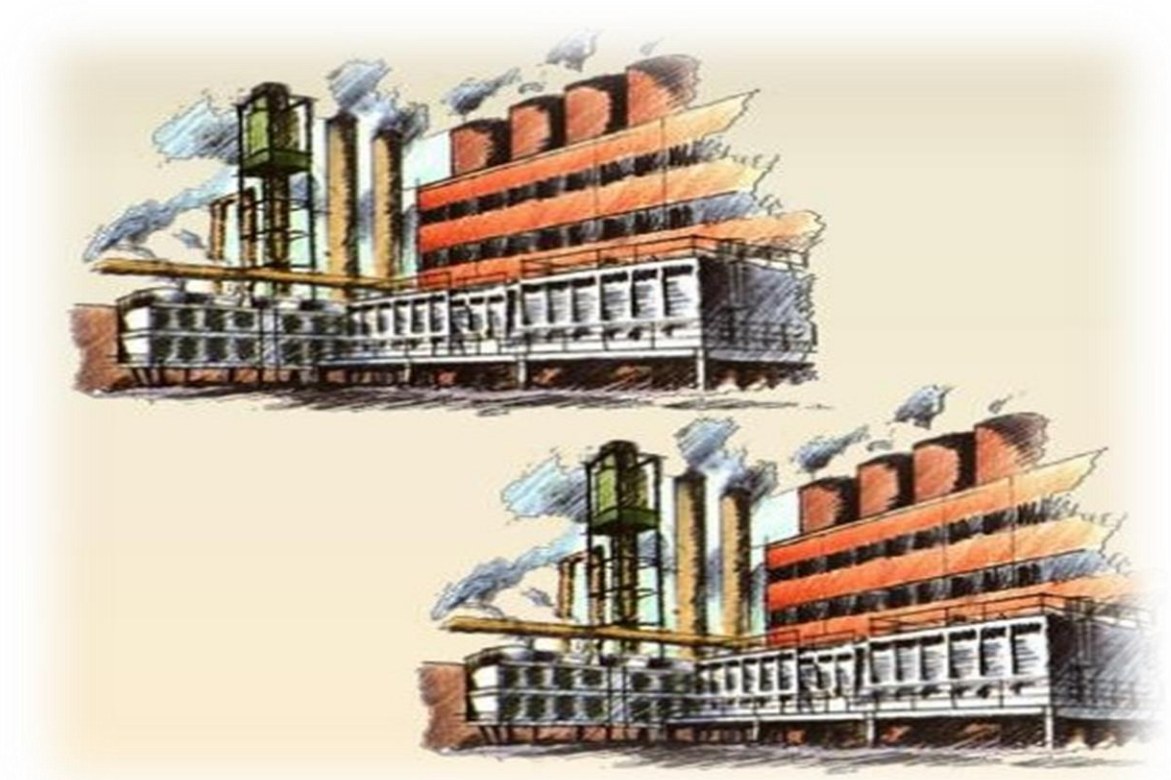

Intra-industry Trade and Economic Development

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Abstract

This paper considers how increase in the knowledge, skills and self-confidence of workers and managers influences the flow of savings and exports that validate investment and simultaneously increases the capacity of the economy to participate in intra-industry trade and succeed in the development process.

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1. Introduction

In the second part of his classic piece on "economic development with unlimited supplies of labour," Lewis (1954) provided insights into the benefits of rationalisation of inter-industry trade by reference to relative marginal costs rather than Ricardian relative prices. However, in the decades since then, trade has shaped economic development largely through the capacity to participate in intra-industry trade, which is to say trade in the differentiated varieties produced by similar industries. The main capacity deployed in intra-industry trade is the knowledge, skills, and self-confidence of workers and managers. The purpose of this paper is to update the analysis of economic development to take account of the influence of such growing capacity and the role of intra-industry trade. The structural changes in the mode of trade associated with economic development provide an appropriate context for investigation of the effects of intra-industry trade since the analysis of the absolute level of such trade does not tend to be very meaningful. One can choose the level of aggregation of ISIC industries conveniently just to obtain desired results.

There are two pathways to the economic growth that underlie the development process. One is through population growth plus growth of living standards, where the latter is generated by investment to improve the share of capital in GDP, update the institutions of the society, and improve its production technology (innovation) (James and Hamilton, 2022). The other pathway is through growth of the productivity of labour that is augmented by the knowledge, skills, and self-confidence of workers plus growth of this augmenting factor. This augmented labour power is a capital input that can be produced competitively in the domestic Caribbean economy if supported by suitable financing arrangements. Productivity growth is achieved by investment to deepen the stock of capital.

On each pathway, for an import-dependent economy in which a significant share of productive capital inputs is imported because of lack of capacity to produce them competitively, investment for development must be validated by commensurate savings growth as well as growth of exports to meet import needs. The question then arises, what are the implications of the growing knowledge, skills, and self-confidence of workers for the flow of validating savings and exports, and in particular what are the implications for the mode of trade?

Under the assumption of surplus labour, Lewis (1954) suggested that savings would grow if the marginal product of labour exceeds the associated stationary wage. This answer was based on a concept of labour as basic labour power, without augmentation by the critical elements of the knowledge, skills and self-confidence of workers and managers, which Lewis treated as forms of capital. The role of the marginal product of labour as well as the wage can be updated if the concept of labour power is updated to include the knowledge, skills, and self-confidence that augment it and

if the wage is treated as the unit payment for such capacities. Lewis also suggested that exports would restructure and grow if specialisation in trade is guided by comparative advantage defined in terms of the marginal product of labour rather than Ricardian unit labour costs. This focus yielded important insights about the content of inter-industry exports, namely the need for surplus labour economies to specialise in exporting manufactured goods while importing their food. However, this analysis ignored at least two important facts. One is that in an import-dependent economy exports are produced with imported inputs along with the knowledge, skills, and self-confidence of workers and managers (Best, 1968). The other is that in practice, comparative advantage does not motivate trade in total isolation from the capacities that drive intra-industry trade. The modes of trade exist on a continuum and where a country falls depends on its capacity to extract increasing returns, innovate, and deploy associated pricing power as needed. To exploit the comparative advantage defined by relative marginal products, each trading country must still have the capacity to supply the market at competitive prices as well as to sustain market presence by bringing new winning solutions to problems with sufficient frequency. To the extent that access to imported inputs at a unit cost defined by the real exchange rate and limited problem-solving capacity can constrain the development of production and exports, economic managers must consider how, in addition to growing savings, exports can be increased by growth of the produced input of the knowledge, skills and self-confidence of workers and managers of the economy. This paper answers both questions and extracts the implications for the evolution of trade.

The paper has 5 sections in addition to this introduction. Section 2 derives the principle of convergence between the growth path defined through GDP per capita growth and that defined through productivity growth. Section 3 examines how investment determines the rate of savings when the role of the knowledge skills and self-confidence of workers is considered in the determination of profits. Section 4 analyses how investment to grow the knowledge, skills and self-confidence of workers transforms and grows exports when necessary noncompeting imports are treated as inputs into the production process. Section 5 derives the overall implications of growing knowledge, skills, and self-confidence of workers for the evolution of intra-industry trade, with attention to the role of comparative competitiveness. Section 6 summarises the findings and points to some policy implications.

2. Capacity-Building and the Convergence of Growth Paths

Let Y be GDP, y_l be GDP per capita, and L be population size. Then, we can write the first fundamental identity of economic growth as:

1. $\frac{dY}{Ydt} = \frac{dy_l}{y_l dt} + \frac{dL}{Ldt}$

Equation (1) says that growth of the economy is achieved by growth of its living standards and its population. It is commonplace to treat population growth, $\frac{dL}{Ldt}$, as exogenous, to be shaped by

population policy, including policy on immigration. On the other hand, $\frac{dy_l}{y_l dt}$ is endogenous, explained by investment to adjust the structure of the economy, improve institutions and upgrade technology simultaneously.

As in classical economics, the dynamic model of Leontief (1953; 1970), and Lewis (1954), the structure of the economy is best measured by the share of capital-producing industries in GDP. For any specific economy, the relevant capital producing industries are those that can produce and trade competitively in the global marketplace. For Caribbean countries, those are the producers of capital services, such as education, healthcare, and the creative industries, each characterized by production technologies that rely heavily on the produced knowledge, skills, and self-confidence of workers and managers. Specifically, the output of each capital services industry is best described by a functional $Y = Y(\widetilde{N}(K))$, where K is the stock of heterogenous capital required to employ workers and managers, $\widetilde{N}(K)$ is the produced output of augmented labour power by the capital services and $\widetilde{N} = E_N N$, with N the number of employees and E_N the level of knowledge, skills and self-confidence per employee.

Now, define productivity in terms of the ratio of output to the augmented labour of workers employed, $y = \frac{Y}{E_n N}$. Then, the second fundamental identity of economic growth is given by:

2. $\frac{dY}{Ydt} = \frac{dy}{ydt} + \frac{d\widetilde{N}}{\widetilde{N}dt}$

Equation (2) says that economy-wide growth is achieved by augmented labour productivity growth, growth of the average knowledge, skills and self-confidence of workers and growth of the number of workers employed. Productivity growth is a multi-sectoral process, achieved by investment to deepen the stock of capital, which must be validated by an expanded flow of savings and exports, since some of the investment involves expenditure of foreign exchange on necessary imports. This reinforces a key observation of the Leontief (1953; 1970) models that, in an open economy, the capacity of an industry to stimulate and satisfy export demand is one of its fundamental properties.

The rate of growth determined directly by equations (1) to (2) are likely to be different, but they reflect a common growth factor. To identify this factor, observe that, consistent with ul Haque (1995), $\frac{dy}{ydt}$ and $\frac{dy_l}{y_l dt}$ are related by:

3. $\frac{dy_l}{y_l dt} = \beta(t)\frac{dy}{ydt}$

where in this case, $\beta(t) > 1$. That is, GDP per capita rises faster than the productivity of augmented labour. Using equations (2) and (3) in equation (1) gives the unifying growth rate consistent with both aspects of the growth process as:

4. $\frac{dY}{Ydt} = \frac{1}{(\beta(t)-1)}[\beta(t)\frac{d\widetilde{N}}{\widetilde{N}dt} - \frac{dL}{Ldt}]$

In equation (4), population growth represents a drag on the rate of economic growth while growth of the knowledge, skills and self-confidence of workers represents a boost. The economy grows when the $\beta(t)\frac{d\tilde{N}}{\tilde{N}dt} > \frac{dL}{Ldt}$, so that the elasticity-augmented rate of growth of the knowledge, skills, and self-confidence of workers exceeds the rate of growth of the population.

It is known that $\frac{dy_l}{y_l dt}$ is caused by investment to restructure the economy by increasing the share of capital in GDP, upgrading institutions, and improving technology (innovation) (James and Hamilton, 2022). It has been known since Lewis (1954) and Best (1968) that growing productivity, $\frac{dy}{ydt}$, is a process caused by investment to achieve necessary capital deepening in key sectors of the economy. In any economy, investment (whether foreign or domestic) must be validated by appropriate flows of savings. In an import-dependent economy, investment includes the purchase of necessary imported inputs, which must ultimately be validated by growth of exports. In equation (4), $\tilde{N}$ is a produced input used in the production process and can be produced competitively by domestic industries such as education, healthcare, and the creative industries. Thus, a natural question for the policymaker is, how does increase in production and employment of $\tilde{N}$ cause growth of the validating savings and exports needed to underwrite the required investment that generates growth? This question is answered in the next two sections.

3. Worker Capacity-Building and Growth of Savings

Savings arise mainly from profits on capital, so the form of investment relevant to savings growth lead the accumulation of capital, understood here as the assets of the owners of property less the liabilities incurred to acquire them. These capital assets are normally combined with the knowledge, skills and self-confidence of workers and managers to organise and run real production processes. First, consider the proposition that the savings rate, S, is proportional to the flow of profits, rK, for r the variable rate of profit, K the accumulated stock of capital assets, and s_p, the savings-profit ratio, is the proportionality constant. That is:

5. $S = s_p rK$

The associated differential is:

6. $dS = s_p[rdK + Kdr]$

Thus,

7. $\frac{dS}{dK} = s_p[r(1 + \frac{Kdr}{rdK})]$

Since capital is required to employ the knowledge, skills, and self-confidence of workers and managers, real output is properly described by a functional $Y = Y(\tilde{N}(K))$, where $\tilde{N}(K)$ is the produced output of augmented labour. We treat imported final capital inputs as included in K, so the applicable income identity is:

8. $rK = pY - w\tilde{N}$

where p is output price and w is the average wage for employee capacities that includes a premium over the subsistence wage. Using the total differential, the identity in (8) yields:

9. $r\left(1 + \frac{K}{r}\frac{dr}{dK}\right) = [\left(p\frac{dY}{d\tilde{N}} - w\right) + (py_{\tilde{N}}\frac{\tilde{N}dp}{pd\tilde{N}} - w\frac{\tilde{N}dw}{wd\tilde{N}})]\frac{d\tilde{N}}{dK}$

where $y_{\tilde{N}} = \frac{Y}{\tilde{N}}$ is the average productivity of knowledge, skills and self-confidence. Substituting from (9) into (8) gives:

10. $\frac{dS}{dK} = s_p\frac{d\tilde{N}}{dK}[\left(p\frac{dY}{d\tilde{N}} - w\right) + (py_{\tilde{N}}\frac{\tilde{N}dp}{pd\tilde{N}} - w\frac{\tilde{N}dw}{wd\tilde{N}})]$

Dividing by $\frac{d\tilde{N}}{dK}$, equation (10) implies that:

11. $\frac{dS}{d\tilde{N}} = s_p[\left(p\frac{dY}{d\tilde{N}} - w\right) + (py_{\tilde{N}}\frac{\tilde{N}dp}{pd\tilde{N}} - w\frac{\tilde{N}dw}{wd\tilde{N}})]$

Equation (11) says that given s_p, growth of the knowledge, skills, and self-confidence of workers and managers causes growth of savings by growing the sum of two factors. The first, $\left(p\frac{dY}{d\tilde{N}} - w\right)$, generalizes the result identified by Lewis (1954) to the difference between the value of the marginal product of knowledge, skills and self-confidence of workers and managers and the average wage paid for such capacities. The higher the marginal product of the knowledge, skills and self-confidence of workers and managers, the faster will validating savings grow. The second factor, $(py_{\tilde{N}}\frac{\tilde{N}dp}{pd\tilde{N}} - w\frac{\tilde{N}dw}{wd\tilde{N}})$, is the difference between the average product of knowledge, skills and self-confidence and the wage, augmented respectively by the elasticities of price and the wage with respect to the knowledge, skills and self-confidence of workers and managers. The higher the average productivity of the knowledge, skills, and self-confidence of workers and managers relative to the average wage rate paid for their capabilities, the faster will investment be able to grow the validating savings of the economy. The factor $(py_{\tilde{N}}\frac{\tilde{N}dp}{pd\tilde{N}} - w\frac{\tilde{N}dw}{wd\tilde{N}})$ does not appear in the model of Lewis (1954), because under the assumptions of that model $\frac{\tilde{N}dp}{pd\tilde{N}} = \frac{\tilde{N}dw}{wd\tilde{N}} = 0$.

In the context of a shortage of capital in many of the sectors of the economy, a jointly rising difference between the value of the marginal product of augmented labour and the wage,

$\left(p\frac{dY}{d\tilde{N}} - w\right)$ and difference between the changing value of the average product of augmented labour and the changing wage, $py_{\tilde{N}}\frac{\tilde{N}dp}{pd\tilde{N}} - w\frac{\tilde{N}dw}{wd\tilde{N}}$ is an indication of growing capacity to benefit from increasing returns and growing capacity to innovate. Together with growing capital production as a share of GDP and institutional progress, these are among the core foundations of increasing competitiveness, especially in global markets, and hence the foundations for successful participation in growing intra-industry trade, characterised by the import and export of similar though typically highly differentiated products (goods and services) from within similar industries.

4. Worker Capacity-Building and Growth of Exports

Exports are a share of the output of the domestic economy, produced with capital as defined above in combination with the accumulated knowledge, skills, and self-confidence of workers and managers. As global trade becomes increasingly intra-industry trade, the crucial form of investment that yields competing exports is the spending undertaken to grow the knowledge, skills and self-confidence of workers and managers who can then entrench a dynamic process of problem-solving and innovation. In an import-dependent economy, investment to grow savings must include a component of expenditure of foreign exchange on non-competing imports that are necessary (final capital, skills, and intermediate) inputs into the production process. The fundamental concern of an economy pursuing development is with the influence of accumulation of knowledge, skills and self-confidence of workers and managers on the development of exports to yield the foreign exchange that can validate the expenditures on necessary imports. Since the economy cannot depend on official foreign assistance to sustain the investment process, exports are critical to continuous validation of the foreign exchange financing of the non-competitive imports necessary to run the production system of import dependent economies.

For a relevant representation of the flow of exports, we adopt the proposition that the volume of exports, X, is proportional to the productivity of the knowledge, skills and self-confidence of workers and managers ($y_{\tilde{N}} = \frac{Y}{\tilde{N}}$), where the constant of proportionality is $x_y = \frac{X}{Y}$, the export-output ratio of the economy. That is:

12. $X = x_y y_{\tilde{N}} \tilde{N}$

From equation (12), it follows that:

13. $\frac{dX}{d\tilde{N}} = x_y[y_{\tilde{N}}(1 + \frac{\tilde{N}}{y_{\tilde{N}}}\frac{dy_{\tilde{N}}}{d\tilde{N}})]$

In an economy that relies on non-competitive imported inputs to organise production and exports, the value of tradeable output that can be exported is total value-added less the cost of those necessary imported inputs. That is:

14. $y_{\widetilde{N}}\widetilde{N} = Y - \frac{\varepsilon p_m}{p}M$

where εp_m is the price of imported inputs in domestic currency units with ε the price of foreign currency or exchange rate and M is the imported inputs used in current production. It follows from equation (14) that:

15. $y_{\widetilde{N}}(1 + \frac{\widetilde{N}dy_{\widetilde{N}}}{y_{\widetilde{N}}d\widetilde{N}}) = \frac{dM}{d\widetilde{N}}[(\frac{dY}{dM} - \frac{\varepsilon p_m}{p}) + \frac{\varepsilon p_m}{p}(\frac{M}{p}\frac{dp}{dM} - \frac{Mdp_m}{p_m dM} - \frac{Md\varepsilon}{\varepsilon dM})]$

Substituting from equation (15) into equation (13) gives:

16. $\frac{dX}{d\widetilde{N}} = x_y \frac{dM}{d\widetilde{N}}[(\frac{dY}{dM} - \frac{\varepsilon p_m}{p}) + \frac{\varepsilon p_m}{p}(\frac{M}{p}\frac{dp}{dM} - \frac{Mdp_m}{p_m dM} - \frac{Md\varepsilon}{\varepsilon dM})]$

Equation (16) indicates that, given the export ratio, x_y, the growth of validating exports induced by growth of the knowledge, skills and self-confidence of workers and managers, $\frac{dX}{d\widetilde{N}}$, is a multiple of the growth of necessary imports, $\frac{dM}{d\widetilde{N}}$. In particular, the induced growth of exports corresponds to the associated increase in necessary imports, $\frac{dM}{d\widetilde{N}}$, augmented by the sum of two sets of factors. The first factor is the difference between the marginal productivity of imported inputs and the real exchange rate $(\frac{dY}{dM} - \frac{\varepsilon p_m}{p})$. The greater the difference, the greater the validating flow of exports. As before, the growth of import productivity (also embedded in equations (10) and (11)), is integrally linked to institutional progress, technological change and economic restructuring through growth of the capital share of GDP. The second factor, $\frac{\varepsilon p_m}{p}(\frac{M}{p}\frac{dp}{dM} - \frac{Mdp_m}{p_m dM} - \frac{Md\varepsilon}{\varepsilon dM})$, is the difference between the rate of increase in export prices induced by the rate of increase in use of necessary imported inputs and the rate of increase in the real exchange rate, jointly magnified by the real exchange rate itself – essentially the difference between the domestic and foreign rates of inflation induced by growing imports of inputs. Here too, the higher this induced inflation gap, the greater the flow of validating exports created by the knowledge, skills and self-confidence of workers and managers.

It is useful to note that, in equation (16), even if p_m is set exogenously, so $\frac{Mdp_m}{p_m dM} = 0$, it would not normally hold that ε is independent of M, so $\frac{Md\varepsilon}{\varepsilon dM} \neq 0$. Thus, we can make the small country assumption that p_m is exogenous and thus independent of M. In that case, equation (16) specializes to:

17. $\frac{dX}{d\widetilde{N}} = x_y \frac{dM}{d\widetilde{N}}[(\frac{dY}{dM} - \frac{\varepsilon p_m}{p}) + \frac{\varepsilon p_m}{p}(\frac{M}{p}\frac{dp}{dM} - \frac{Md\varepsilon}{\varepsilon dM})]$

The difference between equation (16) and equation (17) is only that the influence of $\frac{Mdp_m}{p_m dM}$ on the induced inflation rates disappears, and the remaining elements of the second augmenting factor are the capacity to compete by adjusting domestic prices and the capacity to adjust the exchange rate in

support of the export growth process. This is a small country effect that allows the economy to compete under the radar without price-related reactions by international competitors. The greater the room for such price-making behaviour, the faster will validating exports grow.

5. Implications for Intra-industry Trade

What then are the implications of the results in equations (11) and (16) for the evolution of the mode of trade in the economic development process? Since the resources $\widetilde{N}$ and M are also products, and because of the changing supply and employment of the resources deployed and the associated changes in factor and product prices, the results are not simply applicable to inter-industry trade as traditionally explained by given relative resource endowments and associated relative costs, even when the latter are considered in terms of marginal costs as proposed by Lewis (1954). However, they can provide important insights about the evolution of intra-industry trade.

The main basis of intra-industry trade analysis is the impact of innovation-driven increasing returns and related falling production costs and price-making behaviour on product development and diversification. In equation (11) the indicators of increasing returns are therefore rising $(p\frac{dY}{d\widetilde{N}} - w)$, rising $(py_{\widetilde{N}}\frac{\widetilde{N}dp}{pd\widetilde{N}} - w\frac{\widetilde{N}dw}{wd\widetilde{N}})$, and rising $\frac{\frac{Kd\widetilde{N}}{\widetilde{N}dK}}{\left(1+\frac{Kdr}{rdK}\right)}$, which result from a rising rate of growth of the knowledge, skills and self-confidence of workers as the rate of capital accumulation increases, faster than the related growth of the rate of profit even if the cost of money is factored in. Such changes are not consistent with the assumption of fixed endowments and associated fixed comparative costs used in models of inter-industry trade.

A reasonable measure of product diversification is the number of varieties of products (v) brought to market, local or international. Assume for simplicity that each variety (bundle) is brought to market by a single firm. Then, the number of varieties will be the value of resources available to an industry divided by the value of resources devoted to production by an individual firm. The resources devoted to production by the i^{th} firm in industry j is the sum of its fixed costs (F_j) and its variable costs (wages and interest (i)), where unit variable cost of firm output is $c_i = \frac{w\widetilde{N}_j + iK_i}{Y_i}$, with Y_i the value-added of the firm and it is assumed that w and i are determined by factor market conditions across the economy. Under optimal conditions, c_i can be equated with marginal costs as suggested by Lewis (1954). Using equations (8) and (9), the resources deployed by industry j, the sum of its wages and operating surplus, can be represented as:

$$18.\ rK^j + w\widetilde{N}^j = \widetilde{N}^j\{w + \frac{\frac{K^j d\widetilde{N}^j}{\widetilde{N}^j dK^j}}{\left(1+\frac{K^j\ dr}{r\ dK^j}\right)}\left[\left(p\frac{dY^j}{d\widetilde{N}^j} - w\right) + \left(py_{\widetilde{N}^j}\frac{\widetilde{N}^j dp}{pd\widetilde{N}^j} - w\frac{\widetilde{N}^j dw}{wd\widetilde{N}^j}\right)\right]$$

Under the conditions of monopolistic conditions, typically assumed by theories of intra-industry trade, the industry operating surplus rate would be independent of the size of the capital stock of the

industry and we would have $\left(1+\frac{K^j}{r}\frac{dr}{dK^j}\right)=1$. Moreover, firms collectively have some discretion in setting price, so $\frac{\tilde{N}^j dp}{p d\tilde{N}^j}\neq 0$. In that case, the number of varieties produced by industry j would be given by

19. $v_j=\frac{\tilde{N}^j}{F_i+c_iY_i}\{w+\frac{K^j}{\tilde{N}^j}\frac{d\tilde{N}^j}{dK^j}\left[\left(p\frac{dY^j}{d\tilde{N}^j}-w\right)+\left(py_{\tilde{N}}{}^j\frac{\tilde{N}^j dp}{p d\tilde{N}^j}-w\frac{\tilde{N}^j dw}{w d\tilde{N}^j}\right)\right]\}$

Equation (19) indicates that, assuming conditions of monopolistic competition and the existence of some markup pricing power, the number of varieties brought to market, hence to intra-industry trade, by an industry grows as capital accumulation increases the knowledge, skills, and self-confidence of workers in the industry ($\tilde{N}^j$) as well as by the related ability of the industry to compete by extracting increasing returns as measured by a growing $\left(p\frac{dY^j}{d\tilde{N}^j}-w\right)$ and growing $\left(py_{\tilde{N}}{}^j\frac{\tilde{N}^j dp}{p d\tilde{N}^j}-w\frac{\tilde{N}^j dw}{w d\tilde{N}^j}\right)$. The number of varieties also grows if technical progress and innovation cause a fall in typical firm level unit costs as measured by $\frac{F_i}{Y_i}+c_i$. This is the kind of effect generated by modern ICT, which allows establishment of a production unit in the creative services with only the cost of a laptop and the cost of time on hand. Viewed through the lens of the influence of competitive capacity on the varieties successfully brought to market, the implications of equation (19) for the flow of intra-industry trade can be specified, consistent with but going beyond the analysis of Dixit and Stiglitz (1977), Dixit and Norman (1980) and Krugman (1981). For example, as with equations (10) and (11) above, productivity growth in equation (19) embeds the underlying process of simultaneous institutional upgrade, technological progress, and economic restructuring towards capital production.

First, if unit cost is considered as $\frac{F_i}{Y_i}+c_i=\frac{iK_i+w\tilde{N}_i}{Y_i}$, and if some market power is assumed, the firm's price can be represented in terms of a markup over marginal (variable) cost at a rate r typical of the industry. So, we can write:

20. $p_i=\frac{F_i}{Y_i}+c_i=(1+r)c_i$

Equation (20) implies that:

21. $\frac{F_j}{Y_j}=rc_j$

And, using equation (21) in equation (19), we get:

22. $v_j=\frac{\tilde{N}^j}{Y_i(1+r)c_i}\{w+\frac{K^j}{\tilde{N}^j}\frac{d\tilde{N}^j}{dK^j}\left[\left(p\frac{dY^j}{d\tilde{N}^j}-w\right)+\left(py_{\tilde{N}}{}^j\frac{\tilde{N}^j dp}{p d\tilde{N}^j}-w\frac{\tilde{N}^j dw}{w d\tilde{N}^j}\right)\right]\}$

Or,

23. $v_j Y_i = \frac{\tilde{N}^j}{(1+r)c_i}\{w + \frac{K^j}{\tilde{N}^j}\frac{d\tilde{N}^j}{dK^j}\left[\left(p\frac{dY^j}{d\tilde{N}^j} - w\right) + \left(py_{\tilde{N}^j}\frac{\tilde{N}^j dp}{pd\tilde{N}^j} - w\frac{\tilde{N}^j dw}{wd\tilde{N}^j}\right)\right]\}$

Thus, assuming that all varieties described by v_j are similarly priced, $v_j Y_i$ is a reasonable approximation of the total output of an industry. This approximation can then be used that to construct an assessment of trade between two countries in terms of the relative size of similar industries.

Thus, suppose there are two industries, say education (ξ) and healthcare (η), and two countries, say home h and foreign f. Then, education would have output $v_\xi Y_{\xi i}$ and healthcare output $v_\eta Y_{\eta i}$. Let the total resources of the economy be indexed at 1, so to characterize the distribution of resources between industries in the home country (h), we get:

24. $v_\xi^h Y_{\xi i}^h + v_\eta^h Y_{\eta i}^h = 1$

And, for the foreign country (f), we would have

25. $v_\eta^f Y_{\eta i}^f + v_\xi^f Y_{\xi i}^f = 1$

For the relative size of industries across countries, we get:

26. $\frac{v_\xi^h Y_{\xi i}^h}{v_\xi^f Y_{\xi i}^f} = \frac{1 - v_\eta^h Y_{\eta i}^h}{v_\xi^f Y_{\xi i}^f}$

And

27. $\frac{v_\eta^h Y_{\eta i}^h}{v_\eta^f Y_{\eta i}^f} = \frac{v_\eta^h Y_{\eta i}^h}{1 - v_\xi^f Y_{\xi i}^f}$

In other words, by equations (26) and (27), it is trivially true that the relative size of similar industries across the two countries is determined by the ratio of resources available to the industries in the countries. Here, it is useful to bear in mind that the key resources are produced and tradeable. To gain more useful insight, we use weighted sums to make assumptions about how $v_\eta^h Y_{\eta i}^h$ and $v_\xi^f Y_{\xi i}^f$ are produced and used in each country, with weights α and $1 - \alpha$ which sum to 1 for the distribution of each type of output across countries. Suppose that $\alpha v_\xi^f Y_{\xi i}^f$ is produced in country f and $(1 - \alpha)v_\xi^h Y_{\xi i}^h$ is produced in country h, with these being different varieties of education services. Now, assume that country h imports $\frac{1}{2}\alpha v_\xi^f Y_{\xi i}^f$ from country f and country f imports $\frac{1}{2}(1 - \alpha)v_\xi^h Y_{\xi i}^h$ from country h. Then, simultaneously, country h is exporting $\frac{1}{2}(1 - \alpha)v_\xi^h Y_{\xi i}^h$ to country f while importing $\frac{1}{2}\alpha v_\xi^f Y_{\xi i}^f$ from country f. And, for healthcare, suppose that $(1 - \alpha)v_\eta^f Y_{\eta i}^f$

is produced in country f and $\alpha v_{\eta}^{h} Y_{\eta i}^{h}$ is produced in country h, with these being different varieties of healthcare. Again, assume that country h imports $\frac{1}{2}(1-\alpha) v_{\eta}^{f} Y_{\eta i}^{f}$ from country f and country f imports $\frac{1}{2}\alpha v_{\eta}^{h} Y_{\eta i}^{h}$ from country h. Then, simultaneously, country h is exporting $\frac{1}{2}\alpha v_{\eta}^{h} Y_{\eta i}^{h}$ to country f while importing $\frac{1}{2}(1-\alpha) v_{\eta}^{f} Y_{\eta i}^{f}$ from country f. If we set $\alpha = \frac{1}{2}$, then country h and country f are essentially identical and all trade is intra-industry trade. However, if $\alpha < \frac{1}{2}$, say $\alpha = \frac{1}{3}$, then country h is producing $\frac{2}{3} v_{\xi}^{h} Y_{\xi i}^{h}$ and $\frac{1}{3} v_{\eta}^{h} Y_{\eta i}^{h}$, so it has more of its resources devoted to education than to healthcare and is correspondingly exporting $\frac{1}{3} v_{\xi}^{h} Y_{\xi i}^{h}$ to country f, so relatively more education than it does healthcare by exporting $\frac{1}{6} v_{\eta}^{h} Y_{\eta i}^{h}$ to country f. Moreover, as α moves closer to zero, fewer varieties of healthcare services are available from country h and relatively more of its trade is inter-industry trade. A similar analysis applies if $\alpha > \frac{1}{2}$, this time adjusting in favour of healthcare.

The patterns of intra-industry trade can be estimated as the difference between exports and imports. So, for education and country h, that gives:

28. $IIT_{\xi}^{h} = \frac{1}{2}(1-\alpha) v_{\xi}^{h} Y_{\xi i}^{h} - \frac{1}{2}\alpha v_{\xi}^{f} Y_{\xi i}^{f}$

So, if $\alpha = \frac{1}{3} < \frac{1}{2}$, then

29. $IIT_{\xi}^{h} = \frac{1}{3} v_{\xi}^{h} Y_{\xi i}^{h} - \frac{1}{6} v_{\xi}^{f} Y_{\xi i}^{f}$

Thus, in general, country h exports a higher faction of its varieties of education services than the fraction of country f varieties that it imports. The opposite would apply to country f and healthcare. That is,

30. $IIT_{\eta}^{f} = \frac{1}{3} v_{\eta}^{f} Y_{\eta i}^{f} - \frac{1}{6} v_{\eta}^{h} Y_{\eta i}^{h}$

Therefore, as α falls and the respective number of varieties of education from country f and the number of varieties of healthcare from country h are reduced, inter-industry trade arises since the net exports of fewer and fewer varieties of education will be paying for the net imports of fewer and fewer varieties of healthcare. Overall, trade occurs on a continuum of inter-industry and intra-industry engagement, and where a country's best opportunities fall in the continuum depends on the behaviour of α.

So far, this traditional analysis of intra-industry trade makes no reference to some of the fundamental forces of the economy represented on the RHS of equation (23), such as the difference of the marginal product of augmented labour and the real wage and its implications for competitive capacity. It also makes no reference to the underlying changes in the core pillars of economic development inherent in equation (23). However, direct use of equation (23) provides more insight

into how all such forces affect the conditions of trade between the same industries of different countries. For the trade in the varieties of education, we get:

$$31.\ \frac{v_{\xi}^{h}Y_{\xi i}^{h}}{v_{\xi}^{f}Y_{\xi i}^{f}} = \frac{\tilde{N}_{\xi}^{h}(1+r^{f})c_{\xi i}^{f}}{\tilde{N}_{\xi}^{f}(1+r^{h})c_{\xi i}^{h}} \frac{\left\{w_{\xi}^{h}+\frac{K_{\xi}^{h}d\tilde{N}_{\xi}^{h}}{\tilde{N}_{\xi}^{h}dK_{\xi}^{h}}\left[\left(p_{\xi}^{h}\frac{dY_{\xi}^{h}}{d\tilde{N}_{\xi}^{h}}-w_{\xi}^{h}\right)+\left(p_{\xi}^{h}y_{\tilde{N}_{\xi}}^{h}\frac{\tilde{N}_{\xi}^{h}dp_{\xi}^{h}}{p_{\xi}^{h}d\tilde{N}_{\xi}^{h}}-w_{1}^{h}\frac{\tilde{N}_{\xi}^{h}dw_{\xi}^{h}}{w_{\xi}^{h}d\tilde{N}_{\xi}^{h}}\right)\right]\right\}}{\left\{w_{\xi}^{f}+\frac{K_{\xi}^{f}d\tilde{N}_{\xi}^{f}}{\tilde{N}_{\xi}^{f}dK_{\xi}^{f}}\left[\left(p_{\xi}^{f}\frac{dY_{\xi}^{f}}{d\tilde{N}_{\xi}^{f}}-w_{\xi}^{f}\right)+\left(p_{\xi}^{f}y_{\tilde{N}_{\xi}}^{f}\frac{\tilde{N}_{1}^{f}dp_{1}^{f}}{p_{\xi}^{f}d\tilde{N}_{\xi}^{f}}-w_{\xi}^{f}\frac{\tilde{N}_{1}^{f}dw_{1}^{f}}{w_{\xi}^{f}d\tilde{N}_{\xi}^{f}}\right)\right]\right\}}$$

Equation (31) indicates that the ratio of country resources devoted to the supply of varieties of education is governed by the comparative competitive capacity of the country education industries created by the capacity to extract increasing returns, offset to some extent by the relative unit costs of production. Similarly, for trade in the varieties of healthcare, we get:

$$32.\ \frac{v_{\eta}^{h}Y_{\eta i}^{h}}{v_{\eta}^{f}Y_{\eta i}^{f}} = \frac{\tilde{N}_{\eta}^{h}(1+r^{f})c_{\eta i}^{f}}{\tilde{N}_{\eta}^{f}(1+r^{h})c_{\eta i}^{h}} \frac{\left\{w_{\eta}^{h}+\frac{K_{\eta}^{h}d\tilde{N}_{\eta}^{h}}{\tilde{N}_{\eta}^{h}dK_{\eta}^{h}}\left[\left(p_{\eta}^{h}\frac{dY_{\eta}^{h}}{d\tilde{N}_{\eta}^{h}}-w_{\eta}^{h}\right)+\left(p_{\eta}^{h}y_{\tilde{N}_{\eta}}^{h}\frac{\tilde{N}_{\eta}^{h}dp_{\eta}^{h}}{p_{\eta}^{h}d\tilde{N}_{\eta}^{h}}-w_{\eta}^{h}\frac{\tilde{N}_{\eta}^{h}dw_{\eta}^{h}}{w_{\eta}^{h}d\tilde{N}_{\eta}^{h}}\right)\right]\right\}}{\left\{w_{\eta}^{f}+\frac{K_{\eta}^{f}d\tilde{N}_{\eta}^{f}}{\tilde{N}_{\eta}^{f}dK_{\eta}^{f}}\left[\left(p_{\eta}^{f}\frac{dY_{\eta}^{f}}{d\tilde{N}_{\eta}^{f}}-w_{\eta}^{f}\right)+\left(p_{\eta}^{f}y_{\tilde{N}_{\eta}}^{f}\frac{\tilde{N}_{\eta}^{f}dp_{\eta}^{f}}{p_{\eta}^{f}d\tilde{N}_{\eta}^{f}}-w_{\eta}^{f}\frac{\tilde{N}_{\eta}^{f}dw_{\eta}^{f}}{w_{\eta}^{f}d\tilde{N}_{\eta}^{f}}\right)\right]\right\}}$$

Equation (32) also indicates that the ratio of country resources devoted to the supply of varieties of healthcare is governed by the comparative competitive capacity of the country healthcare industries created by the capacity to extract increasing returns, offset to some extent by the relative unit costs of production of representative firms.

In general, equations (31) and (32) remind that the cross-country ratio of resources devoted to an industry is governed by the fundamental economic forces that shape the comparative capacity of industries to compete through the extraction of gains from increasing returns, innovation, and associated pricing power. In those rare cases when the numerator and denominator of each equation are equal, then the countries are essentially identical, and all trade is intra-industry trade.

For greater insight, consider education represented in equation (31). In this case, the term $\frac{\left\{w_{\eta}^{h}+\frac{K_{\eta}^{h}d\tilde{N}_{\eta}^{h}}{\tilde{N}_{\eta}^{h}dK_{\eta}^{h}}\left[\left(p_{\eta}^{h}\frac{dY_{\eta}^{h}}{d\tilde{N}_{\eta}^{h}}-w_{\eta}^{h}\right)+\left(p_{\eta}^{h}y_{\tilde{N}_{\eta}}^{h}\frac{\tilde{N}_{\eta}^{h}dp_{\eta}^{h}}{p_{\eta}^{h}d\tilde{N}_{\eta}^{h}}-w_{\eta}^{h}\frac{\tilde{N}_{\eta}^{h}dw_{\eta}^{h}}{w_{\eta}^{h}d\tilde{N}_{\eta}^{h}}\right)\right]\right\}}{\left\{w_{\eta}^{f}+\frac{K_{\eta}^{f}d\tilde{N}_{\eta}^{f}}{\tilde{N}_{\eta}^{f}dK_{\eta}^{f}}\left[\left(p_{\eta}^{f}\frac{dY_{\eta}^{f}}{d\tilde{N}_{\eta}^{f}}-w_{\eta}^{f}\right)+\left(p_{\eta}^{f}y_{\tilde{N}_{\eta}}^{f}\frac{\tilde{N}_{\eta}^{f}dp_{\eta}^{f}}{p_{\eta}^{f}d\tilde{N}_{\eta}^{f}}-w_{\eta}^{f}\frac{\tilde{N}_{\eta}^{f}dw_{\eta}^{f}}{w_{\eta}^{f}d\tilde{N}_{\eta}^{f}}\right)\right]\right\}} = \psi$ is the relative competitive market advantage in education achieved through growth of the capacity of the industry to extract increasing returns when bringing varieties to market, magnified by growth of the capacity to innovate through the growth of augmented labour induced by capital accumulation and the wage rate that support the innovation process. If $\psi = 1$, then the relative output of the education varieties of the economies will be determined only by $\frac{\tilde{N}_{\xi}^{h}(1+r^{f})c_{\xi i}^{f}}{\tilde{N}_{\xi}^{f}(1+r^{h})c_{\xi i}^{h}}$, which is to say the relative unit cost of output of the typical firm and the relative augmented worker capacity of the home and foreign industries. The higher the capabilities of augmented workers in the home industry relative to those of augmented workers in the foreign industry, the more the varieties of home country education sold relative to the varieties

of foreign country education. And, the lower the unit cost of production of firms producing home country education, the more this advantage is magnified. This is determination of trade patterns partly by comparative advantage for the foreign country, which still leaves open the possibility of some intra-industry trade but shifts the odds in favour of greater inter-industry trade if the same situation holds for healthcare in equation (32).

The really interesting cases arise when $\psi \neq 1$. For example, if $\psi > 1$, the home country has comparatively higher capacity to bring varieties to market, and the higher is ψ relative to 1, the greater the advantage of home country and the greater its comparative capacity to bring varieties of education to market. However, this advantage can be offset by the relative unit cost of output per augmented worker of the disadvantaged foreign economy, as measured by $\frac{\tilde{N}_{\xi}^{h}(1+r^{f})c_{\xi i}^{f}}{\tilde{N}_{\xi}^{f}(1+r^{h})c_{\xi i}^{h}}$. This means that comparative unit cost continues to play a role in determining the extent of intra-industry trade, and the more parity is evident between the economies on this factor, the greater the likelihood that the extent of intra-industry trade will be determined by ψ. Specifically, the lower the relative unit cost of output per worker of the disadvantaged foreign economy, the more it off-sets the advantages conferred on home country by its greater capacity to innovate and to extract increasing returns in the market process. On the other hand, the higher the relative unit cost per augmented worker, the less it can offset the advantages of home country. In that case, the high relative unit costs of the disadvantaged foreign economy will magnify the advantages of the home country, causing the varieties and the output of education of the foreign country to fall, moving it sharply towards inter-industry trade.

A similar analysis applies to healthcare. It follows that a particular country can find itself with inadequate competitive capacity in both industries at the same time because of limited capacity to extract increasing returns, innovate, and adjust prices competitively in the face of intense monopolistic competition. Such a country would be caught in a tendency to persistent inter-industry trade by producing limited varieties of both education and healthcare; and ultimately be faced with pressures to specialise in producing either education or healthcare for export and use the proceeds to pay for imports of the other.

In equation (23), imported capital inputs are accounted for in K^{j} but equations (16) and (17) allow additional insights into the overall evolution of trade using direct consideration of some of the effects of growing knowledge, skills, and self-confidence of workers on the comparative growth of exports and imports, depending on assumptions about the significance of small industry size. Small industry size makes $\frac{M^{j}dp_{m}}{p_{m}dM^{j}} = 0$. Thus, translated from equation (17), the direct impact on the adjustment of industry trade corresponding to equation (23) is:

$$33.\ \frac{dX^{j}}{dM^{j}} = x_{y}{}^{j}\left[\left(\frac{dY^{j}}{dM^{j}} - \frac{\varepsilon p_{m}}{p}\right) + \frac{\varepsilon p_{m}}{p}\left(\frac{M^{j}}{p}\frac{dp}{dM^{j}} - \frac{M^{j}d\varepsilon}{\varepsilon dM^{j}}\right)\right]$$

Equation (33) indicates that, overall, exports grow relative to imports if the industry marginal product of imported inputs grows relative to the real exchange rate, $(\frac{dY^j}{dM^j} - \frac{\varepsilon p_m}{p})$, as an important complementary indicator to the forces in equation (23) that grow the capacity of the industry to extract increasing returns and innovate in the production process. This is backed by demand-creating information sharing and price changes in $\frac{\varepsilon p_m}{p}(\frac{M^j}{p}\frac{dp}{dM^j} - \frac{M^j d\varepsilon}{\varepsilon dM^j})$. Here, both $d\tilde{N}^j$ and dM^j refer to employment of produced inputs, with $d\tilde{N}^j$ mainly a result of learning by doing as well as an output of the industries that produce education and training services and dM^j reflective of growing capacity to finance imports created by growing exports. Here too, especially because $\frac{dY^j}{dM^j}$ reflects underlying changes in economic structure, institutions and technology, such changes are not consistent with the assumption of fixed relative endowments of resources and associated static differences in comparative costs. However, the smaller is the sum of differences on the RHS of equation (29), the slower will exports grow relative to imports and the greater the likelihood that trade is characterized by the static properties of inter-industry trade.

Now, consistent with equation (23), a significant effect of the growth of the knowledge, skills, and self-confidence acquired by workers and managers is to increase the creativity of the production process, and thus cause increasing innovation in (the variety of) exports and the type of imported inputs used, expressed in both $\frac{dX^j}{d\tilde{N}^j}$ and $\frac{dM^j}{d\tilde{N}^j}$. The increasing returns created by more knowledgeable, skilled, creative, and self-confident workers, including through improved use of imported inputs, also enhances intra-industry trade more so than comparative advantage trade, since by equation (23), the growing trade is more likely to be based on more differentiated products within any industry that produces tradeables. Moreover, under increasing returns, the growth of savings in equation (11) is also very likely to be the result of increasing efficiency associated with factors such as learning by doing, improved division of labour, and savings of fixed costs (equation (23)).

Further, in combination with marginal productivity growth, production of highly differentiated products as a method of competition is typically the result of a dynamic innovative process within industries, which results from and also increases the general knowledge of workers about technology and their skills and self-confidence to use it. In turn, this implies falling unit costs of the knowledge, skills and self-confidence accumulated, such as might be reflected in $\frac{\tilde{N}^j dw}{w d\tilde{N}^j}$ in equation (23). In addition, as long suggested by Posner (1961), in any given industry that can participate in the creative process, the innovations and differentiations inherent in $\frac{dY^j}{d\tilde{N}^j}$ and $\frac{dY^j}{dM^j}$ as well as $\frac{dX^j}{d\tilde{N}^j}$ and $\frac{dM^j}{d\tilde{N}^j}$ provide some of the "barriers to entry" into production of the differentiated products that sustain local participation in intra-industry trade, since it takes time for domestic and foreign firms of other industries to learn of and master the novelties involved, especially in the sense of the time required for learning by doing to result in mastery of the technologies in the light of the underlying institutional arrangements and the structure of the economy. This is evident in the evolution of the creative service industries, especially music, across the Caribbean space.

Considering all industries that can participate in the innovation process, the dynamic industry innovation process, through growth of the knowledge, skills, and self-confidence of workers represented in equations (23) and (33), chips away at the historical Caribbean reliance on inter-industry trade and non-competing imported inputs based mainly on comparative advantage. The productivity-increasing innovation process causes increases in the variety of the products of the exporting industries of the domestic economy, some of which is exported (described by X^j), to increasingly compete with the products of industries that are similar to, but differentiated from, those of the industries that produce the imports described by M^j. Further, as the similarity increases, so does intra-industry monopolistic competition, which causes $(\frac{M^j}{p}\frac{dp}{dM^j} - \frac{M^j d\varepsilon}{\varepsilon dM^j})$ to converge to zero and reduce their influence on the growth of validating exports. The result is that the main remaining influence on the growth of validating intra-industry exports is the difference between the industry's marginal product of imported inputs and the real exchange rate.

6. Summary and Policy Implications

Growth of GDP can be generated in two related ways. One is by growth of living standards plus population growth, with growth of living standards achieved by simultaneous economic restructuring, institutional upgrade and technological progress. The other is by growth of augmented labour productivity and growth of the knowledge, skills and self-confidence of workers. These two approaches are cointegrated by growth of the knowledge, skills, and self-confidence of workers faster than population growth. In an import-dependent economy, investment to generate growth must be validated by commensurate growth of savings as well as by growth of exports to cover necessary expenditure of foreign exchange on imported inputs. An important question then arises of the impact of growth of the knowledge, skills, and self-confidence of workers on savings and exports.

When the wage rate is conceived as the unit payment for the knowledge, skills, and self-confidence of workers, the analysis of the impact of growth of such capacities on savings yields two striking results. First, growth of augmented labour creates commensurate growth of the flow of validating savings when the difference between the marginal product of augmented labour and the wage rate increases, even if the wage rate is not stationary. This result is more general that that provided by Lewis in terms of the difference of the marginal product of labour and the stationary wage. Second, the payment for knowledge, skills and self-confidence is not independent of the growth of demand for such capacities. Thus, the product of the average product of augmented labour and a rising price of output induced by growing employment of augmented labour can exceed the product of the wage rate and the rate at which the wage is increased by increasing employment of the knowledge, skills and self-confidence of workers and managers. The excess also causes the flow of validating savings to increase with investment to grow the knowledge, skills, and self-confidence of workers.

The modes of trade exist on a continuum involving inter-industry and intra-industry exchange, and where a country finds its best opportunities on the continuum depends on the capacity of its industries to extract increasing returns, innovate, and deploy price-making power as necessary. That

capacity depends on the knowledge, skills, and self-confidence of the workers and managers operating the production process with a specific technology and in a specific institutional framework and economic structure as measured by the share of capital in GDP.

Exports are a share of tradeable output net of non-competing imported inputs available at unit cost defined in terms of the real exchange rate. In that case, an increase in the knowledge, skills and self-confidence of workers and managers increases exports in line with the growth of necessary imports to run the production system. Further, the induced exports will increase if the marginal product of imported inputs increases and exceeds the real exchange rate. Induced exports to cover necessary imports will also increase if export prices can be increased faster that the unit cost of imports as measured by the real exchange rate.

Innovations, product differentiation and increasing returns are inherent in growth of the marginal product of augmented labour and the marginal product of imported inputs as well as in growth of the exports and imports induced by increase in the knowledge, skills, and self-confidence of workers, which is a produced input. These are usually complemented by falling unit costs, and together they strengthen capacity for monopolistic competition and favour a successful shift to intra-industry trade rather than continued reliance on inter-industry trade guided by comparative advantage, however conceived.

The main policy implication of this representation of growth of savings and exports is that policymakers in Caribbean countries should actively seek to grow the marginal product of augmented labour relative to the corresponding wage as well as the marginal product of imported inputs relative to the real exchange rate. Important to both initiatives is growth of the innovative capacity of the economy by investment aimed at growing the knowledge, skills, and self-confidence of workers and managers in all industries that can participate in intra-industry trade. The key industries here are education, healthcare, and the creative industries, all of which employ technologies that rely mainly on the knowledge, skills and self-confidence of workers and managers. Much of the output of these industries can be produced competitively by the Caribbean economy if supported by suitable credit flows. The growth of innovative capacity can be achieved by refocusing the output of the industries on the export market, by correspondingly improving the supply of services provided by the existing education and training system, and by deliberate strategies to attract highly skilled foreign natural persons into the domestic competing industries. However, successful investment to grow innovative capacity also requires simultaneous investment to restructure the economy and upgrade its institutions, including its systems of governance, business regulation and the environment for doing business.

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