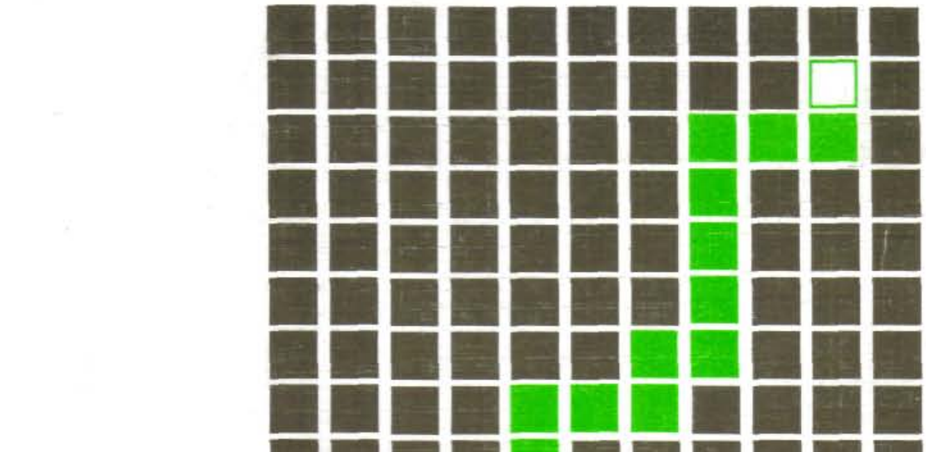
ISSN 1019 – 035 X

Farm & Business



Vol. 6, No.1, October 2003

The Journal of the Caribbean Agro-Economic Society

Export Specialization in Latin America and the Caribbean

Timothy G. Taylor* and Eric T. Bonnett**

Abstract

Over the past twenty years the primary development paradigm pursued by Latin American and Caribbean countries has shifted from the concept of import-substitution-industrialization (ISI) to that of export-led growth and openness to international markets (Bruton). The Caribbean Basin Economic Recovery Act, the Caribbean Basin Trade Partnership Act and the North American Free Trade Agreement were all expected to encourage export expansion and diversification upon their approval. However, virtually no research has been undertaken to assess the degree to which the export structures of Latin American and Caribbean countries have in fact diversified.

This paper examines the structure of exports to the US from 19 selected Latin American and Caribbean countries in order to assess the degree to which export diversification has occurred. Using Galtonian regression, the distribution of exports during the period from 1989 to 1991 is compared to that of the years from 1998 to 2000. The results from the three methods of estimation are presented and compared. The differing inferences drawn from OLS results and Tobit results are then discussed in detail. It is argued that using Tobit estimation is most appropriate when examining export structures from Latin American and Caribbean countries to the US.

**Professor & **Graduate Research Assistant, Food and Resource Economics Department, University of Florida, Gainesville, FL 32611-0240; Ph: 352-392-1845; Fax: 352-392-3646.*
**E-mail: tsquare@ufl.edu and **E-mail: etbone@ufl.edu*

INTRODUCTION

Since the mid-1980s the primary development paradigm pursued by Latin American and Caribbean countries has undertaken a major shift from the concept of import-substitution-industrialization (ISI) to that of export-led growth and openness to international markets (Bruton). The shift was spurred in part by research suggesting the importance of exports as a major factor in stimulating economic growth. This thinking was further enhanced by the so-called Washington consensus and the associated development funds that emerged. As a result, many countries assisted by these funds began undertaking initiatives to expand and diversify exports.

Export expansion and diversification efforts were further encouraged by numerous unilateral policy initiatives directed towards Latin America and the Caribbean. The US enacted the Caribbean Basin Economic Recovery Act in 1983 granting unilateral duty-free access to beneficiary countries for most commodities. In 2001, the passage of the Caribbean Basin Trade Partnership Act (CBTPA) extended these preferences to virtually all products, thereby essentially providing NAFTA parity. Similarly, Canada enacted CARIBCAN in 1986, which also provided duty-free access to Commonwealth Caribbean countries. Many other regional trade agreements have been enacted amongst Latin American and Caribbean countries as well (Taylor).

Despite these efforts, virtually no research has been undertaken to assess the degree to which the export structures of Latin American and Caribbean countries have in fact diversified. This is unfortunate as the trade policy environment facing these countries is poised to undergo significant changes. Within the hemisphere, negotiation of the Free Trade Agreement of the Americas (FTAA) is proceeding, and reaching a final accord by the 2005 target date appears feasible. Negotiation of the FTAA will gain additional impetus should the US Congress grant Trade Promotion Authority to the President. Agreement was also reached at the WTO ministerial in Doha, Qatar to initiate a new round of agricultural negotiations. While it is too soon to predict the final outcome of the WTO negotiations, it is clear that events in this forum will influence the negotiations of the FTAA.

Changes in diversification can be observed by analyzing structural changes in a country's exports over time. One of the empirical methodologies that has been used to analyze changes in export structures is based on the concept of Galtonian Regression (Hart and Prais). The methodology has recently been used in the examination of structural change in exports by Dalum and Villumsen; Dalum, Laursen and Villumsen. This methodology has also been used to investigate national patterns of technological innovation (Cantwell, Archibugi and Pianta, Archibugi) and changes in the structure of intergenerational incomes (Naga).

Utilizing indexes that measure the structure of a country's exports or technological innovations (usually a measure of patents), simple linear regression is used to compare the distribution of the indexes at two points in time. Inferences are obtained about export or technological specialization or de-specialization, based on the ordinary least squares estimates of the "β " coefficient and coefficient of determination. To date, most of the empirical examinations of export structures using this methodology have focused on OECD countries. Because these countries have broad export structures, the use of OLS is justified. However, if analysis focuses on smaller developing countries and export structures are defined at a relatively disaggregate level, the data are likely to contain a large number of zeros. Thus, OLS estimation, which does not explicitly take into account the presence of large numbers of zeros, may result in misleading inferences.

This paper proposes the use of Tobit estimation of the Galtonian regression when export data are characterized by large numbers of industries for which no exports are recorded over the period of analysis. Using HTS-2 digit data on exports to the US from 19 Caribbean Basin countries over the 1989 to 2000 period, three approaches to estimating the Galtonian regression are evaluated: OLS using the complete data set, OLS using censored data, and Tobit estimation. The results suggest that the use of Tobit estimation has a significant impact on the empirical results and resulting inferences.

The plan of the paper is as follows. The next section provides an overview of the analysis of export (non-) specialization using Galtonian regression. Section three argues that OLS estimation is not appropriate when there are no exports for large numbers of industries and presents the Tobit estimator. The fourth section discusses the data used and presents the empirical results, and the final section provides concluding comments.

Export Specialization and Galtonian Regression

The analysis of (non-) specialization of export structures generally begins by defining an index that is a variant of the Balassa revealed comparative advantage (RCA) measure. In the present analysis, this measure is calculated for the exports to the US of each industry and country included in the analysis. Let X_{ij} denote the exports to the U.S. of industry i from country j. The Balassa Revealed Comparative Advantage (RCA) index for industry i and country j is given by:

$$(1) \qquad RCA_{ij} = \frac{X_{ij} / \sum_i X_{ij}}{\sum_j X_{ij} / \sum_i \sum_j X_{ij}}$$

This index essentially compares the proportion of exports attributable to a given industry in country j to the proportion of exports attributable to the same industry in some larger group of countries (in this case 19 Latin American and Caribbean countries). Although the index was developed as a measure of revealed competitiveness, as used in this context it provides a measure of the structure of export specialization.[1] A country is said to specialize in the export of a given product when the proportion of national exports of this product exceeds

[1] *If the denominator in Equation 1 contained total imports into the US, the RCA would represent a measure of revealed competitiveness. However, when the denominator is defined as total US imports from the only the sample of countries included in the analysis, equation one represents a measure of relative export structures. (Dalum and Villumsen).*

those of the reference group. Thus, a value exceeding one indicates that a country is specialized in the export of a given product.[2] A country is considered to be non-specialized in the export of a product if its RCA value is less than 1. Changes in export structure are measured by changes in the observed pattern of export specialization exhibited by each country.

As defined, the value of the RCA for any industry is constrained to lie between 0 and positive infinity. The inherent skewness of this measure casts doubt on the normality of its distribution. Larsen suggests a simple adjustment to the index to yield:

$$(2) \qquad RSCA_{ij} = \frac{(RCA_{ij} - 1)}{(RCA_{ij} + 1)}.$$

The so-called revealed symmetric comparative advantage (RSCA) varies between –1 and +1. An RSCA > 0 implies specialization while an RSCA < 0 implies non-specialization. Note that when exports are zero, the RSCA measure takes a value of -1.

To assess changes in export structure, a Galtonian regression is used to compare the distribution of the RSCA for each country at two points in time. The basic tool of analysis is a linear regression of the form

$$(3) \qquad RSCA_{ij}^{t_1} = \alpha_i + \beta_j RSCA_{ij}^{t_0} + \varepsilon_i .$$

Where t_1, and t_0 refer to terminal and base time periods of analysis respectively, and ε_i is assumed to be a normally distributed disturbance term with mean 0, constant variance and independent of $RSCA_{ij}^{t_0}$. It should be emphasized that period 1 and 0 refer to reference periods and not necessarily successive time periods. In essence, equation (3) measures changes in export structure by comparing the distribution of the RCSA for country j at two points in time.

The interpretation of equation (3) regarding export specialization is as follows. A value of β equal to one implies that there have been no changes in the pattern of export specialization. Thus, those industries[3] exhibiting (non-) specialization continue to do so and the rankings of industries remain unchanged. If the value of β is greater than one, exports in which the country is specialized become more so and exports in which the country is non-specialized become more non-specialized. Under the scenario of 0<β<1 the pattern of export specialization demonstrated by a given country moves toward the group average. Exports in which the country is specialized become less so, and those in which the country in non-specialized increase their values (i.e. they become less non-specialized). Additionally, some change in the ranking of various industries may be observed. This is what is termed regression towards the mean. It is also possible for β < 0 to occur. In this situation there is a reversal in the pattern of

[2] *In the ensuing discussion, the terms product and industry are used interchangeably and refer to each 2-digit grouping*

[3] *The term industries and products are used interchangeably.*

specialization. Industries demonstrating export specialization tend to switch to being non-specialized and those initially demonstrating export non-specialization become specialized.

As noted, estimated values of $0<\beta<1$ suggest that there are changes in the pattern of export specialization demonstrated in the sense that industries exhibiting specialization become less specialized and those revealed to be non-specialized become less so as well. However, the rankings of industries demonstrating export specialization or non-specialization may also change. As equation (3) essentially compares the distribution of the structure of export specialization in the base and terminal periods of analysis, the coefficient of determination (R^2) provides insight into this issue. If $R^2=1$, then there is no change in the ranking of export specialization revealed by a country's industries. In contrast, low values of R^2 suggest that considerable change has occurred in the ranking of industries that exhibit specialization.

Cantwell and others (Hart; Soete) addressed this issue by decomposing the variance of equation (3). More specifically, let

$$(4) \quad \sigma_{t_1}^2 = \beta^2 \sigma_{t_0}^2 + \sigma_\varepsilon^2,$$

where $\sigma_{t_k}^2$ denotes the variance of the RSCA in period k= 0,1. It is a well known result that the coefficient of determination for the regression in equation (3) can be written as:

$$(5) \quad R^2 = 1 - \left(\frac{\sigma_\varepsilon^2}{\sigma_{t_1}^2} \right).$$

After appropriate substitution, equation (5) may be written as

$$(6) \quad \frac{\sigma_{t_1}^2}{\sigma_{t_0}^2} = \frac{\beta^2}{R^2},$$

or equivalently stated as

$$(7) \quad \frac{\sigma_{t_1}}{\sigma_{t_0}} = \frac{|\beta|}{|R|}.$$

The expression in (7) provides an additional measure of the degree to which (non)-specialization has occurred between time period 1 and 0. This expression must be interpreted with care. As R^2, and hence R must be less than one, an estimated value of $\beta>1$ necessarily yields $|\beta|/|R|>1$. This result suggests that there has been an increase in specialization in terms of both the magnitude of the estimated RSCA and the narrowing of the range of products in which specialization occurs. In essence $\beta>1$ is a necessary and sufficient condition for increased export specialization.[4]

When $0<\beta<1$, the expression $|\beta|/|R|$ must be interpreted carefully. Cantwell coined the expressions $(1-\beta)$ and $(1-R)$ as *regression* and *mobility* effects, respectively. The regression effect captures the relationship

[4] *It should be noted that an increase in export specialization is the antithesis of export diversification. Thus, the above discussion implicitly addresses the issue of export diversification.*

between the values of the RSCA measures for each industry over the period of analysis. The closer β is to one, the smaller the regression effect. A small regression effect suggests significant stability in the pattern of exports in that industries have similar RSCA values across time. The mobility effect relates to the relative rankings of the RSCA measures across time. Low values of R (R^2) suggest a high degree of mobility in the rankings of the RCSA export industries.

The dual conditions of $0<\beta<1$ and $|\beta|/|R|>1$ suggest that on balance (non-) specialized industries remain (non-) specialized and that the stability of these RSCA measures dominates any change in the rankings of various industries. In the case of $0<\beta<1$ and $|\beta|/|R|<1$ the converse is true. Changes in the rank of the RSCA measures of various industries dominate the changes in their values, suggesting that there has been significant change in the overall export structure.

TOBIT ESTIMATION

To date, most of the empirical work using the above methodology has focused on OECD countries using moderately disaggregate industry data. While the use of OLS regression may be appropriate for analyzing exports of OECD countries, many developing countries, especially small island states, exhibit a more narrow range of exports. As such, with moderate levels of industry disaggregation, the data may contain a large number of industries that record no exports over the period of analysis. In such cases, even when the transformation in equation (2) is used, the assumption of normality for the distribution of data becomes questionable, and OLS estimation of the Galtonian regression may not be appropriate.

There are three ways one might approach the problem of estimating equation (3) when the data contain large number of zeros. The most straightforward approach is to simply ignore the issue and use OLS estimation over the entire sample of observations. The theoretical argument in favor of this approach is that the universe of potential export industries must include all possible industries. Hence, an observation of zero is taken to be an implicit manifestation of the fundamental non-competitiveness of a given industry in a country. Though in principle a country has the (theoretical) potential to export products in any given industry, economic forces may be argued to have resulted in the absence of such exports. Thus observations of zero over the entire sample period for some industries are valid reflections of a country's export structure.

However, the presence of zero exports in some case may reflect the absolute inability of a country to export products in certain industries. If this is the case for a relatively large number of industries over the entire sample period inferences based on OLS estimates may be misleading. In particular, the presence of a large number of observations that are perfectly correlated (identical RSCA values of -1 in both periods of analysis) may serve to mask changes in the values of the RSCA index for those industries for which exports are observed. A case in point is Grenada, which is included in the present analysis. Of the 98 possible

HTS-2 categories in which exports are classified, Grenada exhibited positive levels in only 15 over the 1989-2000 period. Thus, if OLS estimation is used on the entire sample 85% of the observations for exports would be zero-valued (an RSCA = -1).

An alternative solution is to censor the data to include only observations for which at least one non-zero level of exports is observed over the entire sample period. A theoretical argument to support this approach is that when one is considering small countries, the universe of potential exportable products is a subset of all possible products. For example, this argument would say that since a small country has no possibility of exporting say, HTS-86 Railway or Tram Locomotives, the absence of exports in this category has little to say about the country's export structure from an economic standpoint.

The elimination of observations for which no exports are observed over the period of analysis permits the analysis of changes in export (non-) specialization to focus on a more limited set of industries that have demonstrated real export capacity. Thus, correlations between RSCA patterns are not influenced by the presence of large numbers of zero export values (which are perfectly correlated). Of course, the obvious criticism of censoring the data in this manner is that non-observation of exports in a given industry over a certain period of time is not necessarily indicative a country's absolute inability to do so. While it may be possible to identify some industries in this category, there are many others that may be difficult to identify.

While both of these approaches are defensible on theoretical grounds, both have significant econometric problems. Inclusion of large numbers of zero-valued observations for exports in the sample clearly calls into question the assumption of normality of the distribution, even in the case of the transformed RSCA measure (which is bounded between –1 and 1). In essence, the presence of a large number of zero-valued exports will significantly skew the distribution of the RSCA around the value of -1. Censoring the data to exclude observations for which exports are zero over the entire sample period would seem to potentially solve the problem of skewness. However, while the use of censoring can be justified using the arguments above, it is nonetheless arbitrary.

Fortunately, there exists a third alternative for estimating equation (3) which overcomes the limitations of both previous estimation alternatives. Specifically, Tobit estimation (Tobin; Cragg; Maddala), which explicitly accounts for censoring of the data, may be used. In the present context, the Tobit model assumes that any observations for which the dependent variable takes a value of –1.0 are zero observations by defining a new dependent variable transformed from the original one. The model is defined as:

(8a) $RSCA_{ij}^{t_1 *} = \alpha_i + \beta RSCA_{ij}^{t_0} + \varepsilon_{ij}^{t_1}$

(8b) $RSCA_{ij}^{t_1} = 0$ if $RSCA_{ij}^{t_1 *} = -1.0$

(8c) $RSCA_{ij}^{t_1} = RSCA_{ij}^{t_1 *}$ if –1.0

$< RSCA_{ij}^{t_1 *}$.

Ordinary least squares cannot be used to estimate the regression equation on only the observations where $RSCA_{ij}^{t_1}$ > -1.0 because the residuals violate the assumption that $E(\varepsilon)=0$. However, the Tobit model provides maximum likelihood parameter estimates that can be used under any distributional assumption on the residuals. In order to calculate the Tobit marginal effect for this analysis, the standard normal density and the cumulative normal density were used.

The partial effects for the Tobit and OLS coefficient estimates are defined as:

$$\frac{\partial E(y)}{\partial X_k} = \Phi\left(\frac{\beta' X_i}{\sigma}\right)\beta_k$$

and $$\frac{\partial E(y)}{\partial X_k} = \beta_k,$$

respectively. In words, the unconditional partial effect of the Tobit parameter estimate is calculated by multiplying the estimate by the cumulative normal distribution function of the right hand side of the regression equation over the estimated standard deviation of the residual. Once this partial effect is calculated, it can be compared to the OLS estimate of β.

Empirical Results

The empirical analysis was conducted for 19 countries in Latin America and the Caribbean. The data used to construct the RSCA measures for each country were obtained from the US International Trade Commission Trade DataWeb (http://dataweb.usitc.gov/). Exports from each country to the US were measured by imports for consumption from each country at the 2-digit HTS level over the 1989 to 2000 period (see Table A.1). The initial export structure for the analysis was measured as the average RSCA over the 1989-1991 period[5] and the terminal period was measured by the average RSCA over the 1998-2000 period.

Three sets of estimates were generated, OLS with the complete data set, OLS with censored data[6] and Tobit. The parameter estimates for β and the corresponding upper and lower 95% confidence limits are presented in Table 1, and Table 2 contains the estimated values of R^2[7] and |β|/|R|. The results are categorized into the following groupings: the so-called moderately developed Caribbean countries (MDCs), organization of Eastern Caribbean States (OECS) countries, the non-commonwealth countries of Haiti[8] and the Dominican Republic, Central American countries, and Mexico.

---

[5] *For Nicaragua and Panama, the initial period was defined by the average RSCA over the 1990-1991 period.*

[6] *If no exports were recorded over the entire 1989-2000 period, the relevant industry was deleted. The number of industries include in each censored regression are noted in Table 3.*

[7] *The R^2 for the Tobit estimator is actually a pseudo-R^2 calculated using a method proposed by Laitlia.*

[8] *Haiti recently began the process of formally joining CARICOM*

Table 1. Comparison of Parameter Estimates Using Different Estimators

Country	N	Censored Ordinary Least Squares			Ordinary Least Squares			Tobit		
		β	Confidence Int.		β	Confidence Int.		β	Confidence Int.	
			L95%	*U95%*		*L95%*	*U95%*		*L95%*	*U95%*
Barbados	50	0.7424	0.4929	0.9919	0.8730	0.7235	1.0226	1.1270	1.0934	1.1606
Belize	30	0.5655	0.1986	0.9323	0.7426	0.5737	0.9114	1.7013	1.5774	1.8251
Guyana	33	0.4945	0.1119	0.8772	0.4737	0.2633	0.6841	0.6716	0.4171	0.9262
Jamaica	67	0.6465	0.4455	0.8474	0.7973	0.6609	0.9255	0.9513	0.9056	0.9970
Trinidad	55	0.5475	0.2898	0.8051	0.7034	0.5572	0.8495	0.8412	0.7776	0.9048
Average		***0.5993***			***0.7180***			***1.0585***		
Dominica	37	-0.0320	-0.3807	0.3167	0.1563	-0.0474	0.3600	0.1520	-0.0682	0.3723
Grenada	15	-0.0866	-0.7185	0.6385	0.3474	0.1949	0.4999	2.3564	2.3561	2.3567
St. Kitts	27	0.9507	0.7530	1.1485	0.9062	0.8065	1.0059	1.2415	1.2414	1.2416
St. Lucia	30	0.4222	0.0236	0.8208	0.7655	0.5629	0.9682	1.3932	1.2894	1.4970
St. Vincent	25	0.3237	-0.1804	0.8277	0.6156	0.4179	0.8133	1.4387	1.2948	1.5826
Average		***0.3156***			***0.5582***			***1.3164***		
Dominican Rep	87	0.2934	0.0922	0.4946	0.4868	0.3163	0. 6574	0.3450	0.2705	0.3595
Haiti	62	0.5860	0.3115	0.8604	0.7404	0.5422	0.9386	1.1244	1.0449	1.2039
Average		***0.4397***			***0.6136***			***0.6382***		
Costa Rica	80	0.7740	0.6196	0.9283	0.7969	0.6685	0.9253	0.8833	0.8507	0.9159
El Salvador	64	0.4728	0.1901	0.7556	0.6911	0.4875	0.8947	0.8005	0.7134	0.8875
Guatemala	76	0.6706	0.4423	0.8989	0.7756	0.6001	0.9511	0.8440	0.7861	0.9019
Honduras	68	0.8176	0.6458	0.9894	0.8240	0.7038	0.9442	0.9288	0.8995	0.9581
Nicaragua	50	0.3531	-0.0437	0.7499	0.8378	0.5681	1.1075	1.3196	1.2185	1.4207
Panama	60	0.4062	0.1578	0.6546	0.6123	0.4452	0.7793	0.5862	0.4981	0.6743
Average		***0.5824***			***0.7009***			***0.8937***		
Mexico	98	0.8525	0.7644	0.9406	0.8525	0.7644	0.9406	0.8513	0.8501	0.8525

It should be noted that the MDCs and the Organization of Eastern Caribbean States (OECS) countries are both members of CARICOM. These ten countries combined with Haiti and the Dominican Republic form the regional grouping known as CARIFORUM. With the exception of Panama, the Central American countries are all members of the Central American Common Market (CACM). Discussion of the results follows these respective groupings.

The estimation results for Guyana, Jamaica, and Trinidad are qualitatively similar. The estimates and confidence intervals for β in all three countries fall between 0 and 1, thus suggesting that there has been incremental change in the structure of export specialization. The values of *R* and |β|/|*R*| suggest that each of these countries exhibited considerable mobility in the ranking of export categories in which they were specialized, with the net result being some increase in export specialization. Table 3 supports this result by showing that the share of total exports attributable to industries revealed to be specialized increased in all three countries between the 1989-91 and 1998-200 periods.

The empirical results for Barbados reveal slight differences in the three estimators. The 95% confidence interval for β in the censored OLS regression contains neither 0 nor 1. However, the upper confidence limit is 0.9919. The upper 95% confidence limit for the OLS estimator using the complete data set is 1.0266, suggesting that the null hypothesis of β=1 cannot be rejected. In contrast, the 95% confidence interval for β obtained using Tobit estimation is (1.0934,1.1606) suggesting the null hypothesis of β=1 can be rejected. Thus, while the OLS estimator suggests stability in the export structure of Barbados, the Tobit estimator suggests that export specialization has increased to some degree. Table 3 also suggests specialization, as the share of total exports attributed to product categories revealed to be specialized increased from 92% during 1989-91 to 98% during the 1998-2000 period.

The Tobit results for Belize are dramatically different from those obtained for both OLS and censored OLS. The 95% confidence intervals for the latter two estimators contain neither 0 nor 1. In contrast, the 95% confidence interval for β obtained using Tobit estimation is (1.5774, 1.8251) suggesting that the export structure of Belize became more specialized over the period of analysis.

The empirical results for the OECS reveal that with the exception of Dominica, inferences based on Tobit estimation are dramatically different from those based on both OLS estimators. The 95% confidence interval corresponding to the OLS estimate for β in Grenada is (-0.0866, 0.6385) suggesting that the hypotheses of random change in the export structure cannot be rejected. In contrast, the 95% confidence interval obtained from OLS estimation with the complete data set contains neither 0 nor 1. The Tobit estimator yields a 95% confidence interval of (2.3561, 2.3567) suggesting the export structure of Grenada became increasingly specialized over the period of analysis. Examination of Table 3 confirms this. It may be noted that similar results are obtained for St. Vincent.

In the case of St. Lucia, both OLS estimators generate 95% confidence intervals that contain neither 0 nor 1. However, the 95% confidence interval for the Tobit estimate is (1.2894, 1.4970). This means the null hypothesis of β=1 can be rejected in favor β>1, which suggests increased specialization of St. Lucia's export structure.

Both OLS estimators for St. Kitts suggest that its export structure has been very stable over the period of analysis, as 1 is contained in each of the 95% confidence intervals.

Table 2. Comparison of R and $|\beta|/|R|$ for Different Estimators

Country	Censored OLS			OLS			Tobit		
	β	R	$\|\beta\|/\|R\|$	β	R	$\|\beta\|/\|R\|$	β	R	$\|\beta\|/\|R\|$
MDC									
Barbados	0.7424	0.6439	1.1529	0.8730	0.7628	1.1445	1.1270	0.6309	1.7862
Belize	0.5655	0.5118	1.1049	0.7426	0.6643	1.1178	1.7013	0.5086	3.3449
Guyana	0.4945	0.4141	1.1942	0.4737	0.4141	1.1438	0.6716	0.3710	1.8104
Jamaica	0.6465	0.6160	1.0495	0.7973	0.7825	1.1889	0.9513	0.7142	1.3320
Trinidad	0.5475	0.4966	1.1025	0.7034	0.6972	1.0087	0.8412	0.6468	1.3005
OECS									
Dominica	0.0320	0.0304	1.0530	0.1563	0.1532	1.0201	0.1520	0.2122	0.7164
Grenada	0.0866	0.0812	1.0658	0.3474	0.4182	0.8307	2.3564	0.5291	4.4536
St. Kitts	0.9507	0.8924	1.0654	0.9062	0.8783	1.0317	1.2416	0.6329	1.9617
St. Lucia	0.4222	0.3788	1.1145	0.7655	0.6068	1.2617	1.3932	0.4520	3.0822
St. Vincent	0.3237	0.2641	1.2256	0.6156	0.5326	1.1559	1.4387	0.3852	3.7353
Dominican Rep	0.2937	0.2962	0.9908	0.4868	1.4998	0.9742	0.3450	0.4700	0.7341
Haiti	0.5860	0.4753	1.2327	1.7404	0.6024	1.2291	1.1244	0.5986	1.8785
Central America									
Costa Rica	0.7740	0.7438	1.0406	0.7969	0.7819	1.0192	0.8833	0.7503	1.1773
El Salvador	0.4728	0.3843	1.2304	0.6911	0.5656	1.2218	0.8005	0.5462	1.4657
Guatemala	0.6706	0.5562	1.2057	0.7756	0.6660	1.1645	0.8440	0.6236	1.3535
Honduras	0.8176	0.7541	1.0842	0.8240	0.8108	1.0163	0.9288	0.7411	1.2533
Nicaragua	0.3531	0.2441	1.4465	0.8378	0.5317	1.5757	1.1396	0.4513	2.9238
Panama	0.4062	0.3879	1.0472	0.6123	0.5951	1.0287	0.5862	0.5313	1.1033
Mexico	0.8525	0.8904	0.9575	0.8525	0.8904	0.9575	0.8513	0.8913	0.9551

As with the previously discussed OECS countries, the 95% confidence interval for β obtained using Tobit estimation is (1.2144, 1,2146) implying an increase in export specialization. Dominica is the lone OECS country in which all three estimators yield the same results. In all three cases the 95% confined interval contains 0, indicating the null hypothesis of random change in Dominica's export structure cannot be rejected.

All three estimation methods yield qualitatively similar empirical results for the Dominican Republic. The 95% confidence intervals for all three contain neither 0 nor 1, suggesting some incremental change toward less specialization. Table 3 supports this conclusion, as the share of total exports attributable to industries revealed as specialized declined over the period of analysis.

In contrast, Tobit estimates for Haiti are significantly different than those obtained by OLS using either the complete or censored data set. While the 95% confidence intervals for both OLS estimators contain neither 0 nor 1, the 95% confidence interval for the Tobit estimator is (1.0449, 1.2039). Thus, while OLS estimates suggest that Haiti's export structure has become somewhat less specialized, the Tobit estimates suggest the exact opposite.

With the exception of Nicaragua, the empirical results for the remaining Central American countries were qualitatively similar for all three estimators. In all cases the 95% confidence intervals contained neither 0 nor 1, suggesting some degree of change in export structure. It should be noted however, that the regression effects ($1-\beta$) for the Tobit estimator are much smaller than either of the OLS estimators. The Tobit estimator suggests considerably more export stability than OLS estimation with or without censored data.

The inferences pertaining to Nicaragua's export structure vary considerably for the different estimators. The 95% confidence interval obtained using OLS with censored data suggests that the hypothesis of $\beta=0$ cannot be rejected. This suggests that the changes in Nicaragua's export structure have been largely random. OLS estimation using the complete data yields a 95% confidence interval for β of (0.5681,1.1075), suggesting the hypothesis that $\beta=1$ cannot be rejected. This, of course indicates that there has been no significant change in the nature of export (non-) specialization exhibited over the period of analysis. Finally, Tobit estimation of β yields a 95% confidence interval of (1.2185, 1.4207) which suggests that Nicaragua's export structure has become more specialized.

Mexico was the only country in the analysis to have non-zero observations in all HTS-2 categories. As such, the censored OLS and OLS results are identical. So too are the results based on the Tobit estimation. As seen in Table 1, both Tobit and OLS estimation suggest that the export structure has exhibited considerable stability over the period of analysis. This is note-worthy in that the base period (1989-1991) and terminal period (1998-2000) of analysis span the enactment of the North American Free Trade Agreement (NAFTA). While it is clear that NAFTA resulted in increased exports from Mexico to the US, the empirical results for Mexico suggest that the basic structure its exports has remained relatively stable.

CONCLUSIONS

This purpose of this paper was to examine the estimation of the Galtonian regression equation in the context of examining export structures in the presence of a significant number of zero-valued observations. When empirical analysis focuses on small developing countries using disaggregate

Table 3. Summary Measures of Latin American and Caribbean Trade Structures

	1989-91			1998-00		
Country	No. of Specialized Industries	Specialized Share	Share Top-10	No. of Specialized Industries	Specialized Share	Share Top-10
Barbados	6	92.35	99.14	8	97.81	98.39
Belize	4	97.32	99.76	6	98.70	99.82
Guyana	4	63.41	95.64	9	96.29	99.30
Jamaica	11	91.42	89.92	12	97.30	96.36
Trinidad	10	94.55	94.55	13	95.57	93.72
Dominica	2	74.22	91.39	3	35.77	99.90
Grenada	2	72.50	93.53	2	96.68	100.00
St. Kitts	1	90.76	100.00	2	97.44	99.96
St. Lucia	3	93.25	99.40	5	97.21	99.58
St. Vincent	2	72.18	100.00	1	79.87	99.91
Dominican Rep.	17	83.71	74.69	20	67.26	53.11
Haiti	15	93.02	45.40	21	86.09	58.85
Costa Rica	21	84.00	65.10	26	95.86	55.24
El Salvador	15	96.16	58.88	22	85.16	68.26
Guatemala	12	94.48	92.14	24	91.92	78.76
Honduras	12	95.62	94.20	17	83.23	75.20
Nicaragua	4	57.99	99.75	15	97.72	91.13
Panama	10	90.69	90.69	17	95.86	95.86
Mexico	38	80.87	55.23	29	80.69	41.78

data, such situations are likely to arise frequently. For the countries included in the analysis, the number of zero observations (out of a possible 98) ranged from a low of 0 for Mexico to a maximum of 73 for Grenada. Thus, the sample group of countries encompasses a wide range of scenarios with regards to the number of zero observations.

The empirical results clearly indicate that the treatment of zero-valued observations influences the empirical results. Estimation using data that include all zero-valued observations clearly changes the empirical results by lowering the regression and mobility effects. This was most clearly demonstrated by the results for the OECS countries, for which the data contained a large number of zero values.

Omitting zero-valued observations, as one would expect, also impacts the resulting empirical estimates and inferences. In this analysis a rather conservative censoring rule of omitting only observations that were zero-valued over the entire 1989-2000 period was employed. As noted, one can support this theoretically by arguing that the trade universe for small developing countries is a subset of the total trade universe comprised of all possible export categories (in this case HTS-2 categories). The problem is that there is no clear way to objectively define what these subsets are for individual countries, and censoring of the data is therefore arbitrary.

Tobit estimation resolves both the problem of the influence of zero-valued observations on the distribution of the data and the problem of censoring. When the data contain a reasonably large number of zero-valued observations, Tobit estimation of the Galtonian regression appears to be appropriate. Of course, what constitutes a "reasonable number" of zero-valued observations cannot be determined from the present analysis

REFERENCES

Archibugi, D. "Aggregate Convergence and Secoral Patterns of Specialization in Innovation. *Journal of Evolutionary Economics.* 4(1994):17-33.

Archibugi D. and M. Pianta. "Aggregate Convergence and Sectoral Specialization in Innovation." *Journal of Evolutionary Economics.* 4(1994):17-33.

Balassa, B. "Trade Liberalization and 'Revealed' Comparative Advantage." *The Manchester School of Economics and Social Studies.* 32 (1965): 99-123

Bruton, H. "A Reconsideration of Import Substitution." *Journal of Economic Literature.* 36(1998):903-936.

Cantwell, J. *Technological Innovation and Multinational Corporations.* Oxford: Basil Balckwell, 1989.

Cragg, J.G. "Some Staistical Models for Limited Dependent Variables with Application to the Demand for Durable Goods." *Econometrica.* 39(1971):829-844.

Dalum, B, K. Larsen and G. Villumsen. "The Long Term Development of OECD Export Specialization Patterns: De-specialization and 'Stickiness'." Danish Research Unit for Industrial Dynamics Working Paper No. 96-14, April 1996.

Dalum, B and G. Villumsen. "Are OECD Export Specialization Patterns 'Sticky?' Relations to the Convergence-Divergence Debate." Danish Research Unit for Industrial Dynamics Working Paper No. 96-3, April 1996.

Hart. P. "Galtonian Regression Across Countries and the Convergence of Productivity." Discussion Papers in Quantitative Economics and Computing, Series E, Vol. 2, University of Reading, 1994.

Hart, P and S. Prais. "The Analysis of Business Concentration: A Statistical Approach. Journal of the Royal Statistical Society, Series A. Vol. 119 (1956): 150-191.

Laitla, T. "A Pseudo-R^2 Measure for Limited and Qualitative Dependent Variable Models." *Journal of Econometrics.* 56(1993):341-356.

Larsen, K. "Revealed Comparative Advantage and Alternatives as Measures of Specialization." Danish Research Unit for Industrial Dynamics Working Paper No. 98-30, December 1996.

Maddala, G.S. *Limited-Dependent and Qualitative Variables in Econometrics.* Cambridge: Cambridge University Press, 1983.

Naga. R. Galtonian Regression of Intergenerational Income Linkages: Biased

Procedures, A New Estimator and Mean Square Error Comparisons. DEEP, University of Lausanne, 2000.

Soete, L. "The Impact of Technological Innovation on International Trade Patterns: The Evidence Reconsidered." *Research Policy*. 16(1987): 101-130.

Tobin, J. "Estimation of Relationships for Limited Dependent Variables." *Econometrica*. 26(1958):24-36.

Taylor, T. "An Overview of the FTAAQ Process and the Current Trade Policy Environment in the Western Hemisphere." Food and Resource Economics Department International Working Paper IW 01-26. University of Florida. 2001.

United States International Trade Commission DataWeb. http://dataweb.usitc.gov/.

Table A.1 HTS-2 Commodity Descriptions	
HTS No.	**Commodity Description**
1	Live Animals
2	Meat and Edible Meat Offal
3	Fish and Crustaceans, Molluscs and Other Aquatic Invertebrates
4	Dairy Produce; Birds' Eggs; Natural Honey; Edible Products of Animal Origin, Nesoi
5	Products of Animal Origin, Nesoi
6	Live Trees and Other Plants; Bulbs, Roots and the like; Cut Flowers and Ornamental Foliage
7	Edible Vegetables and Certain Roots and Tubers
8	Edible Fruit and Nuts; Peel of Citrus Fruit or Melons
9	Coffee, Tea, Mate and Spices
10	Cereals
11	Milling Industry Products; Malt; Starches; Inulin; Wheat Gluten
12	Oil Seeds and Oleaginous Fruits; Miscellaneous Grains, Seeds and Fruits; Industrial or Medicinal Plants; Straw and Fodder
13	Lac; Gums; Resins and Other Vegetable Saps and Extracts
14	Vegetable Plaiting Materials and Vegetable Products, Nesoi
15	Animal or Vegetable Fats and Oils and their Cleavage Products; Prepared Edible Fats; Animal or Vegetable Waxes
16	Edible Preparations of Meat, Fish, Crustaceans, Molluscs or Other Aquatic Invertebrates
17	Sugars and Sugar Confectionery
18	Cocoa and Cocoa Preparations
19	Preparations of Cereals, Flour, Starch or Milk; Bakers' Wares
20	Preparations of Vegetables, Fruit, Nuts, or Other Parts of Plants
21	Miscellaneous Edible Preparations
22	Beverages, Spirits and Vinegar
23	Residues and Waste from the Food Industries; Prepared Animal Feed

Table A.1 HTS-2 Commodity Descriptions *(continued)*	
HTS No.	**Commodity Description**
24	Tobacco and Manufactured Tobacco Substitutes
25	Salt; Sulfur; Earths And Stone; Plastering Materials, Lime and Cement
26	Ores, Slag and Ash
27	Mineral Fuels, Mineral Oils and Products of Their Distillation; Bituminous Substances; Mineral Waxes
28	Inorganic Chemicals; Organic or Inorganic Compounds of Precious Metals, of Rare-Earth Metals, of Radioactive Elements or of Isotopes
29	Organic Chemicals
30	Pharmaceutical Products
31	Fertilizers
32	Tanning or Dyeing Extracts; Tannins and Derivatives; Dyes, Pigments and Other Coloring Matter; Paints and Varnishes; Putty and Other Mastics; Inks
33	Essential Oils and Resinoids; Perfumery, Cosmetic or Toilet Preparations
34	Soap etc.; Lubricating Products; Waxes, Polishing or Scouring Products; Candles etc., Modeling Pastes; Dental Waxes and Dental Plaster Preparations
35	Albuminoidal Substances; Modified Starches; Glues; Enzymes
36	Explosives; Pyrotechnic Products; Matches; Pyrophoric Alloys; Certain Combustible Preparations
37	Photographic or Cinematographic Goods
38	Miscellaneous Chemical Products
39	Plastics and Articles thereof
40	Rubber and Articles thereof
41	Raw Hides and Skins (Other than Fur skins) and Leather
42	Articles of Leather; Saddlery And Harness; Travel Goods, Handbags and Similar Containers; Articles of Gut (Other than Silkworm Gut)
43	Fur skins and Artificial Fur; Manufactures thereof
44	Wood and Articles of Wood; Wood Charcoal

Table A.1 HTS-2 Commodity Descriptions *(continued)*	
HTS No.	**Commodity Description**
45	Cork and Articles of Cork
46	Manufactures of Straw, Esparto or Other Plaiting Materials; Basket ware and Wickerwork
47	Pulp of Wood or Other Fibrous Cellulosic Material; Recovered (Waste and Scrap) Paper and Paperboard
48	Paper and Paperboard; Articles of Paper Pulp, Paper or Paperboard
49	Printed Books, Newspapers, Pictures and Other Printed Products; Manuscripts, Typescripts and Plans
50	Silk, Including Yarns and Woven Fabrics thereof
51	Wool and Fine or Coarse Animal Hair, Including Yarns and Woven Fabrics thereof; Horsehair Yarn and Woven Fabric
52	Cotton, including Yarns and Woven Fabrics thereof
53	Vegetable Textile Fibers Nesoi; Yarns and Woven Fabrics of Vegetable Textile Fibers Nesoi and Paper
54	Manmade Filaments, including Yarns and Woven Fabrics thereof
55	Manmade Staple Fibers, Including Yarns and Woven Fabrics thereof
56	Wadding, Felt and Nonwovens; Special Yarns; Twine, Cordage, Ropes and Cables and Articles thereof
57	Carpets and Other Textile Floor Coverings
58	Special Woven Fabrics; Tufted Textile Fabrics; Lace; Tapestries; Trimmings; Embroidery
59	Impregnated, Coated, Covered or Laminated Textile Fabrics; Textile Articles Suitable for Industrial Use
60	Knitted or Crocheted Fabrics
61	Articles of Apparel and Clothing Accessories, Knitted or Crocheted
62	Articles of Apparel and Clothing Accessories, Not Knitted or Crocheted
63	Made-Up Textile Articles Nesoi; Needlecraft Sets; Worn Clothing and Worn Textile Articles; Rags
64	Footwear, Gaiters and the like; Parts of such articles
65	Headgear and Parts thereof

Table A.1 HTS-2 Commodity Descriptions *(continued)*	
HTS No.	**Commodity Description**
66	Umbrellas, Sun Umbrellas, Walking-Sticks, Seat-Sticks, Whips, Riding-Crops and Parts thereof
67	Prepared Feathers and Down and Articles thereof; Artificial Flowers; Articles of Human Hair
68	Articles of Stone, Plaster, Cement, Asbestos, Mica or Similar Materials
69	Ceramic Products
70	Glass and Glassware
71	Natural or Cultured Pearls, Precious or Semiprecious Stones, Precious Metals; Precious Metal Clad Metals, Articles thereof; Imitation Jewelry; Coin
72	Iron and Steel
73	Articles of Iron or Steel
74	Copper and Articles thereof
75	Nickel And Articles Thereof
76	Aluminum and Articles thereof
78	Lead and Articles thereof
79	Zinc and Articles thereof
80	Tin and Articles thereof
81	Base Metals Nesoi; Cermets; Articles thereof
82	Tools, Implements, Cutlery, Spoons and Forks, of Base Metal; Parts thereof of Base Metal
83	Miscellaneous Articles of Base Metal
84	Nuclear Reactors, Boilers, Machinery and Mechanical Appliances; Parts thereof
85	Electrical Machinery and Equipment and Parts thereof; Sound Recorders and Reproducers, Television Recorders and Reproducers, Parts and Accessories
86	Railway or Tramway Locomotives, Rolling Stock, Track Fixtures and Fittings, and Parts thereof; Mechanical etc. Traffic Signal Equipment of All Kinds
87	Vehicles, Other than Railway or Tramway Rolling Stock, and Parts and Accessories thereof
88	Aircraft, Spacecraft, and Parts thereof