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CANADIAN SENSITIVITY TO ECONOMIC CYCLES IN THE UNITED STATES: SOME CROSS SPECTRAL STATISTICAL TESTS*

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I. Introduction

In the continuing discussion about the American dominance in Canadian economic life, the Canadian sensitivity to economic activity in the United States has been a prominent topic. There have been a number of studies over the years which have sought to quantify the degree of dependence of Canadian cyclical fluctuations on the United States. In a recent study, Keith Hay[1] compared the timing of business cycle turning points for the two countries since 1870. In an earlier series of studies, Edward Chambers and Gideon Rosenbluth[2] compared the timing and amplitude characteristics of many series reflecting aggregate economic activity, such as commodity prices, employment and production.

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*An earlier version of this paper was read at the Western Economic Association meetings in Davis, California. We would like to thank our formal discussant, Calvin Siebert, as well as Grant Reuber for useful suggestions. All remaining errors are ours.

[1]Keith A. J. Hay, "Early Twentieth Century Business Cycles in Canada," Canadian Journal of Economics and Political Science, August, 1966, pp. 354-365.

[2]Edward J. Chambers, "Canadian Business Cycles Since 1919: A Progress Report," CJEPS, May 1958, pp. 166-189, and "Canadian Business Cycles and Merchandise Exports," CJEPS, August 1958, pp. 406-410, and Gideon Rosenbluth, "Changing Structural Factors in Canada's Cyclical Sensitivity to United States Fluctuations," CJEPS, November 1957, pp. 480-503.

Unfortunately, these studies have left many questions unanswered. A simple comparison of timing points of business cycle troughs and peaks, or some crude measure of the relative amplitude of business cycles, provide little information about the overall dependence or closeness of association between the two economies over cycles of all lengths.

In this paper, we seek evidence on the hypothesized dependence of Canada to business fluctuations in the United States, utilizing a comprehensive set of aggregative data for the two countries. Moreover, and more importantly, we apply spectral methods of statistical analysis to test hypotheses relating to (i) the extent and nature of the economic dependence and (ii) the changing structure of dependence.

Unlike most other studies that employ spectral techniques (which usually are merely statistical descriptions of the time series data and their variance components) we are interested in testing hypotheses about the relationships estimated. In our tests, we make use of tables of confidence values for spectral statistics recently developed and utilized by Vittorio Bonomo and Charles Schotta;[3] hence, we are able to make proper inferences from our statistical findings on the nature and extent of Canadian dependence.

The second section of the paper summarizes some discussions on the effects of external influences on Canada's economic environment. Section III briefly outlines spectral analysis. No formal mathematical presentation is given since rather good compact treatments are available. However, since few economists are familiar with the details of the approach, the necessary basics

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[3]V. Bonomo and C. Schotta, "Statistical Tables for Time Series Analysis," Technical paper No. 69-1, Department of Economics, Virginia Polytechnic Institute and State University, Blacksburg 1969 and "A Spectral Analysis of Post-Accord Federal Open Market Operations," Amer. Econ. Rev., March 1969, pp. 50-61.

are presented for an understanding of our findings. Sections IV and V present the statistical findings. Section VI summarizes the major findings of the paper.

II. A Review of the Explanations for Canada's Cyclical Sensitivity

In this section we attempt to explain why Canadian economic fluctuations may be dependent upon economic fluctuations in the United States. The most frequently presented argument for this is that Canada - U.S. trade transmits American cycles into Canada.[4] Since historically approximately 20-30 per cent of Canada's total production has gone to exports with the U.S. taking a large percentage, trade serves as the primary medium for the transmission of American cycles to Canada. The foreign impact upon Canada was recognized in the 1920's when the Rowell-Sirois Commission reported:

> ...Canada supplied a large proportion of the total world requirements; therefore she would feel the full impact of any external disturbances.[5]

The Commission also argued that the effects of these export changes were diffused throughout the economy. Both the multiplier effect of consumer expenditures and the induced investment in export industries served to spread the effects as well as to aggravate the fluctuations in income.

A more refined version of the trade argument suggests that as the North American economies develop, there will be an increase in the interdependence of

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[4] For a recent presentation of this view and references to the literature, see Derek A. White, Business Cycles in Canada, Economic Council of Canada, Staff Study No. 17, Queen's Printer, 1967.

[5] Report of the Royal Commission on Dominion-Provincial Relations (Ottawa, 1940), Book 1, p. 126.

the U.S. and Canadian economies. Not only has the U.S. traditionally been Canada's major trading partner, but the trend in Canada's trade pattern is gravitating more towards the U.S. As Table 1 shows, the Canadian trade pattern has shifted from equal trade with the United Kingdom and the U.S. at the turn of the century to one dominated by the U.S. today. In addition, because Canada has

Table 1[6a]

Percentage of Canadian Trade with U.S., U.K., and rest of the World

	U.S.		U.K.		Rest of World	
	Exports To	Imports From	Exports To	Imports From	Exports To	Imports From
1896-1900	28	57	60	27	12	16
1926-1929	38	67	35	16	27	17
1947-1950	51	71	21	11	28	18
1957-1958	60	70	15	10	25	20
1967	64	72	10	6	26	22

become a major source of supply for many raw materials vital to the U.S. (aluminum, iron ore, nickel, copper, lead, zinc, crude petroleum, natural gas, lumber, pulp, newsprint), "there is little doubt that the future will bring a very significant increase in this U.S. dependence on Canadian sources of supply."[6b]

[6a] From R.J. Wonnacott, Canadian-American Dependence: An Interindustry Analysis of Production and Prices, North Holland Publishing Company, Amsterdam, 1961, p. 5. The 1967 figures are from Canada Year Book, 1969, Queens Printer, pp. 989-90.

[6b] Wonnacott, op. cit., p. 5.

To the extent that trade serves as the primary mechanism for the transference of economic cycles, the shifting trade pattern would suggest that Canada is becoming more sensitive to U.S. economic cycles.

A second main argument for Canada's sensitivity stresses the importance of the direct effect of United States fluctuation on Canadian domestic investment.[7a] In addition to the close connection between the securities markets in the two countries, and the resultant large capital flows between them[7b], the strong linkage of Canadian firms to U.S. firms and business opinion, technology and many prices[8], as well as direct U.S. control over a large segment of Canadian business, makes for a strong dependence of Canadian investment on business conditions in the U.S.

As Table 2 indicates, United States residents in 1963 owned almost a third of the major sectors of Canadian industry including almost fifty per cent control over oil and gas, mining and smelting, and manufacturing. These figures are almost twice as large as in 1926. This trend has continued. In 1966, U.S. direct investment accounted for more than 40 per cent of new investment in plant equipment in Canada boosting their control by 1968-69 to "...three-quarters of the oil and gas industry and three-fifths of mining and smelting and Canadian manufacturing."[9]

[7a] See R.B. Bryce, "The Effects on Canada of Industrial Fluctuations in the United States," CJEPS, 5, August 1939, pp. 373-86.

[7b] For a recent discussion of the transmission effects of capital flows and references to the literature, see R.E. Caves and G.L. Reuber, Canadian Economic Policy and The Impact of International Capital Flows, Univ. of Toronto Press, 1969.

[8] "Major Labor Trouble Looming for the U.S. This Year Could Result in Serious Spillover Problems for Canadian Industry," in What U.S. Labor does in 1970 may mean trouble in Canada," Financial Post, January 31, 1970, p. 9.

[9] G.L. Reuber and Frank Roseman, The Take Over of Canadian Firms, 1945-61, Special Study No. 10 for the Economic Council of Canada, Queen's Printer, 1969, p. 6.

Table 2

United States Resident Control as a Percentage of Selected Canadian Industries

	1926	1939	1948	1957	1963
Manufacturing	30	32	39	43	46
Petroleum and Natural Gas	n.a.	n.a.	n.a.	70	62
Mining and Smelting	32	38	37	52	52
Railways	3	3	3	2	2
Other Utilities	20	26	24	4	4
Total of Above and Merchandising	15	19	22	27	27

n.a.: not available

With the continued increase in the proportion of control of the U.S. residents over Canadian firms, it would seem likely that Canadian business activity has become more sensitive to conditions in the United States. Since two-fifths of new investment is currently financed from within the U.S., the evaluation of the future Canadian investment projects is strongly influenced by United States conditions. Although these effects are intangible and not readily measurable their influences are no less effective than those transmitted by way of exports.

An additional hypothesis upon which we seek to shed light is the larger independence of cyclical stabilization policy available in flexible exchange rate periods. It has been argued that flexible exchange rates permit a greater degree of independent

domestic stabilization than fixed exchange rates. With internationally mobile capital, "an increase in the level of output an d employment as a result of fiscal or monetary policy will ceteris paribus increase the net inflow of foreign capital. Under the flexible exchange rate system, this,...shifts the IS curve to the left, causing an offsetting decrease in the level of output and employment relative to their initial increases. Under the fixed exchange rate system, the net inflow of capital (will)...increase the country's money supply without a policy of complete sterilization. In other words, there is a further increase in the level of output and employment...".[10] If, in fact, flexible exchange rates permit effective contra-cyclical policies and these policies were employed, the period of flexible exchange rates should show a less close relationship to United States economic activity. For the period from October 1950 to May 1962, Canada abandoned the "Pegged rate" in favor of the flexible exchange rates.

III. An Outline of Spectral Analysis

Briefly, spectral analysis decomposes a stationary time series into a set of frequency bands. The object of the analysis is to measure the relative importance of each frequency band in terms of its contribution to the variance (called power) of the entire series. When we graph the variance against frequency, we have a "power spectrum". In order to secure the power spectrum we estimate the auto covariance of the series for a set of lags which is one greater than the number of frequency components. It is advisable to use as many lags (or frequencies) as possible so that the frequency bands are narrow.

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[10] Akira Takayama, "The Effects of Fiscal and Monetary Policies Under Fixed and Flexible Exchange Rates," C.J.E., May 1969, p. 193. This paper provides an up-to-date summary of the effectiveness of monetary and fiscal policies under fixed and fluctuating exchange rates. See also, John F. Helliwell, "Monetary and Fiscal Policies for An Open Economy," Oxford Economic Papers, 21:35-55, March 1969.

Unfortunately, if useful confidence bands are to be retained, the limitation on the number of lags should be no more than a fourth of the data points. This limitation is the most serious barrier to its use for analysis of economic time series.

The major advantage of spectral analysis over the more conventional techniques is that it is a tool which can handle the mixture of regularity and randomness typically found in economic time series. As a consequence, rather than testing cycles of an exact length, with the spectral statistical technique, we are testing cycles of a given average frequency. With this in mind, the frequency figures given in this paper are location points of frequency bands and they do not refer to the exact frequency.

IV. Results

While several studies of the sensitivity of Canadian economic activity to U.S. economic activity have been conducted, we are not aware of any study which has used spectral analysis and compared the relationship among all cycles. Our data base comprises monthly indexes which reflect real output from 1919 through 1967. Using this entire period of forty-nine years, we estimated the relationships between Canada and the United States at 50 different frequencies. Table A below presents summary cross spectral statistics for those frequency bands (in terms of length of time) for which there was

a significant relation (at the 95 % confidence level) between the seasonally unadjusted indexes of industrial production for Canada and the U.S.

Because the cross spectral method relates the frequencies of one series to corresponding frequencies in a second series, the method produces statistics for the frequencies which are roughly analogous to the statistics obtained from the familiar correlation and regression analysis. The analogue of the coefficient of determination is the cross spectral statistic of coherence and it, too, lies between zero and one. Two series that have a coherence of 1.0 implies that at the particular phase angle used, the series are not different. On the other hand, if the coherence coefficient is zero, the two series are said to be totally unalike or incoherent. The analogue of the regression coefficient is the cross spectral statistic called gain. The statistic, gain, measures the amplification of one series which produces the values in the second series with which it is crossed. There are no exact analogues in regression analysis of the cross spectral statistics phase and tau which indicate the lead or lag of the series in radians or real time units respectively. Phase is the angular measure of the time shift of the crossed series relative to the base series at which the coherence is maximized. The tau statistic converts this angular measure into a real time measure. In interpreting the result it should be recognized that when tau is positive, the phase shift is such that the base series leads the crossed series.

Table A

Base Series: Index of Industrial Production for U.S., 1919-67
Crossed Series: Index of Industrial Production for Canada, 1919-67

Frequency (in Months)	Coherence Squared	Gain	Phase (Degree Radian)	tau (Months)
100	.76	.69[b]	-.08	-1.24
50	.73	.62[b]	.01	.07
33.3	.63	.52[b]	.13	.70
25.0	.48	.40[b]	.23	.93
20	.28	.29[b]	.30	.95
16.7	.16	.37[b]	.13	.35
14.3	.27	.87	.17	.38
12.5	.36	1.23	.26	.51
11.1	.36	1.12	.32	.56
10.0	.35	.73	.30	.46
9.1	.43	.50[b]	.22	.32
8.3	.36	.35[b]	.20	.27
7.7	.19	.24[b]	.48	.59
7.1	.21	.37[b]	.65	.74
6.7	.47	.90	.77[c]	.81[c]
6.3	.65	1.23	.82[c]	.82[c]
5.9	.66	1.26	.84[c]	.79[c]
5.6	.50	1.07	.84[c]	.74[c]
5.3	.16	.52	.69	.58
5.0	.11[a]	.38	.36	.29
4.8	.21	.52	.47	.35
4.5	.26	.59	.60	.43
4.3	.54	1.02	.83[c]	.57[c]
4.2	.75	1.40	.91[c]	.60[c]
4.0	.77	1.48[b]	.94[c]	.60[c]
3.8	.68	1.38[b]	.97[c]	.59[c]
3.7	.42	1.00	.96[c]	.56[c]
3.6	.16	.65	.44	.25
3.4	.20	.95	.03	.01
3.3	.17	1.09	-.22	-.12
3.2	.15	.94	-.15	-.08
3.1	.18	.95	.26	.13
3.0	.18	1.01	.39	.19

a Not significantly different from zero at the .95 probability level.
b Significantly different from unity at the .95 probability level.
c Significantly different from zero at the .95 probability level.

The evidence presented in Table A clearly supports the impression which most people have from casual observation that economic activity in Canada moves quite closely with economic activity in the United States. All economic cycles in Canada and the U.S. from 100 months to 3 months in duration (save for the 5 months cycle) are significantly related. In addition, as tau indicates, the timing of the fluctuations is extremely close, since only the 100 months cycle has a lead or a lag of one month or greater. Although Canada appears to lead in cycles of 100 months duration, the U.S. leads in all other cycles except the 3.2 and 3.3 months cycles. Although the U.S. lead is generally not statistically significant, except for the semi-annual or thrice yearly cycles, the evidence does suggest that Canada does lag just a little -- about half a month.

The information contained in the gain statistic is also revealing. In all cycles, save for the seasonals or multiples of it (i.e., near six months, four months, three months, etc.), the cycles in Canada are damped versions of the counterparts in the United States. Whereas the amplitude of the Canadian long cycle (100 months) is roughly seventy per cent of the amplitude of the comparable U.S. cycle, the two to three years cycle in Canada has less than half the amplitude of its American counterpart. This suggests that either Canada successfully exercised independent domestic stabilization policies or that a substantial share of the cycles occurring in Canada were not due to the American influence.

Because this close relationship has been hypothesized to depend upon the trade patterns in which increasing demand in the U.S. leads to an increase in Canada's exports of raw materials, the American Index of Industrial Production was crossed with the mining index of Canada. The statistical results are presented in Table B for all cycles greater than 5 months. Although the timing and amplitude

Table B

Base Series: Index of Industrial Production for the U.S.
Crossed Series: Index of Mining Output for Canada

Frequency (In Months)	Coherence Squared	Grain	Phase (Degree Radians)	Tau (Months)
100	.04	.23[b]	-.29	-4.6
50	.14[a]	.31[b]	.48	3.8[c]
33.3	.32[a]	.46[b]	.79[c]	4.2
25	.23[a]	.44[b]	.76	3.0
20	.06	.25[b]	.34	1.0
16.7	.02	.22[b]	-.64	-1.7
14.3	.02	.30	.56	1.3
12.5	.04	.58	1.11	2.2
11.1	.04	.58	1.16	2.0
10.0	.05	.43[b]	.75	1.2
9.1	.12	.46[b]	.38	.5
8.3	.14[a]	.55	.39	.5
7.7	.11	.57	.72	.9
7.1	.05	.40[b]	-1.53	-1.7
6.7	.05	.29[b]	-1.18	-1.3
6.3	.06	.28[b]	1.57	1.6
5.9	.05	.28[b]	1.51	1.4
5.6	.02	.21[b]	-1.54	-1.4
5.3	.01	.14	.40	.3
5.0	.09	.67	-.04	-.0

a Significantly different from zero at the .95 probability level.
b Significantly different from one at the .95 probability level.
c Significantly different from zero at the .95 probability level.

statistics are similar to those presented in Table A, the coherence between the Canadian mining index and the American index of industrial production is substantially inferior. Nevertheless, for the cycles in the two to four years range, the relationships are significantly greater than zero at the 95 per cent probability level.

V. The Changing Influence of the United States

It has been argued that Canadian sensitivity to economic cycles in the U.S. has been undergoing a long run decline. For example, Rosenbluth writes that "...the amplitude of Canadian fluctuations exceeded that in the United States before 1914, was frequently about the same in the 1920's, was usually lower in the 1930's and was often lower after 1946. One thus gains the impression of a long-run decline in Canadian sensitivity to United States fluctuations..."[11] In this section we re-examine the evidence by sub-periods. In addition we attempt to shed additional light on the inter-relationships of the Canadian and U.S. economics during the flexible exchange rate period of the 1950's.

Our first test compared the structure for the pre-World War II period with the post-WWII period. The results are presented in Table C. Save for the gain statistic of the twelve month cycle, the statistics for the two sub-periods are very close to each other as well as to the entire sample period. The low gain statistic for the 12 month cycle (i.e. the seasonal) in the post-WWII period, while not significantly different from unity, is surprising especially when the gain statistic for the cycle in the pre-WWII period was substantially greater than one (but still not significantly different from unity). These statistics seem to suggest that there has been a relative decline in the seasonal amplitude of

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[11] Rosenbluth, (1957), p. 489. These conclusions were further documented in a subsequent article by Rosenbluth (1958).

Table C

The Changing Structure: A Two Subperiod Comparison

Base Series: Index of Industrial Production: U.S.
Crossed Series: Index of Industrial Production: Canada

Frequency (In Months)	Coherence Squared		Gain		Tau	
	1919-39	1946-67	1919-39	1946-67	1919-39	1946-67
100	.71[A]	.66[A]	.65[B]	.54[B]	-1.31	2.23
50	.71[A]	.79[A]	.60[B]	.55[B]	.18	.92
33.3	.65[A]	.76[A]	.55[B]	.49[B]	.74	.79
25	.50[A]	.54[A]	.45[B]	.38[B]	.99	.83
20	.27	.14	.33[B]	.17[B]	.98	.63
16.7	.21[A]	.07	.51	.13[B]	.28	2.76
14.3	.39[A]	.27[A]	1.21	.41[B]	.54[C]	2.54[C]
12.5	.53[A]	.36[A]	1.69	.62	.71[C]	2.47[C]
11.1	.51[A]	.29[A]	1.49	.55	.73	2.45
10.0	.44[A]	.14	.88[B]	.27[B]	.59	-2.35
9.1	.48[A]	.07	.56[B]	.12[B]	.35	-1.76
8.3	.40[A]	.05	.38[B]	.09[B]	.27	1.96
7.7	.23	.01	.27[B]	.05[B]	.50	1.79
7.1	.24[A]	.28[A]	.40	.50[B]	.77[C]	.41[C]
6.7	.48[A]	.79[A]	.97	1.01	.97[C]	.39[C]
6.3	.70[A]	.89[A]	1.40	1.09	1.01[C]	.37[C]
5.9	.72[A]	.91[A]	1.47	1.11	.96[C]	.36[C]
5.6	.51[A]	.86[A]	1.21	1.07	.93	.36
5.3	.14	.66[A]	.54[B]	.85[B]	.75	.36
5.0	.13	.32[A]	.45	.47[B]	.25	.48

A Significantly different from zero at the .95 probability level.
B Significantly different from one at the .95 probability level.
C Significantly different from zero at the .95 probability level.

Canadian economic activity. However, given the large variance of these statistics, such a conclusion is highly tentative.

Although the two sub-periods analysis failed to support the hypothesis of a changing structure, a further breakdown of the sample into five sub-periods did suggest a structural change which is currently being reversed. However, because decades of monthly data are small-sized samples for spectral analysis and do not provide adequate degrees of freedom to analyze cycles of the typical business cycle length, the sub-sample breakdown, and especially the sub-periods of 1946-51 and 1962-67, can do no more than hint at the changing structure. Nevertheless, the implications of the sub-period analysis are highly suggestive of significant changes in the sensitivity of Canadian economic activity to that in the United States.

The changes in sensitivity are most clearly seem from the gain statistics presented in Table D. During the 1920's, cycles of various lengths which were greater than 15 months in length had about equal amplitudes in the two countries. However, for the next three decades, Canadian cycles of greater than 15 months were substantially damped from their American counterparts. During the 1930's the Canadian cycles were about half as severe as the American cycles. The trend continued towards relatively greater fluctuations in the U.S. so that during the sub-period 1946-51, Canadian cycles had amplitudes only about 25 per cent of those of the U.S. However, the trend was reversed in the 1950's, when Canadian cycles had one-quarter to one-half of the U.S. amplitudes, so that during the 1960's Canadian cycles were again of about equal amplitude to their American counterparts.

Table D

The Changing Structure: A Decade by Decade Comparison

Base Series: Index of Industrial Production -- U.S.
Crossed Series: " " " " -- Canada

Frequency (In Months)	Coherence Squared					Gain					Tau (In Months)				
	1919-29	1930-39	1946-51	1952-61	1962-67	1919-29	1930-39	1946-51	1952-61	1962-67	1919-29	1930-39	1946-51	1952-61	1962-67
50	.81[A]	.58[A]		.62[A]		.85	.46[B]		.53[B]		-1.15			-1.20	
33			.15		.28			.25[B]		.76		2.0	-0.0		-.94
25	.56[A]	.44[A]		.37[A]		.82	.51[B]		.38[B]		- .44	2.07		-1.15	
16.7	.36[A]	.40[A]		.08		1.14	.73		.20[B]		.53	1.07		-2.43	
15.0			.10		.41[A]			.21[B]		.99			-2.28		.13
12.5	.43[A]	.47[A]		.10		1.80	.87		.27[B]		.85	.63	-	2.26	
10.0	.37[A]	.45[A]	.12	.09	.72[A]	1.62	.71	.27[B]	.21[B]	1.28	.83	.43	- .91	2.12	.36
8.3	.24	.51[A]		.17		.86	.56[B]		.26[B]		1.09	.36		- .21	
7.5			.44[A]		.86[A]			.66		1.41[B]			.54		.36[C]
7.1	.49[A]	.38[A]		.68[A]		1.0	.65		.71		1.24[C]	.65		.24	
6.3	.66[A]	.41[A]		.84[A]		1.28	.99		.89		1.06[C]	.88		.25	
6.0			.70[A]		.89[A]			.93		1.45[B]			.59[C]		.33[C]
5.6	.67[A]	.36[A]		.84[A]		1.36	.96		.90		.89[C]	.86		.27	
5.0	.57[A]	.27	.59[A]	.73[A]	.90[A]	1.26	.72	.93	.92	1.54[B]	.64[C]	.80	.60[C]	.37	.29[C]
4.5	.64[A]	.51[A]		.83[A]		1.39	.87		1.43		.56[C]	.83[C]		.53	
4.3			.38[A]		.91[A]			.81		1.58[B]			.58		.20[C]
4.2	.73[A]	.77[A]		.92[A]		1.56	1.13		1.66		.63[C]	.82[C]		.49	
3.8	.68[A]	.79[A]		.90[A]		1.58	1.18		1.66		.63[C]	.75[C]		.45	
3.7			.24		.88[A]			.59		1.68[B]			.37		.10
3.6	.37[A]	.64[A]		.69[A]		1.36	1.10		1.32		.55	.85[C]		.38	
3.3	.10	.32[A]	.22	.48[A]	.83[A]	1.00	1.19	.45	.79	1.69[B]	.35	.46	- .05	- .03	-.07
3.1	.14	.35[A]		.76[A]		1.43	2.36		.98		.59	.43		- .14	
3.0			.40[A]		.88[A]			.52[B]		1.86[B]			- .23		-.17[C]

A Significantly different from zero at the .95 probability level.
B Significantly different from one at the .95 probability level.
C Significantly different from zero at the .95 probability level.

The limited numbers of observations in the sub-periods are even more restrictive when we attempt to evaluate the independence of Canada during the flexible exchange rate period. Even though we find that the gain statistics, for the flexible exchange rate period of cycles greater than a year, are less than for either the 1960's or for the entire sample, we cannot conclude that Canada achieved significant isolation from fluctuations emanating from the United States. The gain statistics for the immediate post-WWII period (1946-51) are even smaller. Likewise, the timing relationships for the flexible exchange rate period are crosses between the 1940's and the 60's. Yet, the coherence statistics for the longer cycles are higher for the flexible exchange rate period than for the periods immediately preceding or succeeding it. This would imply that, if the flexible exchange rate gave Canada more autonomy, she apparently didn't use it.

VI. Conclusions

This paper assesses the degree of sensitivity of business fluctuations in Canada to those in the United States. In doing so, we have also tried to determine if this sensitivity has been changing in a systematic manner. The method of analysis was to use cross spectral statistical technique on monthly economic data for the period 1919-67.

For the period as a whole we found:

1) Statistically significant relations between American and Canadian economic cycles of lengths between three and one hundred months.
2) For cycles fifteen months or longer, Canadian cycles have a significantly smaller amplitude than their American counterparts.

3) Overall, the timing of the cycles in the two countries are not statistically significantly different from each other, but the Canadian cycles do tend to lag behind the United States' cycles for cycles less than fifty months long. However, the Canadian lag behind the United States appears to be less than a month.

Except for Canadian cycles having significantly less amplitude than their American counterparts, these results were substantially supported by the sub-period analysis. The sub-period analysis indicated that the magnitude of the economic cycles in the two countries were very similar during the 1920's and the 1960's. However, Canadian cycles in the 1930's, 40's and 50's were significantly damped from their American counterparts. During the flexible exchange rate period, 1952-61, we found the relationship between Canadian and U.S. economic activity of cycles more than 15 months about the same as for the sample as a whole. As a consequence, we find it impossible to conclude that flexible exchange rates during the 1950's decreased the degree of Canadian sensitivity to economic cycles originating in the United States.