THE EVOLVING PATTERN OF TRADE IN A SMALL HYDROCARBON EXPORTING ECONOMY AND SOME POLICY RECOMMENDATIONS FOR SUSTAINABLE DEVELOPMENT

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ABSTRACT

This paper evaluates the changing pattern and structure of the comparative advantage of a small petroleum-rich economy, Trinidad and Tobago (T&T), using a transition probability matrix. The paper outlines the various theoretical arguments regarding the determination of comparative advantage. The paper also assesses the revealed comparative advantage structure of the T&T economy using the popular Balassa Revealed Comparative Advantage Index and one of its recent permutations, the Revealed Symmetric Comparative Advantage (RSCA) index. The study found that the areas of comparative advantage of the T&T economy resided in its exports of hydrocarbon-intensive commodities and then goes on to detail that given the deteriorating reserves to production ratios for crude oil and natural gas, a greater attempt should be made at diversification of the economy's export platform.

Keywords: revealed comparative advantage, Balassa index, revealed symmetric index, transition probability matrix.

1.0 Introduction

Comparative advantage is an important concept to both policymakers and practitioners. The principle of comparative advantage is one of the oldest and most important concepts in economics but some ambiguity remains regarding its meaning, scope and measurement. The nature of an economy's comparative advantage has utility as it can help to identify the implications for an economy of a shift in a policy regime and to determine the influence on economic welfare both in the long run and in the short run. An understanding of comparative advantage can help provide clearer directives regarding the direction that an economy's trade and investment regime should adhere to in order to benefit from explicit differences in international factor endowments and relative demand. Gains from international trade are realized due to an improvement in the allocation of scarce resources when an economy produces its comparative advantage.

This paper makes a contribution to the empirical analysis of international trade and economic growth and assesses the dynamic nature of trade in the Trinidad and Tobago (T&T) economy. In this study, we calculate the popular Balassa index alongside one of the more recent permutations of this same index. In tandem with the new slant in the literature, this study will also assess various properties of the distribution of the RCA index to investigate if there has been persistence in T&T's comparative advantage.

The rest of the paper proceeds as follows. First a literature review will be undertaken detailing the various theoretical perspectives on specialization both for static and dynamic changes in RCA indices. A discussion of various measurement issues followed by the Hillman condition is then undertaken. An empirical review of the T&T economy's RCA scores follows. The paper then outlines the direction of T&T's exports and the reserves to production ratios in crude oil and natural gas. The paper then concludes with some relevant policy suggestions.

2.0 Theoretical Perspectives on Specialization and Dynamic Specialization

It is widely accepted by most technocrats that an important contributing factor to success in trade is the nature of specialization engaged in by an economy (Krugman 1994). Knowledge about the comparative advantage status of an economy plays a critical role in the economic development and planning of economies, especially as concerns the allocation of scarce resources between generations. Especially within the context of achieving sustainable development defined as the achievement of intergenerational equity in the allocation of scarce resources, understanding the nature of a country's comparative advantage is critical. Significantly, a country's comparative advantage does not change in the short run but sometimes evolves only slowly.

Building on the work of Adam Smith, David Ricardo formulated the theory of comparative advantage. Ricardo illustrated the principle of comparative advantage by drawing reference to the following example:

> Two men can make shoes and hats and one is superior to the other in both employments; but in making shoes he can only exceed his competitor by one third, or $33^1/_3$ percent. Will it not be for interest that the superior man should employ himself exclusively in making shoes, and the inferior man in making hats?

To generalize, the theory of comparative advantage supports the need for specialization and trade in spite of the fact that one country may have an absolute advantage in the production of both goods. Ricardian comparative advantage is premised on the internal differences in cost and technology.

The workhorse neoclassical Heckscher /Ohlin model identifies that a nation should produce and export those commodities in which it has an abundance of factors of production and import those commodities

which call for factor proportions in the opposite direction.[1] In Ohlin's own words:

> Commodities requiring for their production much of [abundant factors of production] and little of [scarce factors] are exported in exchange for goods that call for factors in the opposite proportions. Thus indirectly, factors in abundant supply are exported and factors in scanty supply are imported.
>
> (Ohlin, 1933, p. 92)

If the factor endowments of an economy remain constant, then in the purview of the Heckscher-Ohlin theory the bundle of commodities a country produces will remain the same (i.e. there will be persistence in the pattern of production). With the Heckscher-Ohlin model, the perspective is that the pattern of production changes only when there is a change in the factor endowment bundle[2]. When we include increasing returns to scale into the discussion the analysis becomes a little more complicated, and depends on the assumptions that are made with specific regard to increasing returns to scale. If we have output-generated national external economies then the resultant effect on the pattern of trade hinges on the effect on the production possibility curve of the firm (Markusen and Melvin, 1981)[3]. Markusen and Melvin note that if the extent of external economies of scale is small regarding the differing factor intensities of the

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[1] One segment of the trade literature has identified that if an economy is engaged in the wrong type of specialization then the long-run growth potential of the economy may be harmed, (Lucas (1988) and Young (1991)).

[2] The Product Cycle Theory (PCT) was introduced into the economics in literature 1966 by Raymond Vernon, as an explanation of comparative advantage and infers that an economy's comparative advantage is determined by the state of its technology and the extent of its learning by doing. Vernon cited that the highly educated workforce for some economies and the budgetary outlay on R&D meant that certain sets of economies were able to produce newer commodities at a faster pace than other economies. Yet other researchers see comparative advantage as occurring because of state influence and have gone so far as to infer that the state helps to create winners. Li (2002) identifies South Korea and Japan as two economies in which the state picked winners and helped to create export strongholds in these economies.

[3] Kemp (1969) and Markusen and Melvin 1981.

two sectors, then the same outcomes as those which occurred in the standard H/O model will prevail as the slope of the relative supply curve would be positive.[4]

Other researchers such as Ethier (1979, 1982) take the position that economies of scale are international rather than national and so the extent of economies of scale depends on the size of the global economy. Ethier illustrated that in the presence of internationally decreasing costs, the platform of inter-industry trade is not influenced by increasing returns.[5] Wong (1995) also demonstrates that in some situations economies of scale can influence trade outcomes.

Because of learning by doing, some researchers such as Lall (2000) have argued that an economy can maintain its comparative advantage, even though it may have lost its initial advantage. In this regard, Yuichiro and Cook (2004) argue that generally

> this occurs because the best countries have in place learning systems that allow them to absorb technologies efficiently and to react competitively to changing technological conditions. By contrast, countries with weak learning systems find it difficult to establish competitive positions, even in simple or resource-based activities.[5]

To put it differently, because of cumulative learning, leading economies maintain the productivity gap. Additionally, path dependency and the historical lock in effect of resource reallocation also have an impact on the productive structure of an economy.

Economies that have lower patterns of stability in their RCA (i.e. those economies with a greater degree of change in their patterns of specialization) tend to be 'catch up' economies (Beelen and Verpagen 1994). Krugman (1989) identifies that high growth economies also experience some degree of structural change in their pattern of comparative advantage as these economies respond to favourable income elasticity of demand. The productivity of resources in Krugman's model is a function of cumulative experience, i.e. learning by doing, so that once an

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4 J. Brasili et al (2000).

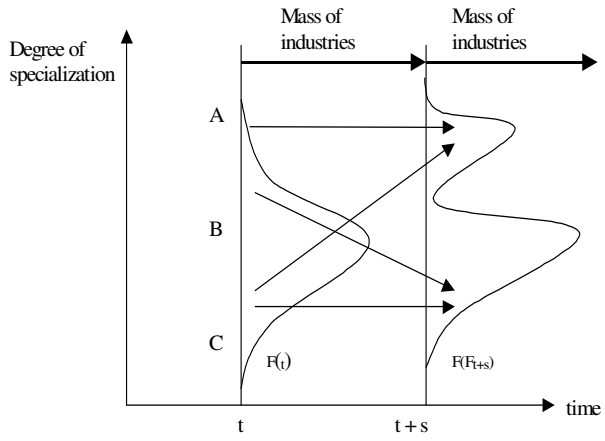
5 W.J. Ethier (1979) and W.J. Ethier, (1982).

economy has a particular pattern of specialization, learning by doing helps to reinforce its margin of comparative advantage[6].

Figure 1 below summarizes this theoretical outcome. In this diagram, F(T) is the density function associated with an initial index of sectoral trade performance. The distribution $F(T_{t+s})$ shows the expected outcome and sectoral trade performance when dynamic scale economies lead to initial areas of comparative advantage and initial areas of comparative disadvantage become denser and areas of intermediate comparative advantage disappear, i.e. sectoral trade performance becomes increasingly polarized.

Researchers such as Proudman and Redding (1998) have argued that the determination of whether an economy's pattern of trade is persistent or mobile should be empirically determined.

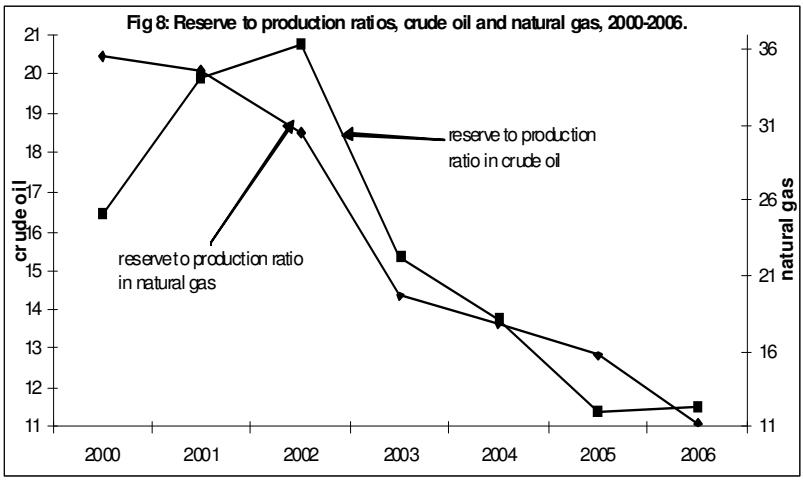
Figure 1: Distribution associated with differing evolution of RCA indices



[6] Beelen and Verpagen (1994) argue in relation to 'catch up' economies that these economies are likely to have the highest degree of structural change. These countries accelerate the pace of change of specialization patterns by absorbing foreign technology at a pace faster than the technology shelf progresses.

3.0 Measuring Revealed Comparative Advantage

Quantifying comparative advantage is a detailed task. Several difficulties easily arise when such calculations are being undertaken. One problem experienced when quantifying revealed comparative advantage measures occurs when we consider aggregation. It is well understood that the economic welfare and allocative efficiency in the use of resources occur when nations engage in international trade in those commodities in which they carry a comparative advantage. However, this relationship becomes blurred particular, what this means is that whilst an economy may have a comparative advantage in some parts of a commodity, it may have a comparative disadvantage in other parts. For example, whilst Saudia Arabia may have a strong comparative advantage in SITC 3 (aggregate), the country may still import considerable amounts of some particular commodity line falling under the classification of SITC 3.



Another problem arises because with actual data an economy's comparative advantage may appear to be what an economy's post-trade data reflects, whilst this may not be the case. In this regard Volrath (1991) has argued that policy makers have to be careful about the blurring effect of government intervention.

Balassa (1965), in an evaluation of the factors that determine the comparative advantage of an economy, noted that

> Comparative advantage appears to be the outcome of a number of factors, some measurable, others not, some easily pinned down, others less so. One wonders, therefore, whether more could not be gained if instead of enunciating general principles and trying to apply these to explain actual trade flows, one took the observed pattern of trade as a point of departure.

On this basis, Balassa promoted the line of enquiry focusing on post-trade equilibrium rather than pre-trade equilibrium.[7] Concerning post-trade equilibrium, Balassa highlights that it "reflects relative costs as well as differences in non price factors."

Ballance et al. (1987) note that economic conditions in an economy have the ultimate influence on the economy's comparative advantage. In turn, the pattern of international comparative advantage influences trade, production and consumption patterns of any particular good. An excellent example of this is the Cayman Islands. During the 1960s the Cayman Islands was a small poverty-stricken parish of Jamaica; since its independence, this economy has focused heavily on developing its offshore financial services sector, the overall consequence of which is that the country today boasts a GDP per capita of over US$44,000. some 10 times higher than that of Jamaica.

Using data on trade, production and costs (which are 'post-trade' data) one can estimate an economy's comparative advantage (the word 'estimate' here is indicative of 'revealed').

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[7] Greenaway and Milner (1993) noted that these indirect methods obviously needed to make assumptions about the relationship between observable and unobservable variables.

The Balassa (1965) "Revealed" comparative advantage index can be expressed as follows:

$$B = [X_{ij} / X_{it}] / [X_{nj} / X_{nt}]$$

where:
X: exports,
i: is the exporting country,
j: is a commodity,
t: a set of commodities,
n: a set of countries.

Balassa (1979) has argued that RCA measures can be used to help analyse the changing comparative advantage of economies, given their accumulation of the various factors of production. The Balassa index (BI) has a theoretical range from 0 to infinity and is based on post-trade and not on pre-trade data. This range of the index can be divided into two substantive groups:

$0<RCA< 1$

$1<RCA<$ infinity.

It carries a fixed demarcation value of 1, a variable upper bound and a lower bound of zero. Hinloopen and Marrewijk (2001) have argued that the widely used criterion, $RCA>1$ to select industries which carry a comparative advantage, selects about one third of an economy's exports. To provide a more even distribution of the RCA scores, Hinloopen and Van Marrewijk (2001) have divided the theoretical range of the Balassa RCA values into four classes.

These classes are as listed in Table 1 below.

Table 1: RCA Classifications		
Class a	0 < RCA < 1	Industries with a comparative disadvantage
Class b	1< RCA < 2	Industries with weak comparative disadvantage
Class c	2 < RCA < 4	Medium comparative advantage
Class d	4 < RCA	Strong comparative advantage

4.0 The RSCA Index

The Balassa index has remained one of the most popular measures of revealed comparative advantage available in the literature.[8] However, because of its inherent asymmetry, (0 to 1 represents a comparative disadvantage, and 1 to infinity a comparative advantage), a number of procedures have been considered as possible alternatives; the most common is the use of a logarithmic transformation of the Balassa index as explained by Soete and Verspagen (1994)[9]. When we use logarithms (natural), however, a change in the RCA score from say 0.01 to 0.02 (or vice versa) has the same numerical transform as a change in RCA scores from 50 to 100. Even more, small RCA scores when transformed into a natural logarithmic format, adopt a high negative ln (RCA) value.

[8] Hinloopen and Van Marrewijk (2001) found that in each case the BI was skewed with a mean value more than the median and with the density function of the distribution monotonically declining. Even more, this tendency was robust amongst the different time periods reviewed.

[9] Fagerberg (1994) in analysing Technology and International differences in growth rates, arbitrarily added a small integer to the RCA scores in order to be able to transform logarithmically the zero value cases. This, Fagerberg argued, would improve both the normality attributes of the distribution as well as the problem of transforming to lags, but this method had no economic basis.

Laursen (1998) has argued that the "Balassa measure has the disadvantage of an inherent risk of lack of normality because it takes values between zero and infinity with a weighted average of 1.0". To address this problem of skewness Dalum et. al (1998) use a variant proposed by Laursen and Engedal (1995).[10] These authors use the following formulation.

$$RSCA = (B - 1) / (B + 1) \qquad (2)$$

This reformulated index has a theoretical range from negative unity to unity i.e. $-1 \leq RSCA \leq 1$. The strength of this index is that it is symmetric.[11] However, de Benedictis and Tamberi (2001) noted that although the RSCA index carries most of the distributional attributes of the original BI, the forced symmetry

> may obscure some of the BI dynamics, especially when these are expressed by a change of kurtosis or of the symmetry itself. Its reduced asymmetry does not imply normality; and its use may induce a bias associated with extreme values of the distribution, when these are relevant as they usually are for LDCs.

5.0 Hillman Condition

Hillman (1980) examined the relationship between the Balassa index and pre-trade relative prices. He focused on cross country comparisons for a specific sector, using homothetic preferences and treating all other goods as a Hicksian composite good. Hillman considered the post-trade equilibrium-based Balassa index as a measure of comparative advantage and what pre-trade indices suggest. He illustrated that it was inappropriate to use the B index in making cross-country comparisons since, when making cross-country comparisons, the B index is independent of Ricardian-premised comparative advantage (Ferto and Hubbard, 2003).

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[10] B. Dalum, K. Laursen and G. Villumsen (1998.

[11] A similar measure is available in the literature and is referred to as the revealed patent advantage (RPA). Specifically, Grupp (1994) outlines, $RPA_{ij} = (RTA^2 - 1)/(RTA^2 + 1) * 100$, where RTA refers to revealed technological advantage.

Hillman (1980) provided a theoretical basis for the Balassa index and offered a diagrammatic illustration of the necessary and sufficient condition which will facilitate correspondence between the post-trade Balassa index and pre-trade relative prices. The condition is verifiable empirically. Hillman illustrated that in pre-trade equilibrium, comparative advantage meant the following condition held:

$$[1 - (X_{ij}/W_i)] > [(X_{ij}/X_j)\ (1 - X_j/W)] \qquad (4)$$

In this formulation:

X_{ij}: exports of commodity i by country j,
X_j: aggregate exports (all commodities),
W_i: world export of commodity i,
W: aggregate world exports.

As outlined, Hillman's condition has three parts:

(i) $X_{i,t}/W_i$: the share of a country's export in a particular commodity as a proportion of total exports of a group of reference economies in that sector (this is a market share term),

(ii) $X_{i,j}/X_j$: share of exports in sector relative to the economy's aggregate exports, (this is an export penetration term),

(iii) (X_j/W), the size of the economy to total exports, relative to the world (this provides an indication of the relative size of the economy)[12]

[12] Hinloopen and Marrewijk (2005) note that the Hillman condition is violated in the general environment where the economy has a highly concentrated market and export specialization. The degree of sector specialization also affects the extent to which the Hillman condition is violated. As more sectors of aggregation are identified it becomes more likely for an economy to illustrate a dominant position in a specific sector. Alternatively said, the more narrowly defined the community range, the greater the likelihood that it can show dominance in at least one sector.

To transfer the Hillman condition into an operationally testable format, Marchese and Nadal de Simone (1989) utilized the following version of the Hillman index:

$$HI = (1 - X_{ij} / W_i) / (X_{ij} / X_j) (1 - X_j/W) \quad (5)$$

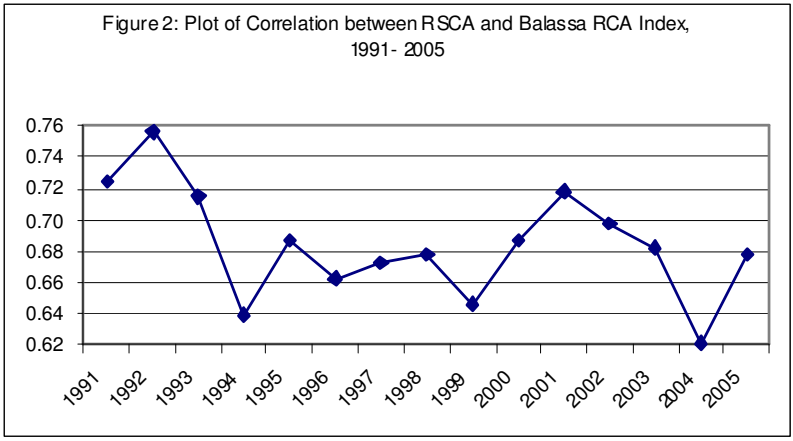
Using expression (5), for a HI score greater than unity, the B index represents a good indicator of comparative advantage. Marchese and Nadal de Simone (1989) argue that researchers should investigate whether the Hillman condition holds, before proceeding to use the Balassa index to examine the comparative advantage stance of an economy.

The Hillman criteria was applied to data from the T&T economy and in each case the data passed the Hillman test, paving the way for the Balassa index to be utilized as an indicator of comparative advantage.

6.0 Statistical Approach

Proudman and Redding (1998) have argued that the determination of the specialization pattern of an economy can only be resolved by reference to empirical enquiry. In this section, an assessment of changes in the T&T economy's overall degree of specialization (between the two time periods 1991-93 and 2003-05) is undertaken. The RCA calculations are carried out at the three digit level. Further, in this study, in order to avoid having to deal with erratic bits of data which can arise because of price and/or exchange-rate volatility, three-year average values of the RCA indices for the beginning and end time period are utilized.

From here onwards only the Balassa index is computed to reflect comparative advantage, for as the Figure 2 below reflects, there is a high correlation between the Balassa index and the RSCA index.



7.0 Shape of the Distribution

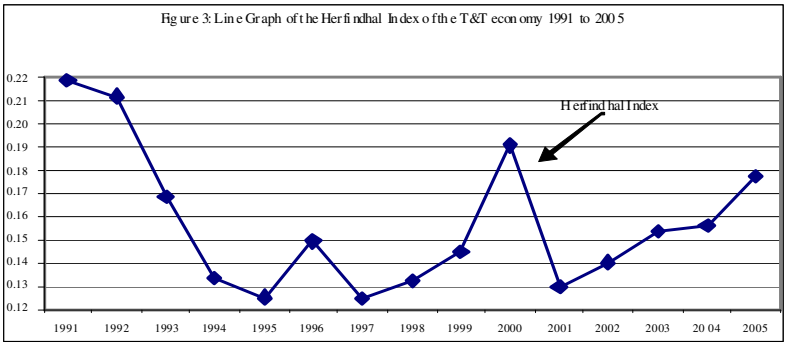
An aggregate picture of whether or not T&T's export basket has broadened over time can be gleaned through the use of the Herfindahl index (S). Such an index may be calculated as follows:

$$S = \sum_{i=0}^{9} (Xsitc_i/X)^2, i=0,....,9$$

where: $Xsitc_{ij}$: the exports of $sitc_i$: (i equals the 0… 9 single digit export sectors).

The Herfindahl index can provide some indication regarding the extent to which an economy is becoming more specialized or more diversified. The higher the value of this index, the greater the degree of export specialization engaged in by an economy. It is clear that the Herfindahl index for the T&T economy (see Figure 3), although decreasing sharply between 1991 and 1997, has since appreciated,

indicating that the T&T economy is becoming increasingly specialized. This is not surprising, as the structural adjustment-based trade liberalization strategy is engineered to encourage production along comparative advantage lines.[13]



RCA indices when plotted help to provide information on the intra distribution dynamics. If the RCA attributes of an economy displayed signs of persistence, then what one would find is that industries with high RCA values in one period also have high RCA values in another time period. In the RCA plots, (Figures 4 and 5 below), there appears to be a high degree of persistence and similarity in the distributions. However, because of the difficulty of gauging the requisite set of details from a visual inspection of these graphs, this study uses a back-up array of other derivations.

[13] In 1990, after seven years of recession, the T&T economy implemented a structural adjustment programme under the guidance of the World Bank.

Figure 4: Average RCA scores (SITC 3 digit 1991 to 1993

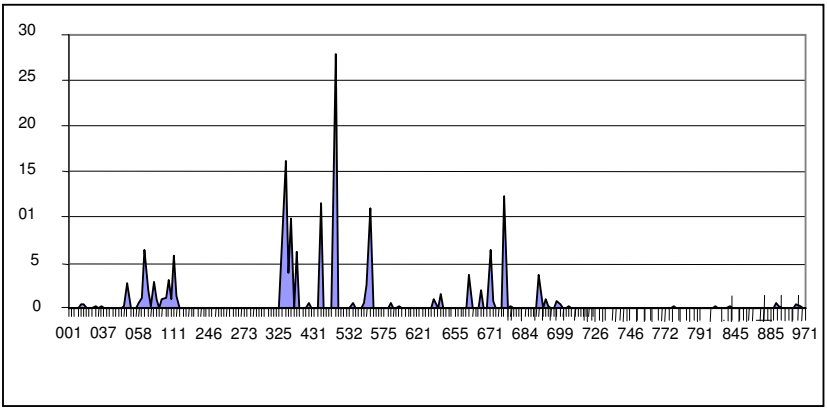


Figure 5: Average RCA Values, 2003 to 2005 at the 3 digit SITC level

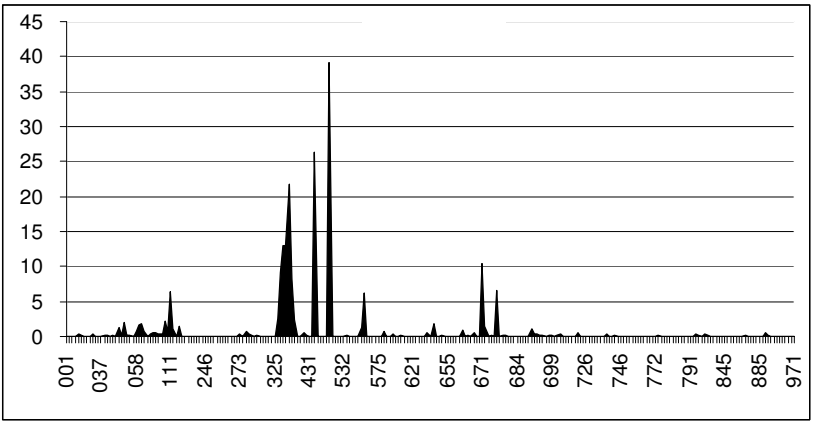


Table 2 below compares the trends in the RCA for the T&T economy to the world for the period 1991 to 1993 (average value used) and 2003 to 2005 (average value used). Between the two time intervals there was a decline in the number of areas in which T&T had a comparative advantage with the world (from 27 in the period 1991 to 1993 to 24 in 2003 to 2005). This suggests some degree of polarization in the pattern of RCA of the T&T economy.

Table 2: RCA indices of T&T with the World

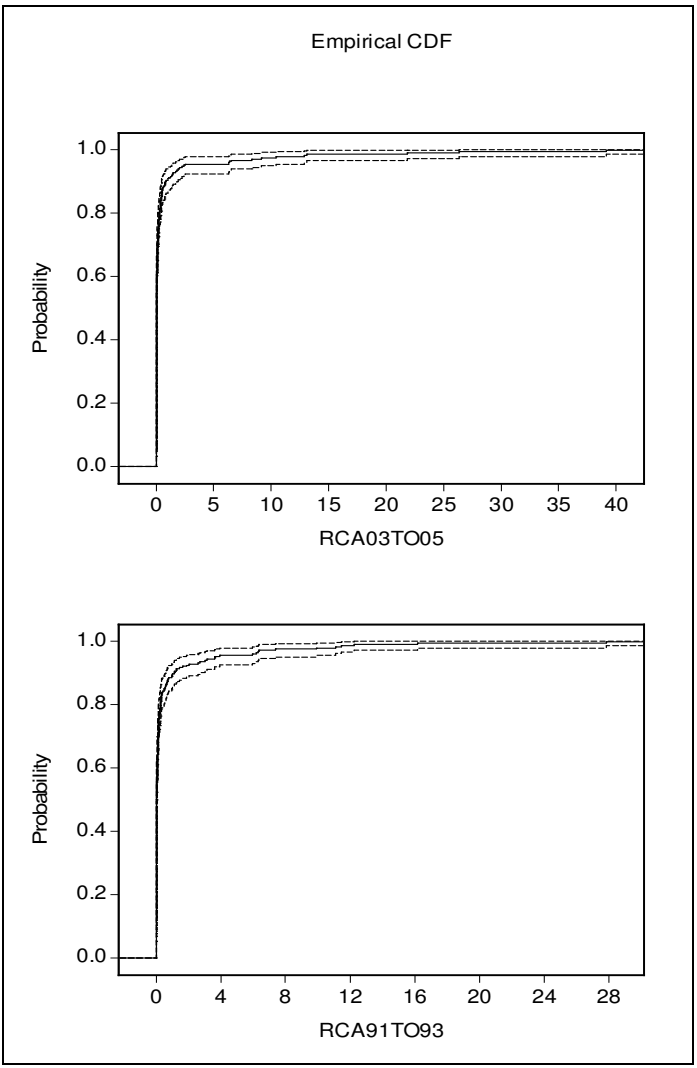
	1991-1993		**2003-2005**
SITC	**RCA**	**SITC**	**RCA**
		046	**1.4**
048	2.7	048	2.0
059	1.3	059	1.7
061	6.3	061	1.9
062	1.9		
072	**3.0**		
073	**1.1**		
075	**1.1**		
081	**1.2**		
091	3.2	091	2.2
111	6.0	111	6.4
112	1.5	112	1.0
		122	**1.5**
333	7.4	333	2.5

Table 2 (Continued)
RCA indices of T&T with the World

	1991-1993		**2003-2005**
SITC	**RCA**	**SITC**	**RCA**
334	16.2	334	9.2
335	3.9	335	13.1
342	9.9	342	12.9
		343	**21.8**
344	6.2	344	8.3
		345	**2.4**
512	11.5	512	26.3
522	27.9	522	39.2
554	2.6	554	1.3
562	11.1	562	6.3
635	**1.0**		
642	1.6	642	1.8
661	**3.6**		
665	**2.0**		
671	6.4	671	10.4
		672	**1.4**
676	**12.3**		
691	3.6	691	1.1
	27		23

Regarding the shape of the RCA distribution, a more complete picture can be had from looking at the cumulative distribution function illustrated below. The Cumulative Distribution Function plots the probability of not observing a value from the data which does not exceed a specific value (r). The CDF plots for both RCA_{91to93} and $RCA_{03to2005}$ are shown below.

Figure 6: Empirical CDF



The cumulative distribution plots help to show that the majority of the sectors have a very high probability of carrying a score equal to or close to zero, i.e. indicating that a high proportion of sectors, across both time periods, carry a comparative disadvantage, in turn indicating that the RCA index is very asymmetrically distributed.

8.0 Stability of the Index

To investigate the stability of the Balassa index a number of options are available. Hoekman and Djankov (1997) and Ferto and Hubbard (2003) employ a simple approach. They estimate the correlation coefficient between RCAs in different time periods. A high correlation score indicates that between the two time periods the relative comparative advantage status of industries remained the same. The correlation between the two RCA distributions is 0.81, indicating a high degree of persistence.

Table 3: Statistical attributes of T&T's RCA indices 1991 to 1993 and 2003 to 2005

	RCA_{91TO93}	RCA_{03TO05}
Mean	0.70	0.80
Median	0.032	0.025
Maximum	27.87	39.17
Minimum	0.000	0.00
Std. Dev.	2.60	3.60
Skewness	6.57	7.42
Kurtosis	56.39	66.55
Jarque-Bera	32247.92	45428.77
Probability	0.00	0.00
Observations	256	256

Table 3 above shows various statistical properties of the distributions for the time intervals 1991 to 1993 and 2003 to 2005.[14] In the listed time intervals, the mean of the RCA indices increased from 0.69 to 0.80, with the median value decreasing from 0.032 to 0.025. According to Chew (1990), the arithmetic mean is a poor indicator of the underlying distribution of an index, when it is characterized by a pronounced degree of skewness.[15] In these types of distributions the median is a better indicator of location as it is not influenced by extreme values.[16] Even more, some sectors having a BI above unity means that at least one other sector would have a Balassa score below unity, so that there is no statistical sense in saying that u(BI) is greater than or less than one. In contrast the median values have an immediate interpretation in that a high median value implies that an economy has a large number of its industries with comparative advantage whilst an economy with a low median value is one which has a high degree of comparative disadvantage. de Benedictis et. al. (2003) also identify that the median is preferred to the mean because it is highly correlated with other indicators of importance such as those which reflect on per capita income. The decline in the median RCA value across the two distributions for the T&T economy indicates that the economy's comparative advantage strength resides in a smaller number of sectors.

These results, in the context of Figure 1, are not entirely surprising as the comparative advantage of an economy reflects that it would become more specialized in the production of those goods in which it is strong and weaker in those goods in which initially held a comparative disadvantage. Even more, in the presence of the Dutch Disease which is currently affecting the T&T economy, one would expect that there would be some crowding out of the non-booming tradable segments of the T&T economy on account of the appreciation of the real effective exchange rate (REER) that occurs in the presence of a boom in a tradable

[14] When considering structural stability it is very useful to look at the range of the distribution and this is reflected by looking at the difference in the maximum and minimum values of the distribution.

[15] See also de Benedictis and Tamberi 2004 for a similar discussion.

[16] See Chew 1990.

product.[17] This result is also supported by an increase in the level of skewness of both distributions, this expanded from 6.57 in the period 1991 to 1993 to 7.42 in the time interval 2003 to 2005. The level of kurtosis between the two distributions increased from 56.3 to 66.5 and indicates an increase in the peakedness of the distribution. Not surprisingly, therefore, the Jarque Bera test (which measures the difference between skewness and kurtosis of a distribution from the normal distribution) rejects the presumption of normality in both distributions. The maximum RCA score attained by any sector increased from 27.87 in the period 1991 to 1993 to 39.16 in the period 2003 to 2005.[18] The increase in the maximum value suggests an increasing emphasis on some commodity line.

Collectively, these statistics indicate that both sets of distributions are asymmetric and skewed to the right. They also inform the emergence of a greater degree of polarization in the pattern of specialization in the Trinidad and Tobago economy.

9.0 Galtonian Regression

Following Hart and Prais (1956), Hart (1976) and Cantwell (1989), a Galtonian regression can be deployed to determine whether the T&T economy has become more or less specialized in each of the three digit categories for which data from the COMTRADE database was utilized.[19]

In this regard, a simple regression of the form:

$$RSCA^{t2} = \alpha_0 + \beta_1 RSCA^{t1} + e_1 \qquad \text{(equation 1)}$$

can be used to help determine the correlation between the RCA calculations for period t_1 and period t_2. In this formulation t_1 is the initial year for which RCA has been calculated and t_2 is the final year. The

[17] See Hosein (2008, forthcoming).

[18] With RCA calculations of this nature the minimum value is almost invariably zero so that the range is really equal to the size of the maximum value.

[19] See also Pavitt (1988) and Zaghini (2003).

assumption made here is that e ~ N (0, σ) and e are assumed to be independent of RCA_{t1}, α_0 and β are the standard linear regression parameters. The interpretation of the β coefficient may be cast as follows. For $\beta = 1$, there is no change in the degree of specialization between the two time periods. If $\beta > 1$, the economy has become more specialized in its area of comparative advantage and less specialized in those commodities in which it initially carried a low level of specialization. In other words it means that the spread between competitive and uncompetitive industries has widened. If $0 < \beta < 1$, then those commodities with initially low values of RCA experience a decline between the listed time periods whilst those with initially low scores experience growth over time and so overall a β score in this range indicates that the specialization pattern has not changed. If $\beta < 0$, it means that there is a sharp reversal in comparative advantage. The magnitude $1-\beta$ measures the regression effect. For a value of $|1-\beta| = \lambda$ which is low, (i.e. for high values of β) there is a concentration of the pattern of specialization. A high value of λ indicates a significant amount of diversification.

Estimates of the coefficients of equation 1 and the associated battery of statistics are presented in Table 4 below:

Table 4: Dependent Variable: RCA03TO05

Method: Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.0147	0.134	0.089	0.9128
RCA91TO93	1.131	0.049	22.645	0.0000
R-squared	0.668	Mean dependent var		0.796
Adjusted R-squared	0.667	S.D. dependent var		3.609
S.E. of regression	2.078	Akaike info criterion		4.308
Sum squared resid	1097.202	Schwarz criterion		4.336
Log likelihood	-549.53	F-statistic		512.797
Durbin-Watson stat	1.857	Prob(F-statistic)		0.000

The value of β is 1.13 and this indicates that overall the T&T economy has become more specialized. This statistical result is corroborated by output from a Wald test (see Table 5 below) which rejects the null hypothesis that $\beta = 1$.

Table 5: Wald Test, null hypothesis $\beta = 1$			
Test Statistic	Value	df	Probability
F-statistic	6.900399	(1, 254)	0.0091
Chi-square	6.900399	1	0.0086
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
-1 + C(2)		0.131224	0.049955
Restrictions are linear in coefficients.			

10.0 Intra Distribution Dynamics: Transition Probability Matrices and Markov Chains

Information provided by descriptive statistics, although useful, can hide some of the attributes of the two distributions and may even be misleading regarding how they evolve over time. An evaluation of the mobility of an index involves looking at the distribution of the degree of specialization of that index. It is preferable to analyze the mobility of different sectors in a specialization index using transition probability matrices. A transition probability matrix may be defined as a square array of non negative numbers such that the rows tally to unity and represent a discrete Markov chain[20]. The estimated transition matrices are based on the time interval 1991 to 1993 (the initial time period) and 2003 to 2005

[20] A Markov Chain may be simply defined as a sequence of random values whose probability values at time period t hinge on the value of the number in the time interval t-1. The overall controlling factor in a Markov Chain is the transition probability.

(the new time period) and show the probability of moving from one state in the first time period to another state in the final time period.

Table 6: Transition probability matrix

		From			
		a	**b**	**c**	**D**
to	**a**	0.965	0.026	0.009	0.000
	b	0.333	0.333	0.222	0.111
	c	0.250	0.000	0.500	0.250
	d	0.091	0.000	0.091	0.818

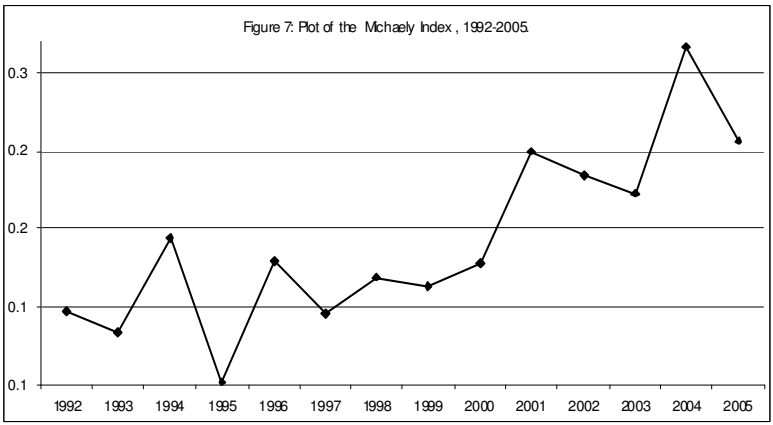
Using the classes illustrated in Table 1, the first diagonal element of 0.97 indicates that there is a high degree of persistence amongst the comparative disadvantage class. In particular the high value of 0.97 indicates that a commodity with a comparative disadvantage in the first period was hardly likely to change comparative advantage in the second time period. The other diagonal elements are 0.33, 0.50 and 0.82 respectively. Except in the case of class b, and to a lesser extent class c, there is a high probability that the various classes remain unchanged in the indicated interval of time. The prospect of moving to a lower cell typically has a low probability (maximum 0.25), whilst the probability of moving onto a higher class is also typically low (highest value 0.33).

Shorrocks (1978) proposes an index of mobility that captures the relative magnitude of both diagonal and off-diagonal elements. This index is derived using the formulation:

$$M_1 = K\text{-}tr(P)/K\text{-}1$$

In this expression, K is the number of classes and P is the transition probability matrix. This mobility index has a score of 0.46 and this indicates a relatively low level of overall mobility.

Finally, it is possible to make a further comment on the dynamics of the RCA by reference to a synthetic indicator of dissimilarity such as the Michaely Index[21] (MI). The MI has a theoretical range from 0 to 1 with a value of 0 indicating perfect stability in the specialization pattern and a value of 1 indicating perfect mobility in the specialization pattern. For T&T, the MI fluctuated from 0.1 in 1992 to around 0.3 at the end of the data period and, overall, indicates only a low intensity of change in the pattern of specialization.



[21] See Pavitt (1988).

Export Market Concentration

Table 9: The Direction of T&T's exports, 1990-2004									
	Level of exports, US$m				Share, %				
Year	Total	USA	EU	Caricom	Total	USA	EU	Caricom	Rest of World
1990	1961.9	1144.0	110.4	259.8	100	58.3	5.6	13.2	22.9
1991	1751.3	965.3	168.2	220.5	100	55.1	9.6	12.6	22.7
1992	1661.9	879.0	99.2	257.4	100	52.9	6.0	15.5	25.6
1993	1526.6	742.2	69.8	328.2	100	48.6	4.6	21.5	25.3
1994	1769.9	859.6	166.2	371.7	100	48.6	9.4	21.0	21.0
1995	2372.1	955.2	212.4	503.3	100	40.3	9.0	21.2	29.5
1996	2360.0	1092.9	183.3	610.4	100	46.3	7.8	25.9	20.0
1997	2468.4	998.3	208.7	573.9	100	40.4	8.5	23.2	27.9
1998	2192.6	826.4	140.9	656.8	100	37.7	6.4	30.0	25.9
1999	2815.6	1097.1	184.2	726.7	100	39.0	6.5	25.8	28.7
2000	4314.7	1849.2	255.2	970.0	100	42.9	5.9	22.5	28.7
2001	4062.5	1764.8	192.2	978.0	100	43.4	4.7	24.1	27.8
2002	3809.4	1792.2	180.6	767.4	100	47.0	4.7	20.1	28.1
2003	5101.1	2791.1	160.9	1008.0	100	54.7	3.2	19.8	22.4
2004	6382.9	4420.2	193.2	822.4	100	69.3	3.0	12.9	14.8
Average	2970.1	1478.5	168.4	603.6	100	48.3	6.3	20.6	24.8
% change	4421.0	3276.2	82.8	562.6	0	11.0	-2.6	-0.3	-8.0

Source: Balance of Payments Yearbook of T&T, (various years), and unpublished Central Bank data.

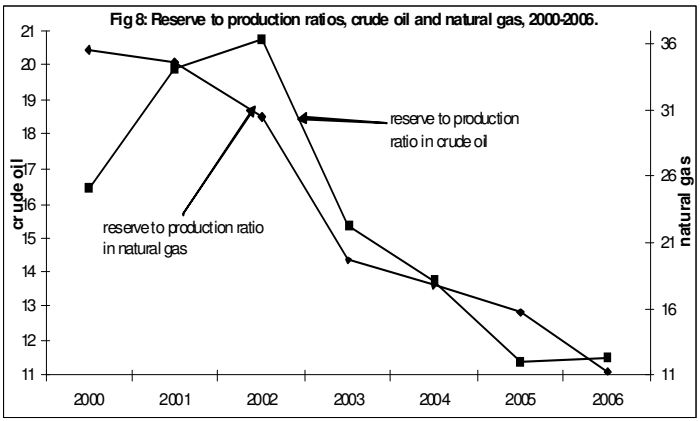
As Table 9 above shows, the USA is an important export market for the T&T economy, absorbing approximately 70% of total exports from T&T in 2004. Although Caricom absorbed 12.9% of total exports from T&T in 2004, this was still much lower than the 30% which the regional block imported from T&T in 1998. Also observe that from 1998 to 2004, the significance of the USA as an export market increased by over thirty percentage points. This structural change in the direction of T&T's exports is on account of two main influences:

- the composition of exports to the USA and
- the start up of LNG production in 1999.

Specifically, the main export to the USA is in hydrocarbon products, including Liquefied Natural Gas (LNG) production which started in 1999.

11.0 Dwindling Hydrocarbon Factor Endowment Base.

Figure 8 below shows the trends in the reserves to production ratios of natural gas resources and crude oil for the period 2000 to 2006. Observe that the available data indicate an almost continuous decline in both variables. Unless there is a major new discovery of natural gas and/or crude oil, focus on the production of these commodities or goods will eventually stall.



12.0 Conclusion

This paper utilized the classic Balassa index (and the revealed symmetric comparative advantage index) to assess the revealed comparative advantage attributes of the T&T economy over the time period 1991 to 1993 and 2003 to 2005. The study found that there is a high degree of persistence amongst commodities with comparative disadvantage but amongst some of the other commodities carrying weak to medium to strong comparative advantage there is some variation.

The T&T economy exports a concentrated basket of goods to a narrow range of economies. In trying to maintain its export revenue inflows, the T&T economy would need to promote the export of its commodities to a wider range of countries and expand the range of commodities in which it carries comparative advantage. This would enable the economy to reduce the risk associated with a concentrated export basket. Additionally, given the falling reserves to production ratios in the factor endowment base on which the economy's comparative advantage is built, there is urgent need to expand the production base of the economy into those segments of the export basket which carry comparative advantage status but which are not dependent on hydrocarbon resources. A further consideration would involve providing adequate incentives and opportunities for those commodities that have shown an improvement in their revealed comparative advantage score in the recent past, between 2000 to 2006, but which still need an extra push for their RCA score to cross unity. The products that should be targeted are those commodities that face an increase in international demand.

Some of the sectors with potential comparative advantage can also be boosted by government intervention. To facilitate the whole process the T&T government will need to effectively manage its overall external competitiveness which has been declining in the last ten years. Any intervention would require significant investments on improving the supply side of the economy to ensure sustainable growth.

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