explain the growth of the profit rate and bring the wage rate into the story, we use the distribution of income. That is:

15. $$Y = rK + wN$$

where w is the real wage rate and r the real rate of profit. From the total differential of Y in (15), we get:

16. $$dY = rdK + Kdr + wdN + Ndw$$

This gives:

17. $$r + K\frac{dr}{dK} = \frac{\frac{dY}{dN} - w - N\frac{dw}{dN}}{\frac{dK}{dN}}$$

Substituting from (17) into (14) yields the rate of growth as:

18. $$\frac{dY}{Y} = m[\frac{T-G}{K} + \frac{d}{dt}\frac{A}{K} + s_k(\frac{\frac{dY}{dN} - w - N\frac{dw}{dN}}{\frac{dK}{dN}})(1-t_p) - \delta_k - \delta_h]$$

In equation (18), $\dfrac{\frac{dY}{dN}}{\frac{dK}{dN}} = \dfrac{dY}{dK}$. That is, the marginal product of capital grows by investment that increases employment while growing the marginal product of labour even faster. So the equation indicates that the rate of growth is determined by the savings rate times the marginal product of capital minus the effects of capital accumulation on employment growth and wage growth adjusted by the tax rate on profits and minus the rate of depreciation of capital caused by use and obsolescence or human capital flight. It is also determined by the availability of government savings, the rate of growth of the ratio of net foreign capital assets to the capital stock, and the extent of increasing returns in the economy. The rate of growth is increased by increasing the savings rate, the marginal product of capital and the extent of increasing returns, and by restraining wage growth and decreasing the rate of depreciation of capital and the rate of taxes on profits.

Notwithstanding the importance of the other factors, the main force driving the rate of growth is the marginal product of capital, and hence the marginal product of labour. This is partly because trade performance as well as government and private savings are jointly determined by the marginal product of labour. The marginal product of labour reflects the efficiency with which new workers use the changing stock of knowledge and organisation to increase output and is the main determinant of the marginal product of capital. Consistent with Lewis (1954), it grows when investment creates jobs while enabling the upgrade of technology and the economic and social organisation of production, slowing technological obsolescence and fostering financial and human capital inflows. Such investment enables firms and government to improve the technologies (products and processes) of production available to workers involved in the value-generation process. It also equips workers with better knowledge and skills to work in the upgraded organisational frameworks and use the upgraded technologies. Finally, such investment improves the school systems, the governance arrangements, and other social organisations needed to underwrite the successful use of improved technologies while reducing human capital flight. In addition to increasing the net savings rate, this process enables upgrade of the non-price competitive characteristics of exports and domestic output compared to imports, leading to an increase of foreign market creation and exports faster than imports and to growth of the ratio of the current account balance to investment. It also grows net government revenues relative to investment.

The growth of the marginal product of capital, savings and exports depends on *how* economy-wide capital accumulation is achieved by the industrial clusters as they create employment opportunity in the economy. In general, there are two choices. One is to produce and use capital to create output, value and exports, and the other is to import capital to do the same. Accordingly, we classify the sectors of the economy into two clusters.

One cluster, which we label μ, comprises a set of sectors which accumulate capital mainly by producing and employing it supplemented by imported capital. It includes manufacturers of final capital goods, education, healthcare, business services, ICT and the creative industries, as well as using sectors such as tourism, travel services, domestic agriculture, construction, and government. This is the cluster that embodies Best's inshore sector with its capacity for "independent thought" (Best, 1971). As this cluster grows, it increases the supply and employment of domestic capital which incorporates domestic and international discoveries with wide applicability, fostering embodied improvements of technology and organisation and slowing the depreciation of capital due to obsolescence. It also facilitates improvement of the school system, the healthcare system, governance arrangements, and other institutional upgrades needed to enable workers and managers to use improving technologies and organisation more efficiently. The technological and organisational improvements cause growth of the marginal product of labour while creating new employment opportunity within the industries. As the capital industries grow and create job openings and markets, they slow or reverse the flight of human capital and attract underemployed labour from other sectors in the cluster, leading to growth of the marginal product of labour in these other sectors. Further, the capital output of the cluster is used by all other sectors of the economy, fostering disembodied technical and organisational progress and growth of the marginal productivity of labour through the interdependence of demand and supply of the sectors and the spillover of non-rivalrous and non-excludable knowledge. Thus, the marginal product of labour in the entire cluster and economy grows along with savings and the taste- and market-creating capacity that grows exports. The cluster's effect on the growth of exports is partly subject to government policy on the conversion of traditionally non-traded output into traded output and government policy on the supply of development credit and infrastructure to the domestic capital sector.

The other cluster, which we label Y_{nk}, comprises the sectors that accumulate capital mainly by importing it along with foreign entrepreneurship and finance, supplemented by some capital purchased from the domestic capital cluster. This cluster comprises the traditional export activities, including mineral exports and traditional export agriculture. The marginal product of labour in this cluster grows mainly through the embodied technologies and organisational arrangements associated with the use of imported capital and other inputs to facilitate growth of the cluster. Growth of the marginal product of labour in this cluster has no significant impact on growth of the marginal product of labour in the cluster producing and employing domestic capital, except by increasing the supply of foreign exchange through its exports. It may also induce human capital flight if the supply of foreign exchange has the long run effect of raising the domestic wage rate and slowing growth in the domestic capital cluster.

In general, the marginal product of labour satisfies the distributive law of capital accumulation and job creation. It depends on how the sectors of the economy contribute to the accumulation of capital (with technical and organisational progress) and the creation of employment as they grow. That is, the marginal product of labour satisfies:

19. $\frac{dY}{dN} = \frac{dK}{dN}(a\frac{1}{\mu}\frac{d\mu}{dt} + b\frac{1}{Y_{nk}}\frac{dY_{nk}}{dt})$

Use of (19) with equation (18) gives the multisectoral model of economic growth. When these equations are combined with equation (8), the result is a model of economic development subject to the influence of discretionary public policy. While the savings rates play a major role in determining the rate of growth in (18), the main driver is the contribution of the growing industrial clusters to capital accumulation with technical and organisational progress and hence to growth of the efficiency of labour and capital. The cluster which contributes most to this process also contributes most to growth. As has been argued by ul Haque (1995), it is the cluster associated with domestically produced inputs that drive productivity growth in a development process. From the basic concept of capital as 'produced means of production', it is therefore the cluster that produces domestic capital that is expected to contribute most.

Equation (19) contributes two sets of shocks to generate growth in equation (18). One set comprises technology and organisational shocks along with credit policy shocks which affect growth of the domestic capital cluster ($\frac{1}{\mu}\frac{d\mu}{dt}$) and can contemporaneously affect growth of the traditional export cluster ($\frac{1}{Y_{nk}}\frac{dY_{nk}}{dt}$). Another set of technology and organisational shocks affects growth of the traditional export cluster independently without generating any contemporaneous effects on the domestic capital cluster. A third set of shocks comprises policy shocks that affect growth through the private savings rate, the budget balance or the capital account without contemporaneously affecting growth of the industrial clusters.

4. The Fundamental Assumption – What the Evidence Shows

The main assumption underlying the theory of growth is expressed in equation (19), which indicates that the marginal product of labour adjusts according to how the industrial clusters of the economy contribute to the accumulation of capital (with technical and organisational progress) and the creation of employment as they grow. It is reasonable that the first empirical step should be to see whether the available evidence on the three country cases supports this assumption and validates treating it as a stylized growth fact in the sense of Kaldor (1961). The assumption is tested in the form of the proposition that the efficiency of capital adjusts depending on the rate of growth of each of the industrial clusters. To the extent that the clusters of the economy are beneficiaries, the assumption is consistent with the Ansari (2004) proposition that the efficiency of capital is also adjusted by inflows of foreign capital. However, consistent with Grossman and Helpman (1991), we add the degree of openness of the economy as a source of spillovers from interaction in trade that enable growth of efficiency. Thus, for each case, we run the following regression model with adjustments for stationarity and endogeneity:

20. $\frac{dY}{dK} = a_0 + a_1 g_\mu + a_2 g_{nk} + a_3 tr + e_{kt}$

where $g_\mu = \frac{1}{\mu}\frac{d\mu}{dt}$, $g_{nk} = \frac{1}{Y_A}\frac{dY_A}{dt}$, tr is the trade ratio (the ratio of the sum of exports and imports to GDP) and e_{kt} is an additive white-noise residual with mean zero and variance σ^2. Estimation of equation (20) with OLS raises the issue of whether the variables in the regression are covariance stationary, or I(0). It also raises the issue that correlation between g_μ, g_{nk}, tr and e_{kt} can be high enough to generate serious endogeneity bias when estimating with OLS. One must decide if it is necessary to use instruments for these potentially endogenous variables before proceeding to estimation. The question is whether any endogeneity that may be present is sufficient to prevent use of OLS to obtain consistent estimates of the parameters in the model. The null hypothesis is that OLS estimates of the coefficients are consistent. The hypothesis can be tested with the Durbin-Wu-Hausman (DWH) augmented regression test suggested by Davidson and Mackinnon (1993: 237-242). To implement the method, we treat $l\,.\,g_\mu$, $l\,.\,g_{nk}$ and $l\,.\,tr$ as plausible instruments and estimate the regressions:

21. $$g_h = \pi_0 + \pi_1 l\,.\,g_\mu + \pi_2 l\,.\,g_{nk} + \pi_3 l\,.\,tr + e_{h,t}$$

22. $$g_{nk} = \pi_0 + \pi_1 l\,.\,g_\mu + \pi_2 l\,.\,g_{nk} + \pi_3 l\,.\,tr + e_{nk,t}$$

and

23. $$tr = \pi_0 + \pi_1 l\,.\,g_\mu + \pi_2 l\,.\,g_{nk} + \pi_3 l\,.\,tr + e_{tr,t}$$

The estimated residuals $\hat{e}_{h,t}$, $\hat{e}_{nk,t}$ and $\hat{e}_{tr,t}$ are then retrieved and used in the specification of equation (20) that takes account of the stationarity of the variables. If the coefficients of $\hat{e}_{h,t}$ and $\hat{e}_{nk,t}$ and $\hat{e}_{tr,t}$ are not significantly different to zero, then endogeneity does not create sufficient bias to warrant instrumentation of g_μ, g_{nk} and tr, and the OLS parameter estimates are consistent.

For the case of Barbados, we use the Augmented Dickey-Fuller, Phillips-Perron, and DFGLS tests of the order of integration to check the stationarity of the variables. For the Dickey-Fuller and Phillips-Perron tests, we used one lag as suggested by most information criteria. The test results (Table 1) indicate that $dydk$, g_μ, and g_{nk} are I(0) but tr is I(1), so we use the first difference of tr, $d\,.\,tr$, in the model. Application of the DWH procedure to check for endogeneity bias indicated that the parameters of equation (20) can be consistently estimated with OLS. The estimated capital efficiency equation for Barbados is:

$$24.\ \frac{d\hat{Y}}{dK} = 5.98_{0.000}g_{\mu} + 1.22_{0.000}g_{nk} - .145_{0.380}d\,.\,tr - 0.036_{0.006},\ AdjR^2 = 0.88; RMSE = 0.074; DW = 1.86$$

The diagnostics of the model are strong. The adjusted R^2 is high and there is no serial correlation in the residuals. The evidence supports the assumption that the marginal product of labour depends on the rate of growth of the broad industrial clusters of the economy, with no statistically significant role for the degree of openness of the economy, and with most of the stimulus coming from growth of the domestic capital cluster.

Table 1: Tests of g_{μ}, g_{nk}, $dydk$ and tr for Unit Roots- Barbados					
g_{μ}	Test Statistic	1% CV	5% CV	10% CV	Order of Integration
ADF, lags(1)	-4.03	-3.62	2.95	-2.61	I(0)
PP, (1) lags(1)	-25.65	-18.56	-13.14	-10.6	I(0)
PP, (2) lag(1)	-4.19	-3.61	-2.94	-2.61	I(0)
DFGLS, lags (1)	-3.34	-3.77	-3.26	-2.95	I(0)
g_{nk}	Test Statistic	1% CV	5% CV	10% CV	Order of Integration
ADF, lags (1)	-5.92	-3.62	2.95	-2.61	I(0)
PP, (1) lags(1)	-37.79	-18.56	-13.14	-10.6	I(0)
PP, (2) lags(1)	-6.01	-3.61	-2.94	-2.61	I(0)
DFGLS, lags(1)	-5.07	-3.77	-3.26	-2.95	I(0)
$dydk$	Test Statistic	1% CV	5% CV	10% CV	Order of Integration
ADF, lags (1)	-4.15	-3.62	2.95	-2.61	I(0)
PP, (1) lags(1)	-29.74	-18.56	-13.14	-10.6	I(0)
PP, (2) lags(1)	-4.57	-3.61	-2.94	-2.61	I(0)
DFGLS, lags(1)	-3.75	-3.77	-3.26	-2.95	I(0)
tr	Test Statistic	1% CV	5% CV	10% CV	Order of Integration
ADF, lags (1)	-2.24	-3.61	-2.94	-2.61	I(1)
PP, (1) lags(1)	-7.74	-18.56	-13.14	-10.6	I(1)
PP, (2) lags(1)	-1.99	-3.61	-2.94	-2.61	I(1)
DFGLS, lags(1)	-2.01	-3.77	-3.26	-2.95	I(1)

For the case of Jamaica, the Augmented Dickey-Fuller, Phillips-Perron, and DFGLS tests of the order of integration (Table 2) all suggest that $dydk$, g_{μ} and g_{nk} are I(0) while tr is I(1).

Table 2: Tests of g_μ, g_{nk}, $dydk$ and tr for Unit Roots, Jamaica					
g_μ	Test Statistic	1% CV	5% CV	10% CV	Order of Integration
ADF, lags(1)	-4.09	-3.62	-2.95	-2.61	I(0)
PP, (1) lags(1)	-30.96	-18.56	-13.14	-10.6	I(0)
PP, (2) lag(1)	-4.75	-3.61	-2.94	-2.61	I(0)
DFGLS, lags (1)	-4.1	-3.77	-3.26	-2.95	I(0)
g_{nk}	Test Statistic	1% CV	5% CV	10% CV	Order of Integration
ADF, lags (1)	-5.33	-3.62	-2.95	-2.61	I(0)
PP, (1) lags(1)	-46.5	-18.56	-13.14	-10.6	I(0)
PP, (2) lags(1)	-6.96	-3.61	-2.94	-2.61	I(0)
DFGLS, lags(1)	-4.14	-3.77	-3.26	-2.95	I(0)
$dydk$	Test Statistic	1% CV	5% CV	10% CV	Order of Integration
ADF, lags (1)	-3.97	-3.62	-2.95	-2.61	I(0)
PP, (1) lags(1)	-31.25	-18.56	-13.14	-10.6	I(0)
PP, (2) lags(1)	-4.8	-3.61	-2.94	-2.61	I(0)
DFGLS, lags(1)	-4.51	-3.77	-3.26	-2.95	I(0)
tr	Test Statistic	1% CV	5% CV	10% CV	Order of Integration
ADF, lags (1)	-1.53	-3.62	-2.95	-2.61	I(1)
PP, (1) lags(1)	-4.24	-18.56	-13.14	-10.6	I(1)
PP, (2) lags(1)	-1.67	-3.61	-2.94	-2.61	I(1)
DFGLS, lags(1)	-1.49	-3.77	-3.26	-2.95	I(1)

So, here too, we use the stationary variable $d\,.\,tr$ in the model. The results of the DWH procedure with lagged values of g_μ, g_{nk} and $d\,.\,tr$ as instruments for g_μ, g_{nk} and $d\,.\,tr$ indicate that the parameters of equation (20) can be consistently estimated with OLS. The estimated capital efficiency equation for Jamaica is:

25. $$\frac{d\hat{Y}}{dK} = 3.23_{0.000}g_\mu + 0.55_{0.000}g_{nk} - \ .002_{0.985}d\,.\,tr - 0.013_{0.142},\ AdjR^2 = 0.87; RMSE = 0.054; DW = 1.67$$

Here too, the diagnostics of the model are strong and the evidence supports the assumption that the marginal product of labour depends on the rate of growth of the broad industrial clusters of the economy, with most of the stimulus coming from growth of the domestic capital cluster. The changing trade ratio adds no explanatory power to the core assumption.

For the case of Trinidad and Tobago, the Augmented Dickey-Fuller, Phillips-Perron, and DFGLS tests of the order of integration (Table 3) all suggest that the variables $dydk$, g_μ, g_{nk} and tr are all I(1).

Table 3: Tests of g_μ, g_{nk}, $dydk$ and tr for Unit Roots, Trinidad and Tobago					
g_μ	Test Statistic	1% CV	5% CV	10% CV	Order of Integration
ADF, lags(1)	-2.75	-3.62	2.95	-2.61	I(1)
PP, (1) lags(1)	-18.37	-18.56	-13.14	-10.6	I(1)
PP, (2) lag(1)	-3.32	-3.61	-2.94	-2.61	I(1)
DFGLS, lags (1)	-2.64	-3.77	-3.26	-2.95	I(1)
g_{nk}	Test Statistic	1% CV	5% CV	10% CV	Order of Integration
ADF, lags (1)	-1.91	-3.62	2.95	-2.61	I(1)
PP, (1) lags(1)	-21.83	-18.56	-13.14	-10.6	I(0)
PP, (2) lags(1)	-3.59	-3.61	-2.94	-2.61	I(1)
DFGLS, lags(1)	-1.97	-3.77	-3.26	-2.95	I(1)
$dydk$	Test Statistic	1% CV	5% CV	10% CV	Order of Integration
ADF, lags (1)	-2.04	-3.62	2.95	-2.61	I(1)
PP, (1) lags(1)	-15.03	-18.49	-13.11	-10.58	I(1)
PP, (2) lags(1)	-2.98	-3.62	-2.95	-2.61	I(1)
DFGLS, lags(1)	-1.89	-3.77	-3.27	-2.96	I(1)
tr	Test Statistic	1% CV	5% CV	10% CV	Order of Integration
ADF, lags (1)	-0.82	-3.62	2.95	-2.61	I(1)
PP, (1) lags(1)	-4.65	-18.49	-13.11	-10.58	I(1)
PP, (2) lags(1)	-1.23	-3.62	-2.95	-2.61	I(1)
DFGLS, lags(1)	-3.54	-3.77	-3.27	-2.96	I(1)

We use the Johansen (1988; 1991) trace statistic to test for the existence of cointegrating vectors in the data and found evidence of one cointegrating vector. Then, we use the Stock and Watson (1993) DOLS procedure to estimate the cointegrating coefficients for equation (19). Here, we include the contemporaneous changes $d.g_\mu$ and $d.g_{nk}$ and $d.tr$ in the regression. Their effect is to remove the stochastic trends from g_μ, and g_{nk} and tr. If e_{kt} features no serial correlation, then OLS can be used to generate consistent and efficient estimators for the equation parameters. If e_{yt} features serial correlation, then past and future lags and leads of $d.g_\mu$ and $d.g_{nk}$ as well as of $d.tr$ can also be included to generate consistent and efficient estimators of a_1, a_2, and a_3, which asymptotically support standard t-statistics and F-statistics based on the t and F distributions. Stock and Watson used Monte Carlo analysis to show that their GLS method has the same asymptotic properties as the Johansen (1988; 1991) large sample maximum likelihood cointegration method but is more successful in reducing bias due to small samples and dynamic variables. The general model lag length is conventionally set at 2. Both leads and lags are suggested by Stock and Watson, but it has been shown by Hayakawa and Kurozumi (2006) that use of lags only will tend to produce better estimates.

The estimated capital efficiency equation for Trinidad and Tobago is:

26. $\frac{\hat{dY}}{dK} = 3.1_{0.000} g_\mu + 2.53_{0.000} g_{nk} + 0.51_{0.007} tr - 0.62_{0.24} d \, . \, g_\mu + \, .02_{0.97} d \, . \, g_{nk} - 0.24_{0.408} d \, . \, tr - 0.415_{0.016}, \; AdjR^2 = 0.73; RMSE = 0.17; DW = 1.71$

The diagnostics of the model are reasonably good with no significant serial correlation in the residuals. The residuals are stationary as indicated by the ADF test with test statistic of -5.688, well above the critical values at all conventional levels of significance. Thus, the evidence supports the assumption that the marginal product of labour depends on the rate of growth of the broad industrial clusters of the economy, along with the degree of openness of the economy. As with Barbados and Jamaica, most of the stimulus to the level of efficiency comes from growth of the domestic capital cluster.

Overall then, the evidence in support of the main assumption of the analysis is strong and provides a firm basis for investigation of the engines underlying growth and development.

5. Identifying the Engines of Growth

To identify empirically the causal relationships among the cluster growth rates in equation (19) and the rate of growth in equation (18), and thus determine the engines of growth, we use data provided by the UNSD for 1970 to 2016. Also, we follow McCombie and de Ridder (1983), Bairam (1991), and Atesoglu (1993) in applying time series methods to individual countries. We use two complementary methods:

1. OLS, which is the easiest statistical method to use and yields the most efficient estimates if it can yield consistent parameter estimates (Davidson and MacKinnon, 1993:237).
2. A recursive SVAR guided by the analytical framework specified above.

OLS Estimation

To estimate the relationship among the variables in equation (18) using OLS, we write the model with an additive white noise residual as:

27. $$g_y = \beta_0 + \beta_1 g_\mu + \beta_2 g_{nk} + e_y$$

where $g_y = \frac{1}{Y}\frac{dY}{dt}$, $g_\mu = \frac{1}{\mu}\frac{d\mu}{dt}$ and $g_{nk} = \frac{1}{Y_A}\frac{dY_A}{dt}$ and where e_y is white noise with mean zero and variance σ^2. Estimation of the parameters of equation (27) with OLS raises the issue of the stationarity of the variables in the regression and endogeneity bias. As before, the null hypothesis is that OLS estimates of the coefficients are consistent and this can be tested with the DWH augmented regression test. To implement the method, we again treat $l\,.\,g_h$ and $l\,.\,g_{nk}$ as plausible instruments.

The SVAR and FEVD Estimates

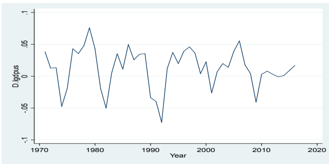
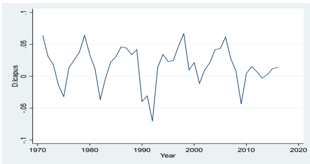
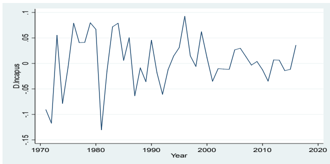
Notwithstanding the absence of sufficient bias, any level of correlation among the variables g_h and g_{nk} makes it impossible to give the estimated coefficients of (27) a causal interpretation. For a causal interpretation, we write the short-run SVAR implied by the analytical framework in terms of the following recursive relationship between the structural parameters and the reduced-form parameters:

$$28.\quad \begin{bmatrix} a_{11} & & \\ a_{21} & a_{22} & \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \begin{pmatrix} u_{\mu,t} \\ u_{nk,t} \\ u_{y,t} \end{pmatrix} = \begin{pmatrix} e_{\mu,t} \\ e_{nk,t} \\ e_{y,t} \end{pmatrix}$$

Here, each row can be viewed as an equation, and the $e_{k,t}$ are weighted averages of selected structural shocks $u_{k,t}$. The coefficients a_{ij} are the weights. The identification procedure is justified by treating the first two equations as descriptions of how the structure of the economy changes. The first equation says that $e_{h,t} = a_{11}u_{\mu,t} + 0 + 0$ and the second that $e_{nk,t} = a_{21}u_{\mu,t} + a_{22}u_{nk,t} + 0$. The shock $u_{\mu,t}$ adjusts both the domestic capital industries and the externally-propelled industries in the same year. It represents a credit, fiscal (including infrastructure) policy and technology shock affecting development of the structure of the economy. On the other hand, the shock $u_{nk,t}$ which leads to growth of the externally-propelled industries does not directly affect the domestic-capital clusters in the same year. So, the shock represents the adjustment of external capital inflows and export prices which target the externally-propelled industries. Finally, the last equation indicates that for the economy $e_{y,t} = a_{31}u_{\mu,t} + a_{32}u_{nk,t} + a_{33}u_{y,t}$, so that the random shocks that directly increase output in a given year combine with the efficiency and restructuring shocks to do so, but do not independently cause restructuring in that year. From equation (18), $u_{y,t}$ represents a mix of trade policy shocks or budget shocks that affect growth directly without contemporaneous effects on the outputs of the industrial clusters in equation (19). It takes time for firms to translate such shocks into investment decisions that lead to installation of new plant and new technologies that affect the technological characteristics or scale of output of the domestic capital industries and the externally-propelled industries. This is the assumption that corresponds to equation (27).

Barbados

In the case of Barbados, the traditional import-dependent cluster includes export agriculture along with import substitution manufacturing and import-dependent mining. Figure 1 graphs the variables (g_y, g_μ, g_{nk}) for the Barbados economy for 1970 to 2016. The graph shows that the variables are generally stationary over the period.

Figure 1: Graphs of g_y, g_μ, g_{nk}, Barbados, 1970-2016		
		
Graph of g_y, Barbados, 1970-2016	Graph of g_μ, Barbados, 1970-2016	Graph of g_{nk}, Barbados, 1970-2016

We used the Dickey-Fuller, Phillips-Perron, and DFGLS tests of the order of integration of g_y to confirm the stationarity suggested by the graphical evidence. The graph of the data shows no distinct time trend, so we assumed a random walk without drift and restricted the trend coefficient to zero. For the Dickey-Fuller and Phillips-Perron tests, we used one lag as suggested by most information criteria. The test results indicating the order of integration of g_y are reported in Table 4. Consistent with the results in Table 1, the variable is I(0).

Table 4: Tests of g_y for Unit Roots, Barbados					
g_y	Test Statistic	1% CV	5% CV	10% CV	Order of Integration
ADF, lags(1)	-4.42	-3.62	2.95	-2.61	I(0)
PP, (1) lags(1)	-27.53	-18.56	-13.14	-10.6	I(0)
PP, (2) lag(1)	-4.26	-3.61	-2.94	-2.61	I(0)
DFGLS, lags (1)	-4.16	-3.77	-3.26	-2.95	I(0)

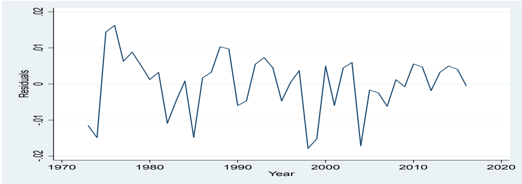
OLS Estimates with DWH Test

Given that the variables g_y, g_h and g_{nk} are I(0), the parameters in (27) can be consistently estimated with OLS, subject to the absence of sufficient endogeneity to cause significant bias. We add the lagged growth of efficiency ($l\,.\,g_{eff} = ld\,.\,dydk$) as an instrument to equation (27) to control for possible autocorrelation. Then, we run the DWH test and find that the coefficients of $\hat{e}_{h,t}$ and $\hat{e}_{nk,t}$ are not significantly different to zero, so there is evidence that the degree of endogeneity is sufficiently low to enable consistent estimation of the parameters of equation (27) using OLS. The estimated growth engine equation for Barbados is:

$$29.\ \hat{g}_y = 0.87_{0.000} g_\mu + 0.23_{0.000} g_{nk} + 0.0021_{0.713} l\,.\,g_{eff} - 0.0022_{0.165},\ adjR^2 = 0.93$$

The RMSE is 0.009. The DW statistic is 1.7, indicating no significant first-order serial correlation in the reasonably stationary residuals reported in Figure 2. So, the diagnostics suggest a reasonable fit. The results suggest that most of the potential for a high rate of growth is located in the domestic capital cluster.

Figure 2: Residuals of the Barbados Growth Equation



FEVDs

Notwithstanding the absence of substantial bias in the parameters of equation (29), there is some correlation of 0.396 between g_μ and g_{nk} and this means that the parameters cannot bear a causal interpretation. For this, we estimate a VAR with the variables ordered as guided by the system in (27), g_μ, g_{nk}, g_y. Four of the information criteria (HQIC; AIC; FPE; and LR) suggest use of three lags for the VAR, while the BIC suggests use of one lag. We therefore specify the VAR with up to three lags. All of the eigenvalues of the companion matrix lie well inside the unit circle (< 1), so the VAR is stable. On this basis, we estimated the FEVDs of the variables using 10 steps for long-run contributions. The estimates reported in Table 5 indicate that 65% of the variance in g_y is accounted for by shocks to g_μ, with 24% accounted for by shocks to g_{nk}. Shocks to g_μ explain 9% of the variation in g_{nk}, while shocks to g_{nk} explain 16% of the variation in g_μ. Finally, shocks to g_y explain only 8% of the variation in g_μ. Thus, the evidence supports the information given by the OLS estimates. It indicates that the domestic capital cluster is the main growth engine of Barbados, the main underutilized potential that could be activated to achieve the growth required to develop the economy and reduce its dependence on external capital inflows, including FDI.

Table 2: Forecast Error Variance Decomposition for g_μ g_{nk} and g_y, Barbados

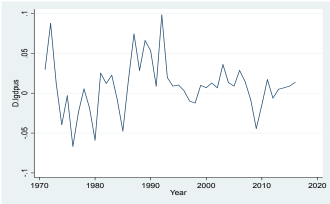
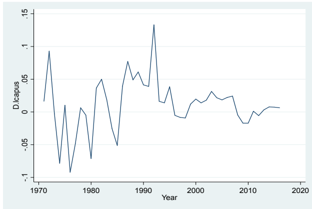
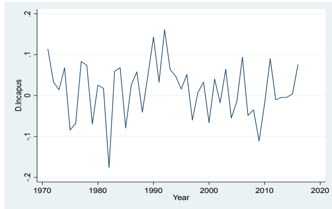
Dependent Variable		Shocked Variable		
g_y	Step	g_μ	g_{nk}	g_y
	0	0	0	0
	1	0.713179	0.192293	0.094528
	2	0.677738	0.243708	0.078554
	3	0.648481	0.230862	0.120657
	4	0.631353	0.250825	0.117822
	5	0.651339	0.235241	0.11342
	6	0.659034	0.231244	0.109721
	7	0.647073	0.240517	0.11241
	8	0.643715	0.239874	0.116411

	9	0.647085	0.237002	0.115914
	10	0.648124	0.236622	0.115254
g_{μ}		g_{μ}	g_{nk}	g_y
	0	0	0	0
	1	1	0	0
	2	0.865021	0.132685	0.002295
	3	0.834863	0.122838	0.042299
	4	0.760806	0.165364	0.07383
	5	0.766759	0.153408	0.079833
	6	0.774951	0.148482	0.076566
	7	0.762256	0.159733	0.078011
	8	0.755788	0.162444	0.081768
	9	0.756923	0.160773	0.082305
	10	0.758144	0.160174	0.081682
g_{nk}		g_{μ}	g_{nk}	g_y
	0	0	0	0
	1	0.011575	0.988425	0
	2	0.02935	0.962031	0.008619
	3	0.029159	0.960582	0.010259
	4	0.055597	0.934334	0.010069
	5	0.076632	0.912101	0.011267
	6	0.080714	0.908013	0.011273
	7	0.081373	0.903451	0.015176
	8	0.085531	0.89765	0.016819
	9	0.088653	0.894581	0.016766
	10	0.08915	0.893967	0.016883

Jamaica

In the case of Jamaica, the traditional import-dependent cluster also includes export agriculture along with import substitution manufacturing and import-dependent mining. Figure 3 graphs the variables (g_y, g_{μ}, g_{nk}) for the Jamaican economy for 1970 to 2016. The graph shows that the variables do not display any sustained upward trend and are potentially covariance stationary over the period.

Figure 3: Graphs of Model Variables, (g_y, g_{μ}, g_{nk}), Jamaica, 1970-2016

		
Graph of g_y, Jamaica, 1970-2016	Graph of g_μ, Jamaica, 1970-2016	Graph of g_{nk}, Jamaica, 1970-2016

We used the Dickey-Fuller, Phillips-Perron, and DFGLS tests of the order of integration of g_y to confirm the stationarity suggested by the graphical evidence. The graph of the data shows no distinct time trend, so we assumed a random walk without drift and restricted the trend coefficient to zero. For the Dickey-Fuller and Phillips-Perron tests, we used one lag as suggested by most information criteria. The test results indicating the order of integration for g_y are reported in Table 6. The tests statistics unanimously reject the null of a unit root at all conventional levels of significance, indicating that the variable is I(0).

Table 6: Tests of g_y for Unit Roots, Jamaica

g_y	Test Statistic	1% CV	5% CV	10% CV	Order of Integration
ADF, lags(1)	-4.12	-3.62	2.95	-2.61	I(0)
PP, (1) lags(1)	-28.78	-18.56	-13.14	-10.6	I(0)
PP, (2) lag(1)	-4.69	-3.61	-2.94	-2.61	I(0)
DFGLS, lags (1)	-4.11	-3.77	-3.26	-2.95	I(0)

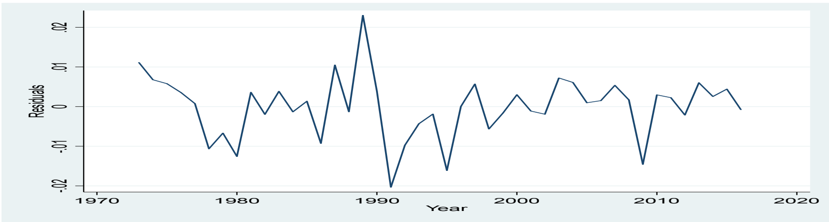
OLS Estimates with DWH Test

Given that the variables g_y, g_h and g_{nk} are I(0), the parameters in (27) can be consistently estimated with OLS, if the degree of endogeneity of g_h and g_{nk} is insufficient to cause significant endogeneity bias. We use $l \,.\, g_h$ and $l \,.\, g_{nk}$ as possible instruments for g_h and g_{nk}. Then, we run the DWH test and find that the the coefficients of $\hat{e}_{h,t}$ and $\hat{e}_{nk,t}$ are not significantly different to zero, so there is no evidence that g_h and g_{nk} need to be instrumented. The degree of endogeneity is sufficiently low to enable consistent estimation of the parameters of equation (27) using OLS. The estimated growth engine equation for Jamaica is:

30. $$\hat{g}_y = 0.66_{0.000} g_\mu + 0.15_{0.000} g_{nk} + 0.014_{0.056} - \,.001_{0.422}, \; adjR^2 = 0.93$$

The RMSE is 0.008. The DW statistic is 1.70, indicating no significant first-order serial correlation in the reasonably stationary residuals reported in Figure 4. So, the diagnostics suggest a good fit. The results suggest that most of the potential for a high rate of growth is located in the domestic capital cluster, which transmits 66% of its growth to GDP growth compared to 15% for the traditional export cluster.

Figure 4: Residuals of the Jamaica Growth Equation (OLS)



FEVDs

Notwithstanding the absence of substantial bias in the parameters of equation (30), there is a significant correlation of 0.619 between g_μ and g_{nk} and this means that the parameters cannot be given a causal interpretation. For a causal interpretation, we estimate a VAR with the variables ordered as guided by the system in (27), g_μ, g_{nk}, g_y. Four of the information criteria (BIC; HQIC; AIC; and FPE) suggest use of one lag for the VAR. We therefore specify the VAR with one lag. The eigenvalues of the companion matrix all lie well inside the unit circle ($<$ 1), so the VAR is stable. On this basis, we estimated the FEVDs of the variables using 10 steps for the long-run contributions. The estimates reported in Table 7 indicate that 80% of the variance in g_y is accounted for by shocks to g_μ, with 9% accounted for by shocks to g_{nk}. Shocks to g_μ explain 6% of the variation in g_{nk}, while shocks to g_{nk} explain about 5% of the variation in g_μ. Finally, shocks to g_y explain only 8% of the variation in g_μ. Thus, the evidence supports and strengthens the information given by the OLS estimates. It indicates that the domestic capital cluster is the only long-run growth engine of Jamaica, the underutilized capacity the country could activate to achieve the growth required to develop the economy and reduce its high degree of dependence on foreign capital inflows.

Table 7: Forecast Error Variance Decomposition for g_μ g_{nk} and g_y, Jamaica

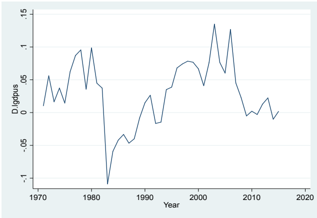
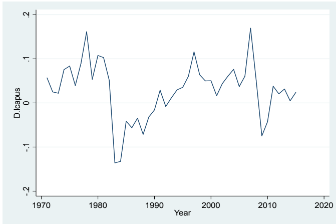
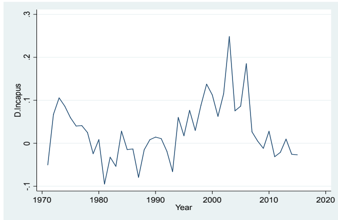
Dependent Variable		Shocked Variable		
g_y	Step	g_μ	g_{nk}	g_y
	0	0	0	0
	1	0.849541	0.078913	0.071546
	2	0.819174	0.08802	0.092806
	3	0.799457	0.090999	0.109545
	4	0.796456	0.091058	0.112486
	5	0.796312	0.091028	0.11266
	6	0.796319	0.091026	0.112655
	7	0.796316	0.091027	0.112657
	8	0.796314	0.091027	0.112658
	9	0.796314	0.091027	0.112658

	10	0.796314	0.091027	0.112658
g_μ		g_μ	g_{nk}	g_y
	0	0	0	0
	1	1	0	0
	2	0.89097	0.046956	0.062073
	3	0.868136	0.049513	0.082351
	4	0.865476	0.04963	0.084895
	5	0.865406	0.049614	0.08498
	6	0.865406	0.049617	0.084977
	7	0.8654	0.049619	0.084981
	8	0.865399	0.049619	0.084982
	9	0.865399	0.049619	0.084982
	10	0.865399	0.049619	0.084982
g_{nk}		g_μ	g_{nk}	g_y
	0	0	0	0
	1	0.04732	0.95268	0
	2	0.057737	0.932402	0.00986
	3	0.057551	0.92986	0.012589
	4	0.057564	0.929518	0.012919
	5	0.057591	0.92948	0.012929
	6	0.057596	0.929475	0.012929
	7	0.057596	0.929474	0.01293
	8	0.057596	0.929474	0.01293
	9	0.057596	0.929474	0.01293
	10	0.057596	0.929474	0.01293

Trinidad and Tobago

In the case of Trinidad and Tobago, the import-dependent cluster comprises mining and manufacturing, including export-oriented manufacturing activity downstream of the mining activities. Traditional export agriculture has virtually disappeared from the economy. Figure 5 graphs g_y, g_μ, and g_{nk} for the Trinidad and Tobago economy for 1970 to 2016. The graph suggests that the variables are nonstationary.

Figure 5: Growth of Key Indicators, Trinidad and Tobago, 1970-2016

		
Graph of g_yT&T, 1970-2016	Graph of g_μ, T&T, 1970-2016	Graph of g_{nk}, T&T, 1970-2016

We used the Dickey-Fuller, Phillips-Perron, and DFGLS tests to determine the order of integration of g_y and confirm the non-stationarity suggested by the graphical evidence. The graph shows no distinct time trend, so we assumed a random walk without drift and restricted the trend coefficient to zero. For the Dickey-Fuller and Phillips-Perron tests, we used one lag as suggested by most information criteria. We also tested the first difference of the variable to ensure it is stationary. The test results indicating the order of integration of g_y are reported in Table 8. The variable is I(1).

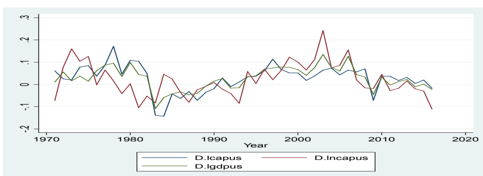
Table 4: Tests of g_y for Unit Roots, Trinidad and Tobago

g_y	Test Statistic	1% CV	5% CV	10% CV	Order of Integration
ADF, lags(1)	-2.11	-3.62	2.95	-2.61	I(1)
PP, (1) lags(1)	-14.78	-18.56	-13.14	-10.6	I(1)
PP, (2) lag(1)	-2.92	-3.61	-2.94	-2.61	I(1)
DFGLS, lags (1)	-2.16	-3.77	-3.26	-2.95	I(1)

DOLS Estimates

Even though the variables g_y, g_μ and g_{nk} are I(1), the parameters in (27) can still be estimated with OLS if the variables are cointegrated. To guide the test for the existence of any cointegrating vectors among them, we observe the joint graphs of these variables reported in Figure 6. The Figure shows that the differences among the variables are not constant, so we modelled the relationship among them with a restricted trend by excluding linear trends in the differenced variables but allowing one in the cointegrating equation(s). We also allowed 1 lag, as suggested by all the information criteria, except the LR. The resulting Johansen trace statistic suggests that there is at least one cointegrating vector in the data.

Figure 6: Joint graph of g_y, g_μ and g_{nk}



To estimate the cointegrating relationship in equation (27) using OLS, we add to the equation a relevant stationary variable, the rate of growth of the efficiency of investment (g_{eff}). This variable is covariance stationary with mean zero, and thus is I(0), so e_y will also be I(0). Thus, we consider the regression:

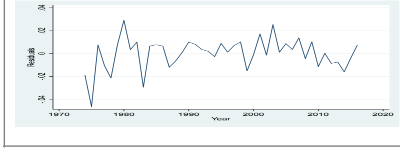
31. $$g_{yt} = \beta_0 + \beta_1 g_{\mu t} + \beta_2 g_{nkt} + \beta_3 g_{efft} + e_{yt}$$

The coefficient β_3 can be estimated and tested with standard procedures but the coefficients β_1 and β_2 cannot be since $g_{\mu t}$, and g_{nkt} have stochastic trends. To estimate these coefficients consistently with OLS, we include the contemporaneous changes $d\,.\,g_{\mu t}$ and $d\,.\,g_{nkt}$ in the regression to remove the stochastic trends from $g_{\mu t}$, and g_{nkt}. To address serial correlation, past and future lags and leads of $d\,.\,g_{\mu t}$ and $d\,.\,g_{nkt}$ as well as of $d\,.\,l\,.\,g_y$ can also be included to generate consistent and efficient estimators of β_1 and β_2, which asymptotically support standard t-statistics and F-statistics based on the t and F distributions. The resulting cointegrating regression is:

32. $$g_y = .007_{0.031} + 0.55_{0.000} g_\mu + 0.33_{0.000} g_{nk} + 0.06_{0.001} g_{eff} - 0.25_{0.003} d\,.\,g_\mu - 0.25_{0.012} ld\,.\,g_\mu - 0.15_{0.099} l2d\,.\,g_\mu - 0.12_{0.110} d\,.\,g_{nk} - 0.15_{0.042} ld\,.\,g_{nk} - 0.13_{0.026} l2d\,.\,g_{nk} + 0.38_{0.006} ld\,.\,g_y + 0.37_{0.006} l2d\,.\,g_y, R^2_{adj} = 0.90; RMSE = 0.016$$

The residuals of the model are stationary as indicated in Figure 7 and feature no serial correlation, as indicated by the Durbin Alt F-statistic of 0.18 with p-value of 0.6729 at lag 1, and of 0.091 with p-value of 0.9136 at lag 2. The fit of the model is good with $R^2_{adj} = 0.9$ and $RMSE = 0.016$. The cointegrating coefficients indicate that the domestic capital cluster transmits about 55% of its growth to the economy, compared to 33% for the traditional import-dependent export cluster producing downstream intermediates. Thus, the domestic capital-producing cluster has almost twice the potential to generate long-run growth as does growth of the traditional import-dependent cluster manufacturing and exporting downstream intermediates.

Figure 7: Residuals, T&T Growth Model



The FEVDs

Using the theory-motivated ordering of the variables as g_μ, g_{nk} and g_y, we estimated the associated vector error correction model (VECM) and used it to generate the orthogonalized FEVDs. The VECM is stable as indicated by the eigenvalues of the companion matrix. The FEVDs are reported in Table 9. The estimates indicate that 53% of the long-run variation in output is explained by growth of the domestic capital cluster, compared to 36% by the traditional export cluster. These estimates correspond closely to the results generated by the DOLS. The domestic capital cluster shows a substantial degree of influence on the growth of the traditional export cluster, explaining about 33% of its output variation in the long-run, while growth of the traditional export cluster explains about 32% of the growth of the domestic capital cluster. The interdependence might reflect dependence of the traditional export sector on human capital produced by the domestic capital sector, while the latter depends on the traditional export sector for foreign exchange. Growth of output about explains 10% of the variation in the output of the domestic capital cluster, compared to 8% of the growth of the traditional export cluster. So, in the case of Trinidad and Tobago, the domestic capital cluster operates alongside the traditional export cluster as one of two main engines of growth.

Table 2: Forecast Error Variance Decomposition for g_μ g_{nk} and g_y, Trinidad and Tobago				
Dependent Variable		Shocked Variable		
g_y	Step	g_μ	g_{nk}	g_y
	0	0	0	0
	1	0.58555	0.209955	0.204495
	2	0.588856	0.246109	0.165036
	3	0.575552	0.276715	0.147733
	4	0.563047	0.298321	0.138632
	5	0.553623	0.313215	0.133162
	6	0.546746	0.323709	0.129544
	7	0.541661	0.331356	0.126983
	8	0.537801	0.337122	0.125077
	9	0.534793	0.341604	0.123603
	10	0.53239	0.34518	0.12243
g_μ		g_μ	g_{nk}	g_y
	0	0	0	0
	1	1	0	0
	2	0.843931	0.114194	0.041876
	3	0.744638	0.190227	0.065134
	4	0.687004	0.235517	0.077479
	5	0.651044	0.264153	0.084803
	6	0.62692	0.283488	0.089592
	7	0.609764	0.297279	0.092957
	8	0.596992	0.30756	0.095448
	9	0.587134	0.3155	0.097367
	10	0.579302	0.321809	0.098889
g_{nk}		g_μ	g_{nk}	g_y

	0	0	0	0
	1	0.07544	0.92456	0
	2	0.111285	0.866372	0.022343
	3	0.154872	0.807262	0.037866
	4	0.195494	0.756086	0.04842
	5	0.230075	0.713793	0.056132
	6	0.25873	0.679175	0.062095
	7	0.282435	0.650683	0.066882
	8	0.302206	0.62697	0.070823
	9	0.318883	0.606987	0.07413
	10	0.333115	0.58994	0.076945

6. Summary and Conclusion

The article can be summarized as follows. In 1968, Best proposed that the 'residentiary sector', which produces and accumulates surplus on the domestic account, is the main engine of growth and structural transformation in Caribbean economies. This was an alternative to Lewis' proposal that this role is best played by the manufacturing sector. Part of the logic of the proposition was that growth of this sector would also systematically reduce dependence on foreign capital and its controlling technologies and organisations over time. Best sought to provide empirical evidence for this hypothesis in 1979/80 but did not have access to adequate data or an appropriate set of econometric methods.

Fifty (50) years have passed since, Caribbean economies have undergone significant restructuring, and we now have access to 46 years of historical records of what happened. Two broad cluster of industries have evolved. One relies primarily on production and employment of capital, especially human capital, to innovate, create value and exports. This "domestic capital" cluster includes sectors such as education, healthcare, ICT, finance, engineering, architecture, and the creative industries, as well as the using industries such as tourism, travel services, wholesale and retail. It embodies Best's residentiary sector. The other cluster continues to rely mainly on imported capital to create value and exports. It includes traditional manufacturing of intermediate inputs downstream of primary output as well as traditional manufactures of consumer output. Appropriate small-scale modelling methods have been developed since 1979/80 that could be used with the available time series to determine which of these clusters has been the primary engine of growth and transformation. In this paper, we developed the necessary supporting theory and then ran the required tests using data from the UNSD for three Caribbean countries: Barbados, Jamaica, and Trinidad and Tobago.

To be an engine of growth and transformation the Kaldor rule must be satisfied. A cluster must generate economy-wide productivity growth while growing, and must also facilitate and foster growth of other sectors in the economy. For the test, we measure productivity as the ratio of the change of output to investment, which is a proxy for the marginal product of capital. This proxy is also equivalent to the ratio of the marginal product of labour to the growth of investment required to grow employment at some given rate. The empirical evidence strongly supports the claim that, while both clusters play a role, growth of the marginal product of labour is primarily explained by the growth of the domestic capital cluster in all three Caribbean countries. Thus, the examination of Best's hypothesis rests on a sound assumption.

Next, we used OLS and a recursive SVAR supported by the theory to test Best's hypothesis directly in all three countries. In the case of Trinidad and Tobago, given the nonstationary properties of the data, OLS was applied in dynamic form. The empirical evidence assembled suggests that the cluster which offers the highest potential for growth in Barbados and Jamaica is the domestic capital cluster. In the case of Trinidad and Tobago, the highest growth potential is also found in this cluster, however the traditional import-dependent cluster also possesses strong growth engine characteristics, albeit with attendant risks of negative exogenous growth shocks. The general results are explained by the capacity of the capital-producing cluster to upgrade the supply characteristics of the output system, raise the efficiency of investment, and increase the production of high-technology and other creative capital output for which the foreign income elasticity of demand is high relative to the domestic elasticity of demand for imports. In the case of Trinidad and Tobago, the strong showing of the traditional export cluster as an engine of growth may be related to its sustained capacity to attract FDI with technological spillovers to produce intermediate capital inputs for both domestic use and exports, while providing all sectors with a substantial supply of foreign exchange.

Overall, the results indicate that even if the economies are not competitive producers of final manufactured capital goods, the domestic capital-producing services cluster can deliver high growth. High vulnerability to negative price and demand shocks and slow growth that affect the traditional export sector might be the consequence of underinvestment in developing the export potential of these domestic capital-producing industries. The results indicate that when the inshore sector is identified with the domestic capital-producing and using cluster of industries, Best's original hypothesis has strong empirical support in the historical record. They imply that the traditional policy of benign neglect of the growth and export potential of the capital-producing service industries is flawed policy. Caribbean countries need a concerted effort to develop the output and export capacity of their capital-producing sectors relative to their traditional exports. Government must lead this effort, and accordingly must promote the central position of the domestic capital sectors as the main engine of prosperity in the region. Investment (domestic and foreign) to develop the output and export potential of these sectors will enable growth at a rate sufficient to cover the interest rate at which liabilities are incurred to undertake the investments. This may also provide the best mechanism for eliminating persistent or recurring deficits on their current accounts and government budgets on a sustainable basis.

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