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Similarities in the demand structures as determinants of Canadian international trade patterns: an empirical view

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SIMILARITIES IN THE DEMAND STRUCTURES AS DETERMINANTS OF CANADIAN INTERNATIONAL TRADE PATTERNS: AN EMPIRICAL VIEW.

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PREFACE

The testing of various explanations of international trade patterns always arouses a good share of academic interest. Unfortunately, due to imperfections embodied in the testing processes and due to imperfect data, the results can only offer additional insight into the hypothesis being tested but cannot prove or disprove a specific theory.

In the context of international trade empirical tests have mainly centered around the Ricardian labor productivity hypothesis and the Heckscher-Ohlin explanation with the related Leontief paradox.

However, in 1961 S.B. Linder presented an alternative explanation. While accepting the Heckscher-Ohlin explanation for trade in agricultural products and raw materials, Linder did not consider it rigorous enough to explain trade for more sophisticated manufactured goods.

According to Linder, all manufactured goods are potential exports, but in order to become an actual export there must exist a domestic demand for the product. In other words, it is demand, not supply, which determines the patterns of trade.

Linder goes further and claims that the more similar the demand preferences, or tastes, of two countries, the higher the volume of their bilateral trade. Moreover, similarities in preferences can be associated with similar levels of income.

This thesis has been tested by Linder through an informal but demonstrating test[1] and others with more or less substantiating results.[2] Most concluded that the Linder postulation offered a complementary explanation for trade. Sailor, Queresh, and Cross, using a Spearman rho criterion found nine countries in which the rank order correlation coefficient was significant at the 5% level, eighth at the 1% level, and fourteen countries with no significant correlation. However, Hoftuzer criticized them for not including the distance variable which he considered the only really significant explanatory variable.

In another study Fortune runs a multi-regression model and finds differences in per capita income important for seven out of twenty-three countries and the distance variable important in seventeen out of twenty-three cases.

Although it is obvious that a full test of the Linder thesis would require evidence from many countries, the more the better, my intention is to test it only with respect to Canada in order to see if it can offer any additional insight into Canadian trading patterns.

METHODOLOGY

The empirical analysis used in this paper is comprised of correlation analysis and regression analysis. If Linder's hypothesis is true for Canada, then it could be expected that Canada trades more with countries with similar tastes as is inferred by similarities in per capita income levels. The larger the income difference between Canada and a certain country, the less the average propensity for trade that will be expected with that country.

A "difference vector", $/\left| GNP_i/N_i - GNP_c/N_c \right|/$, is formed where GNP_i/N_i is the 1972 per capita income of the countries for which data was taken and GNP_c/N_c is the 1972 per capita income for Canada.[3]

A second vector is formed from Canadian exports in 1972 to the same countries. In order to take into account the size of these nations, the Canadian exports to each country were divided by the GNP of the corresponding country. The resulting vector is what Linder calls the "average propensity to import" (in this case from Canada), X_{ic}/GNP_i. It is obvious that a negative correlation coefficient is expected to characterise the relation of these two vectors.

Theoretically the same kind of relation should hold when an additional correlation is tested between the difference in the per capita income vector and the one for imports to Canada from the corresponding countries. $\left[\frac{Mic}{GNP_i}\right]$[4]

To properly test Linder's thesis it is necessary to use exports and imports of manufactured goods rather than total exports and imports. This was accomplished by aggregating Canadian exports of fabricated materials and inedible end products as a proxy for manufactured goods, $X_{manu_{ic}}/GNP_i$.[5]

Another variable to be examined here is distance. Distance is

characterised as a trade-breaking factor due to increased costs and more imperfcct knowledge of market possibilities in distant areas. Empirical studies have placed varying degrees of importance on this variable ranging from completely ignoring it to that of concluding that it is the only important trade factor.

Here two problems were raised, one is particular to Canada--what should be considered as Canada's commercial center since it is a vast country. The second is general and refers to the economic meaning of distance. French enterpreneurs, for instance, may know equally well the market possibilities in Germany and in Canada. Or a Canadian firm cited in Halifax may experience a higher cost to put an advanced technology, including product, which needs domestic service, in Equador's market than in Australia's or Japan's market.

Keeping in mind these reservations, the flight distance between Montreal and the capitals of the other countries was obtained[6] and correlations were tested between X_{ic}/GNP_i, M_{ic}/GNP_i, and X_{manu}/GNP_c with the distance in miles.

CORRELATION ANALYSIS

The results of the six above mentioned correlations are given in Table 1.

TABLE 1

SIMPLE CORRELATION COEFFICIENTS

	$\left\| GNP_i/N_i - GNP_c/N_c \right\|$	DISTANCE
X_{ic}/GNP_i	-.1549	-.2708
M_{ic}/GNP_i	-.1257	-.1500
$X_{manu_{ic}}/GNP_i$	-.1486	-.3265

The thirty-eight countries included in this analysis are Sweden, Denmark, West Germany, Australia, France, Belgium, Norway, Netherlands, New Zealand, Finland, United Kingdom, Austria, Japan, Isreal, Italy, Libya, Ireland, Greece, Singapore, Spain, Venezuela, Portugal, Saudi Arabia, Jamaica, Chile, Iran, Turkey, Colombia, Dominican Republic, Iraq, Guyana, Peru, Mourituous, Honduras, Korea Rep., Philippines, Algeria, Nigeria.

The additional twenty countries included in the correlations for $X_{manu_{ic}}$ are Puerto Rico, Cyprus, Malta, Barbados, Uruguay, Panama, South Africa, Surinam, Lebanon, Costa Rica, Cabon, Fiji, Ivory Coast, Tunisia, Guatemala, Syria, Equador, Jordan, Morocco, Ghana.

All correlation coefficients are negative and not one is close to unity, something which was not expected, anyway, but as a whole they are in accordance with Linder's hypothesis. Note that the negative correlation between distance and all the average propensities to import is stronger in all cases than the correlations between the per capita incomes differences and the average

propensities to import.

The most important feature of Canada's international trade is the huge volume of transactions taking place between the two big partners of North America. For this reason U.S. data which was omitted in Table 1 is included in Table 2 in order to make a comparison.

TABLE 2

SIMPLE CORRELATION COEFFICIENTS INCLUDING THE U.S.

	$GNP_i/N_i - GNP_c/N_c$	DISTANCE
X_{ic}/GNP_i	.1548	-.3201
M_{ic}/GNP_i	-.1909	-.1513
$X_{manu_{ic}}/GNP_i$	.1317	-.3607

Two out of three correlation coefficients have a positive sign in this case for the difference in per capita income. However, coefficients for the distance vector remain negative and have higher values than in Table 1.

REGRESSION ANALYSIS

The same ideas analysed by correlation now will be tested with a few regression models. The models formed are the following:

(1) $X_{ic}/GNP_c = a_1 + b_1 \left| GNP_i/N_i - GNP_c/N_c \right| + u_1$

(2) $X_{ic}/GNP_c = a_2 + b_2 \left| GNP_c/N_c - GNP_i/N_i \right| + c_2 DISTANCE + u_2$

(3) $M_{ic}/GNP_c = a_3 + b_3 \left| GNP_c/N_c - GNP_i/N_i \right| + u_3$

(4) $M_{ic}/GNP_c = a_4 + b_4 \left| GNP_c/N_c - GNP_i/N_i \right| + c_4 \ DISTANCE + u_4$

(5) $X_{manu_{ic}}/GNP_i = a_5 + b_5 \left| GNP_c/N_c - GNP_i/N_i \right| + u_5$

(6) $X_{manu_{ic}}/GNP_i = a_6 + b_6 \left| GNP_c/N_c - GNP_i/N_i \right| + c_6 \ DISTANCE + u_6$

All variables used in these models are the same as employed in the correlation analysis and have been sufficiently explained for the previous tests. For regressions (1) to (4) thirty-eight countries were used while for (5) and (6) the number was fifty-eight. These are the same countries as used before and again the United States is ommitted for the first set of regressions.

It comes straightforward from Linder's hypothesis that all parameters, b_i, i=1,...6 and c_j, j=2, 4, 6, should appear negative.

O.L.S.Q. was the method applied to the data. Autocorrelation is not a problem here since the data was taken from a cross section. Likewise, there is no reason to expect multicollinearity since income around the globe is not spread according to distance from Canada. Estimates for the coefficients of the independent variable, R^2 and F values are presented in Table 3.

TABLE 3

REGRESSION ANALYSIS ESTIMATES

Dependant Variable	Explanatory Variables $\left\lvert \frac{GNP_i}{N_i} - \frac{GNP_c}{N_c} \right\rvert$	Distance	R^2	F
1. $\frac{X_{ic}}{GNP_i}$	-14.76(.941)		.0245	0.8850
2. $\frac{X_{ic}}{GNP_i}$	-13.32 (-.867)	-64.02 (-1.62)	.0928	1.7900
3. $\frac{M_{ic}}{GNP_i}$	-32.02 (-.757)		.0157	0.5738
4. $\frac{M_{ic}}{GNP_i}$	-29.91 (-.704)	-93.76 (-.862)	.0362	0.6569
5. $\frac{XM_{ic}}{GNP_i}$	-3.102 (-1.125)		.0221	1.2655
6. $\frac{XM_{ic}}{GNP_i}$	-2.807 (-1.065)	-14.60 (-2.539)	.1247	3.9178

(T-values in parentheses)

To avoid a large number of zeros the coefficients which have been estimated are multiplied by one million. This is equivalent to other writers multiplying the average propensity to import by various large numbers.[7]

The economic meaning of the results of these regressions is the following: for example, in (2), for every dollar increase in the per capita difference between one importing country and Canada, the importing country will spend \$13.32 (±\$15.36) less to buy Canadian goods and services out of one million dollars of that country's G.N.P. Also, for each additional air mile that the

importing country is further from Canada it will spend \$64.02 (±\$39.24) less on Canadian total exports out of one million dollars of that country's G.N.P. Similar interpretations can be made for the other five regressions.

Every parameter in Table 3 is negatively signed as expected. Nevertheless, only the parameter of distance in the regression (6), with the average propensity to import finished manufactures, as dependant variable, is statistically significant at the 5% level and in regression (2) it is almost significant.

In every equation the coefficient of determination is pretty low, indicating that other important variables have been left out of the models. However, R^2 increases relatively a lot in the regressions which includes both explanatory variables. A complete analysis to determine the specification error could be made through a Chow test give F values and the sum of the squares of the residuals of the full model and the one used her in an attempt to formulate the "correct" model but this is beyond the scope of this paper.

For the same reasons as before the whole series of regressions is run including the statistical information from the U.S. The results of these new regressions are given in Table 4.

TABLE 4

REGRESSION ANALYSIS ESTIMATES INCLUDING U.S.

Dependant Variable	Explanatory Variables		R^2	F
	$\left\lvert \frac{GNP_i}{N_i} - \frac{GNP_c}{N_c} \right\rvert$	Distance		
1. $\frac{X_{ic}}{GNP_i}$	5.468 (.951)		.0245	.9090
2. $\frac{X_{ic}}{GNP_i}$	2.638 (.457)	-71.43 (-1.838)	.1077	2.1722

3.	$\frac{M_{ic}}{GNP_i}$	-1.765 (-.116)		.0004	0.1352
4.	$\frac{M_{ic}}{GNP_i}$	-5.921 (-.376)	-10.489 (.987)	.0267	0.4942
5.	$\frac{XM_{ic}}{GNP_i}$	1.041 (1.003)		.0173	1.0061
6.	$\frac{XM_{ic}}{GNP_i}$	.423 (.419)	-15.667 (-2.732)	.1329	4.2909

(T-values in parentheses)

The values of R^2 and F essentially unchanged confirming again the specification error embodied in the formulation of the model. The statistically significant, or almost so, parameters remain the same, i.e., the distance parameter in regressions (6) and (2) with their level of significance slightly higher. However, the main difference is the sign of the estimated parameters for the per capita difference in regressions (1), (2), (5), and (6) which now come out with a positive sign. This could be expected after similar results were found for the correlation coefficients for the same variables.

LOGARITHM APPROXIMATION

In no pioneering study was an attempt made to estimate a non-linear relation in the context of Linder's thesis. The reason given is that "no compelling logical basis was developed for the use of an alternate measure". [8]

The intention here is not to argue that Linder's thesis is meant to hold either as a linear or non-linear relation but to examine the goodness of fit it may have in a simple non-linear transformation of the model.

The formulation used is the following:

$$(1)' \quad \log X_{ic}/GNP_c = a_1 + b_1 \log\left|GNP_i/N_i - GNP_c/N_c\right| + u_i$$

$$(2)' \quad \log X_{ic}/GNP_c = a_2 + b_2 \log\left|GNP_c/N_c - GNP_i/N_i\right| + c_2 \log DISTANCE + u_2$$

$$(3)' \quad \log M_{ic}/GNP_c = a_3 + b_3 \log\left|GNP_c/N_c - GNP_i/N_i\right| + u_3$$

$$(4)' \quad \log M_{ic}/GNP_c = a_4 + b_4 \log\left|GNP_c/N_c - GNP_i/N_i\right| + c_4 \log DISTANCE + u_4$$

$$(5)' \quad \log X_{manu_{ic}}/GNP_i = a_5 + b_5 \log\left|GNP_c/N_c - GNP_i/N_i\right| + u_5$$

$$(6)' \quad \log X_{manu_{ic}}/GNP_i = a_6 + b_6 \log\left|GNP_c/N_c - GNP_i/N_i\right| + \log DISTANCE + u_6$$

For reasons related with the properties of logarithms, an attempt to explain the economic meaning of the parameters is not made. The values of the estimated coefficients have, as before, been multiplied by a large number, in this case by 1,000. The new situation is described in Table 5, again the first case without U.S. data is studied.

LOGARITHMIC REGRESSION ESTIMATES

Dependant Variables	Explanatory Variables				R^2	F
	$\log\left\lvert\frac{GNP_i}{N_i} - \frac{GNP_c}{N_c}\right\rvert$		log Distance			
(1)' $\log \frac{X_{ic}}{GNP_i}$	-92.733	(2.598)			.1574	6.7497
(2)' $\log \frac{X_{ic}}{GNP_i}$	-81.158	(-2.106)	-275.113	(-.820)	.1738	3.6802
(3)' $\log \frac{M_{ic}}{GNP_c}$	-128.314	(-2.572)			.1553	6.6175
(4)' $\log \frac{M_{ic}}{GNP_c}$	-121.24	(-2.343)	-168.057	(-.356)	.1583	3.2917
(5)' $\log \frac{X_{manu_{ic}}}{GNP_i}$	-55.321	(-1.704)			.0493	2.4044
(6)' $\log \frac{X_{manu_{ic}}}{GNP_i}$	-35.161	(-1.134)	-977.43	(-3.1)	.1924	6.5506

(T-values in parentheses)

The most interesting characteristic of these models is the statistical significance of four out of six estimates of the coefficients of $\left\lvert GNP_i/N_i - GNP_c/N_c \right\rvert$ while the fifth is almost significant. On the other hand the T-values of the other explanatory variables are lower in regression (2)' and (4)' than in (2) and (4), but the parameter of distance in (6)' is even more significant than its counterpart in the regression with the real values of the variables.

It is also of some interest to point out that the fit of the regressions as a whole has increased as is indicated by the higher values of the R^2.

Table 6, including U.S. data, was prepared for the sake of completeness of the analysis and has a very interesting result. The estimates of the parameters of the difference in the per capita income in regressions (1)', (2)', (5)' and (6)' are not only positive but also in two cases are statistically significant, or almost so.

TABLE 6

LOGARITHMIC REGRESSION ESTIMATES INCLUDING U.S.

Dependant Variables	Explanatory Variables $\log\left\lvert\frac{GNP_i}{N_i} - \frac{GNP_c}{N_c}\right\rvert$	Distance	R^2	F
(1)' $\log \frac{X_{ic}}{GNP_i}$	-73.252 (-2.013)		.0981	4.0531
(2)' $\log \frac{X_{ic}}{GNP_i}$	-64.471 (-1.859)	-510.46 (-2.133)	.1998	4.4950
(3)' $\log \frac{manu_{ic}}{GNP_i}$	-104.9 (-2.238)		.1192	5.0072
(4)' $\log \frac{manu_{ic}}{GNP_i}$	-102.93 (-2.100)	-434.31 (-1.245)	.1584	3.3878
(5)' $\log \frac{X_{manu_{ic}}}{GNP_i}$	-405.391 (-1.253)		.0268	1.5644
(6)' $\log \frac{X_{manu_{ic}}}{GNP_i}$	-364.561 (-1.251)	-452.84 (-3.798)	.2262	8.1831

(T-values in parentheses)

This last result requires an interpretation. When the regression was run for (1) in Table 4 the observations taken into account included an extremely high value of Canadian exports to the U.S. which dramatically changed the slope of the regression line in comparison with the regression run for (1) in Table 3 which did not include U.S. data. However, when the logarithm of these values is used a much smaller movement of the slope, or plane, is necessary to minimise the sum of the squares of the residuals since the logarithmic values lie relatively closer together than do the real values. In other words, the extremely high value of the Canadian exports to the U.S. overweithed the normal pattern between the difference in the per capita income and the trade intensities. This helps explain the similarity of results between tables 5 and 6.

CONCLUSIONS

In general the results of this study seem to support Linder's theory with respect to Canada. Specifically, Canadian international trade can be at least partially explained by Linder's thesis, and in any case it doesn't refute his hypothesis.

Surprisingly enough, the strongest relation found was between the average propensity to import Canadian finished manufactured goods and distance. This is surprising since Canada is situated almost the same distance to many of her main trading partners in Europe. However, the inclusion in the analysis of such countries as Japan, New Zealand, Australia, etc. which are very distant from Canada produce this strong relation.

The relationship between differences in per capita income and the other variables seem to follow Linder's expectation - although they are not always shown to have very high statistical significance - especially when the "distorting" influence of the American trade is kept aside.

Nevertheless, while similarities in demand structures and the trade-breaking aspect of distance do offer complementary explanations of Canadian trade, they do not really appear to be the most important factors in determining Canada's international trade patterns.

NOTES

1. Bhagwali criticises Linder's empirical test mainly because the relationship is investigated only with respect to per capita income.

2. Hufbauer classifies the theories which explain the pattern of trade into seven groups, the seventh being the the preferance similarities, that are complementary in justifying the "commodity composition" in the trade of manufactured goods.

3. The fear that GNP data may differ by very much for developing coutries, as Linneman and others have pointed out, tempted us to exclude from the analysis countries with a per capita income of less than $200 in 1972, with the only exception being Nigeria. ($187 in '72)

4. The only reason that Linder, Sailors, Qureshi and Cross and others used total exports is, as N. Fortune indicates, that data for exports is believed to be more accurate.

5. Data for $X_{manu_{ic}}$ was obtained from Canada Statistics 1974 Exports by Countries. The GNP and percapita income data was found in United Nations Statistical Yearbook 1974 and total exports (X_{ic}) and total imports (M_{ic}) in the United Nations Yearbook of International Trade Statistics 1975.

6. The air miles distances were obtained from I.A.T.A.'s Mileage Annual of August 1976.

7. Fortune, for instance, multiplies the values of imports intensities by 10 million.

8. This is supported by Sailors, Qureshi and Cross.

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