L.5.2   RFD 250

Board of Governors of the Federal Reserve System

Division of International Finance

March 22, 1955

Canadian Industrial Production -- An Approximate
    Seasonal Adjustment   10 pages

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NOT FOR PUBLICATION

Canadian Industrial Production -- An Approximate Seasonal Adjustment

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Summary

During the 1953-54 recession, Canadian industrial output did not behave as differently from U. S. output as has commonly been supposed. This becomes clear when the published Canadian index of industrial production is adjusted for seasonal variations, as described in this paper

The 1953 peak came at least as early in Canada as in the United States. In both countries the decline continued into the first quarter of 1954. After that, total industrial output turned upward in Canada, thanks to rising mineral production, while it remained unchanged in the United States during the second and third quarters of 1954. In the manufacturing sector, the upturn waited in both countries until the fourth quarter, and was much sharper in this country than in Canada.

While the overall industrial decline in 1953-54 was less marked in Canada than in the United States, this was largely because mining production continued to rise strongly in Canada throughout the period while it was falling in this country. The percentage decline in manufacturing production was about two-thirds as great in Canada as in the United States.
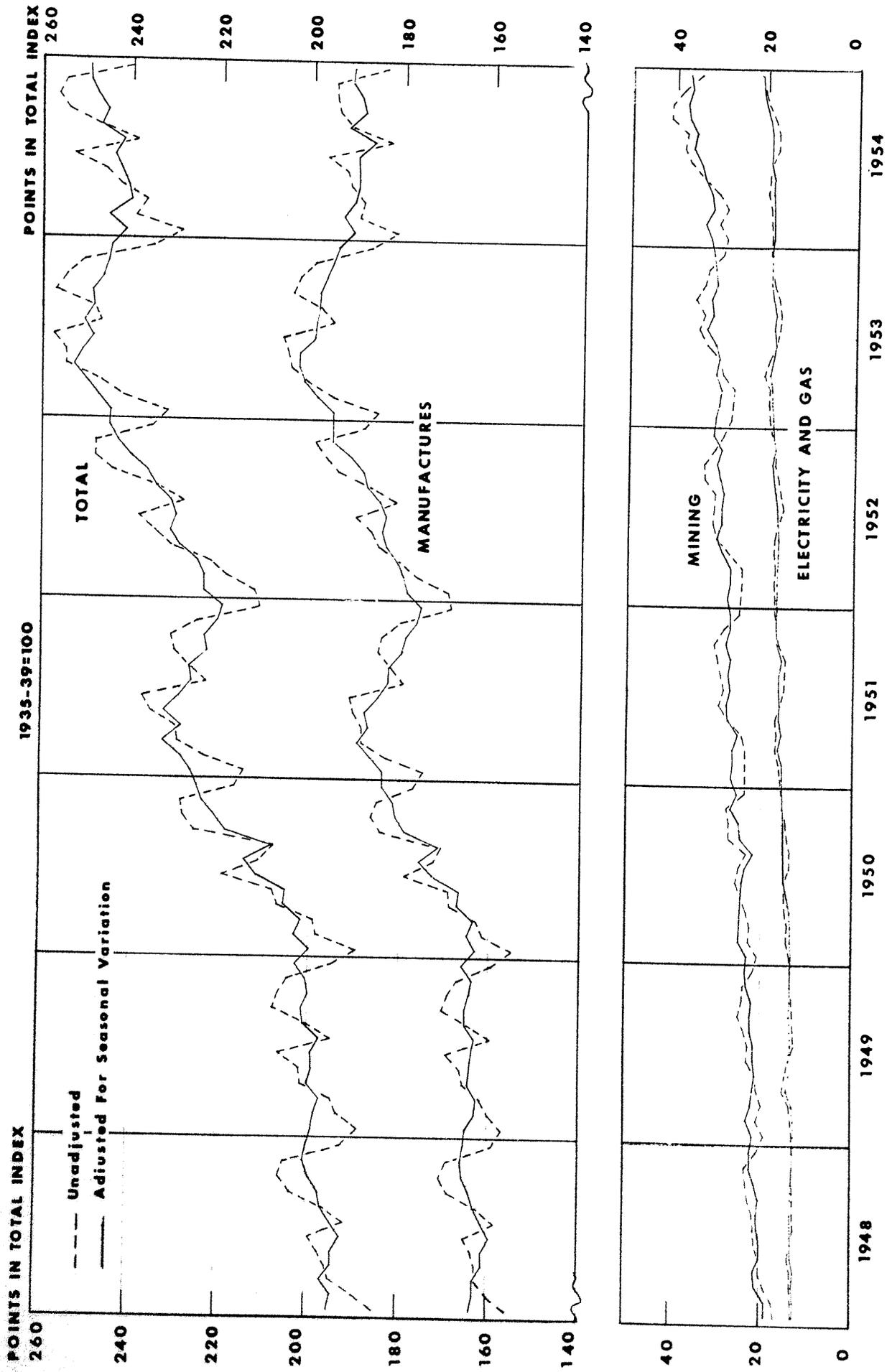
The need for seasonal adjustment

The Canadian index of industrial production currently published by the Dominion Bureau of Statistics is not adjusted for seasonal variations. 1/ In using the index as an indicator of economic activity in Canada, however, analysts have to take seasonal variations into account. One common method of doing this is to compare recent industrial production figures with those for the corresponding months a year ago. But this gives no satisfactory indication of shorter-run developments or of the timing of cyclical turning points.

Even without detailed analysis of the individual components of the index, seasonal factors for the period 1948-53 can be worked out for manufactures, mining, and electricity and gas, which, when applied to the unadjusted figures for this period and for 1954, produce useful seasonally adjusted series for these components and for the total index. Admittedly the results are only approximately accurate -- for accurate adjustments we must wait for detailed work

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1/ D.B.S. Reference Paper No. 34, Revised Index of Industrial Production, 1935-51 (1935-39 = 100), p. 31.

CHART 1. CANADA: INDUSTRIAL PRODUCTION, 1948-54

1935-39=100

POINTS IN TOTAL INDEX

- - - Unadjusted
——— Adjusted For Seasonal Variation

TOTAL

MANUFACTURES

MINING

ELECTRICITY AND GAS

POINTS IN TOTAL INDEX

260 240 220 200 180 160 140

40 20 0

1948 1949 1950 1951 1952 1953 1954

by Canadian statisticians. But the margin of error, discussed in the final section of this paper, seems small enough to allow even these approximate calculations to give us a better indication of trends and turning points than can the unadjusted indexes. For manufactures and for the total, though not for mining, the adjusted series are fairly free of recurrent month-to-month variations. There is some reason to think, as will be shown later, that the adjusted curves are a little too low in April-July relative to other months. With this reservation, the curves give a clear picture of cyclical movements and of the timing of turning points which are not clear in the unadjusted data, as will be seen from Chart 1.

The 1953-54 recession

The seasonally adjusted data (Chart 2) show that total industrial production in Canada expanded rapidly from December 1951 to a peak (on a quarterly basis) in the second quarter of 1953, and then declined into the first quarter of 1954. As adjusted here, the monthly figures show a decline of 5 per cent from the indicated peak in April 1953 to March 1954, which seems to have been the low point. From April 1953 to April 1954 -- a comparison involving no seasonal adjustment -- the decline was 4.8 per cent. Taking quarterly averages of the adjusted figures, which are probably more reliable than figures for particular months, Canadian industrial production in the first and second quarters of 1954 was about 3 1/2 per cent below the peak second quarter of 1953. There has been some increase since March 1954; the fourth quarter seasonally adjusted average (preliminary) is about 2 1/2 per cent above the first and second quarter averages.

In manufacturing, the story has been rather different. The 1951 and 1953 turning points were timed like those of the total industrial production index, but the decline from the peak quarter of 1953 was greater -- about 6 per cent by the second quarter of 1954. The recovery indicated by preliminary fourth quarter figures is very slight -- less than one per cent.
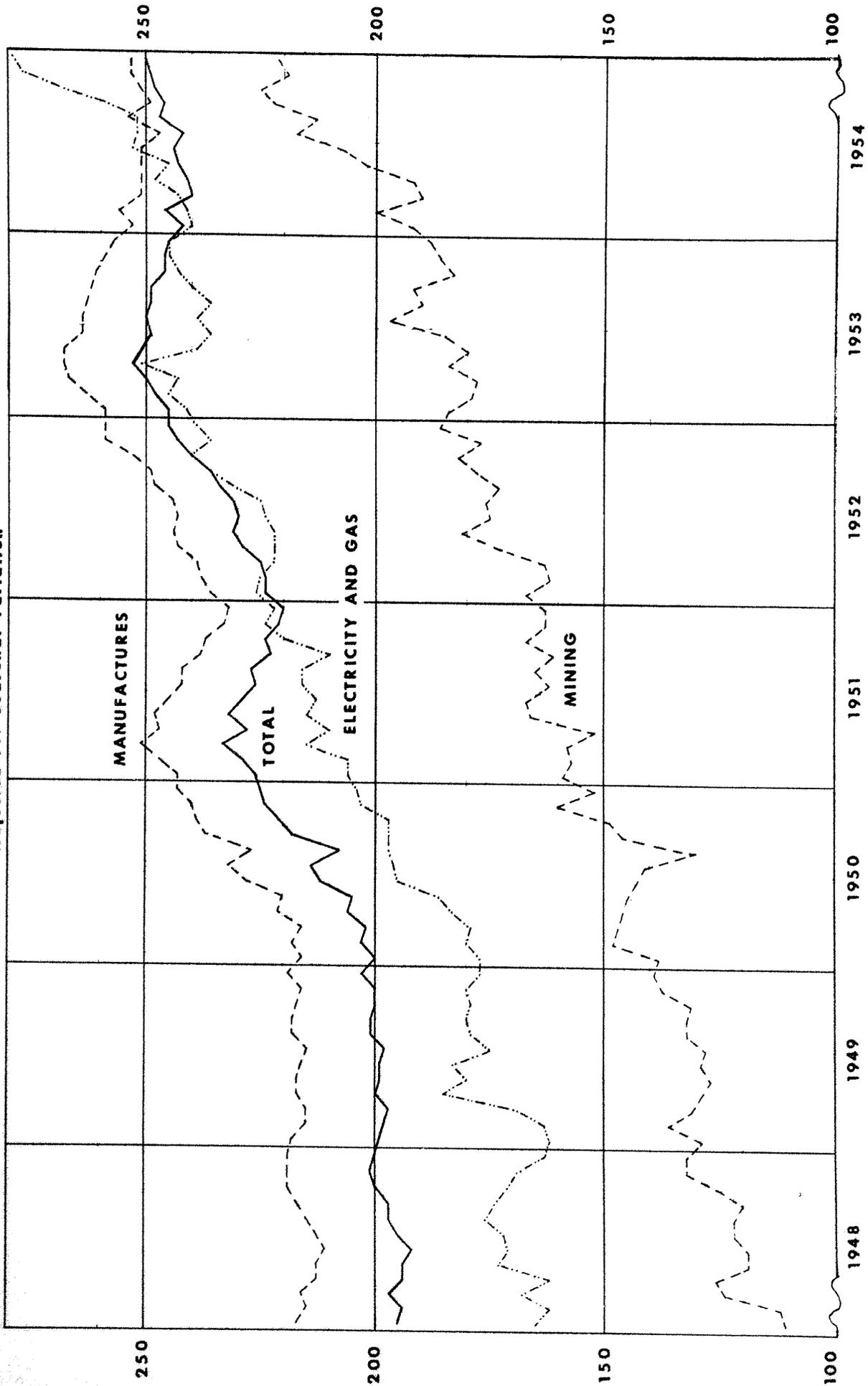
It is the strong upward movement in mining production (and to a smaller extent in electricity and gas) which has pulled the total industrial index upward since March 1954. Canadian mining production in the fourth quarter of last year was 19 per cent higher than in the fourth quarter of 1953, while electricity and gas production was up by 12 1/2 per cent. Manufacturing output, on the other hand, was 2 1/2 per cent lower, although manufactures other than iron and steel products and transportation equipment showed a 2 per cent rise over the year.

It is interesting to compare recent Canadian and United States developments as shown by their respective industrial production indexes. This is done graphically in Charts 3 to 5. It is common

CHART2. CANADA: INDUSTRIAL PRODUCTION, 1948-54
1935-39=100
Adjusted For Seasonal Variation

MANUFACTURES

TOTAL

ELECTRICITY AND GAS

MINING

250

200

150

100

250

200

150

100

1948   1949   1950   1951   1952   1953   1954

knowledge that the overall industrial decline during 1953-54 was less marked in Canada than in the United States -- 3 1/2 per cent against 9 per cent between the second quarter of 1953 and 1954. Perhaps less familiar is the fact that the Canadian downturn appears to have begun at least as early as ours. 1/

In the manufacturing sector, the decline from the second quarter of 1953 to the second quarter of 1954 was 6 per cent in Canada against 9 1/2 per cent in the United States. The difference may reflect the greater weight of durable goods production in the United States, durables having been much more sharply affected than non-durables in both countries. In the last quarter of 1954, with output recovering much more rapidly in this country than in Canada, manu-facturing production in both countries was 5 1/2 to 6 per cent below the peak second quarter of 1953.

The course of mining production during the recession was strikingly different in the two countries, rising sharply in Canada while declining in the United States. Electricity and manufactured gas production are not included in the United States index. In Canada, electricity and gas production, as seasonally adjusted here, was rising during 1954 after declining only a little in the summer of 1953, so that it helped to sustain the level of the total index of Canadian industrial production. Construction is not included in either the Canadian or the U. S. index.

In the absence of a published adjusted index, many observers of Canadian economic developments compare unadjusted monthly index figures with those for the corresponding months of the previous year. In the 1953-54 recession, it was not until the preliminary December 1953 figure was revised toward the end of March 1954 that the Canadian index of industrial production showed any year-to-year decline -- by 0.1 per cent from December 1952 to December 1953. Earlier year-to-year increases had progressively diminished from more than 10 per cent in April to 8 per cent in June and July, 6 per cent in August, and 5 per cent in September. 2/ The diminution was widely interpreted as a slackening in the rate of advance. But the seasonal adjustment presented here indicates that it was more than that. Whereas Canadian industrial

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1/ As noted in the final section of this paper, the peak month for Canada may have been as late as July 1953 (as in the United States) instead of April as shown in the figures presented here, owing to possible errors in the seasonal adjustment.

2/ There is a two-month lag in the publication of these figures. The preliminary August figure was not published until the end of October.

CHART 3. INDUSTRIAL PRODUCTION, 1948-54

Adjusted For Seasonal Variation

CANADA
1935-39=100

UNITED STATES
1947-49=100

UNITED STATES
1947-49=100

CANADA
1935-39=100

scale →

← scale

150

125

100

75

300
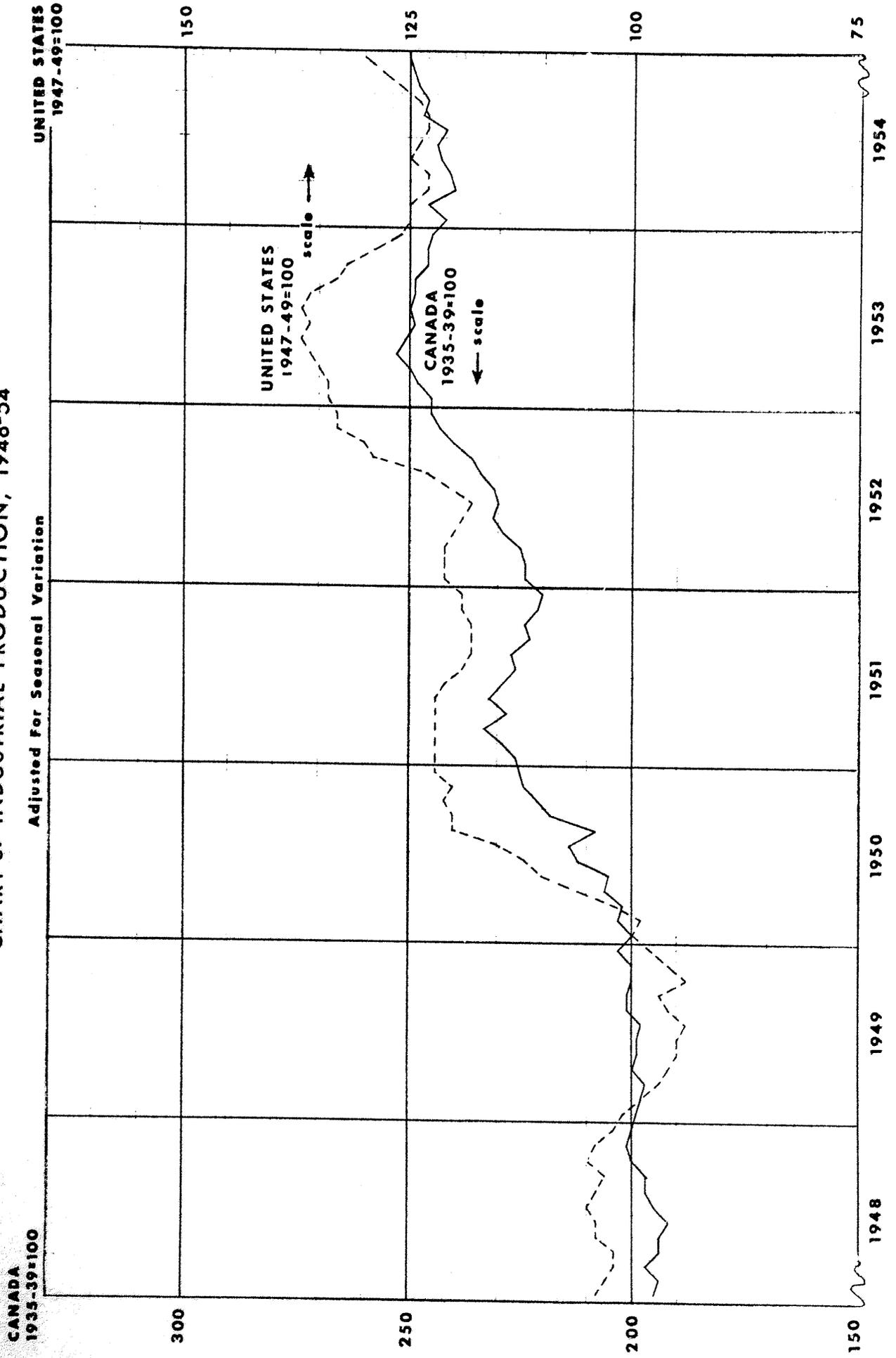
250

200

150

1948   1949   1950   1951   1952   1953   1954

CHART 4. MANUFACTURING PRODUCTION, 1948-54

Adjusted For Seasonal Variation

CHART 5. MINING PRODUCTION, 1948-1954

Adjusted For Seasonal Variation

CANADA
1935-39=100

UNITED STATES
1947-49=100

UNITED STATES
1947-49=100
scale

CANADA
1935-39=100
scale

125

100

75

50

1954   1953   1952   1951   1950   1949   1948

250

200

150
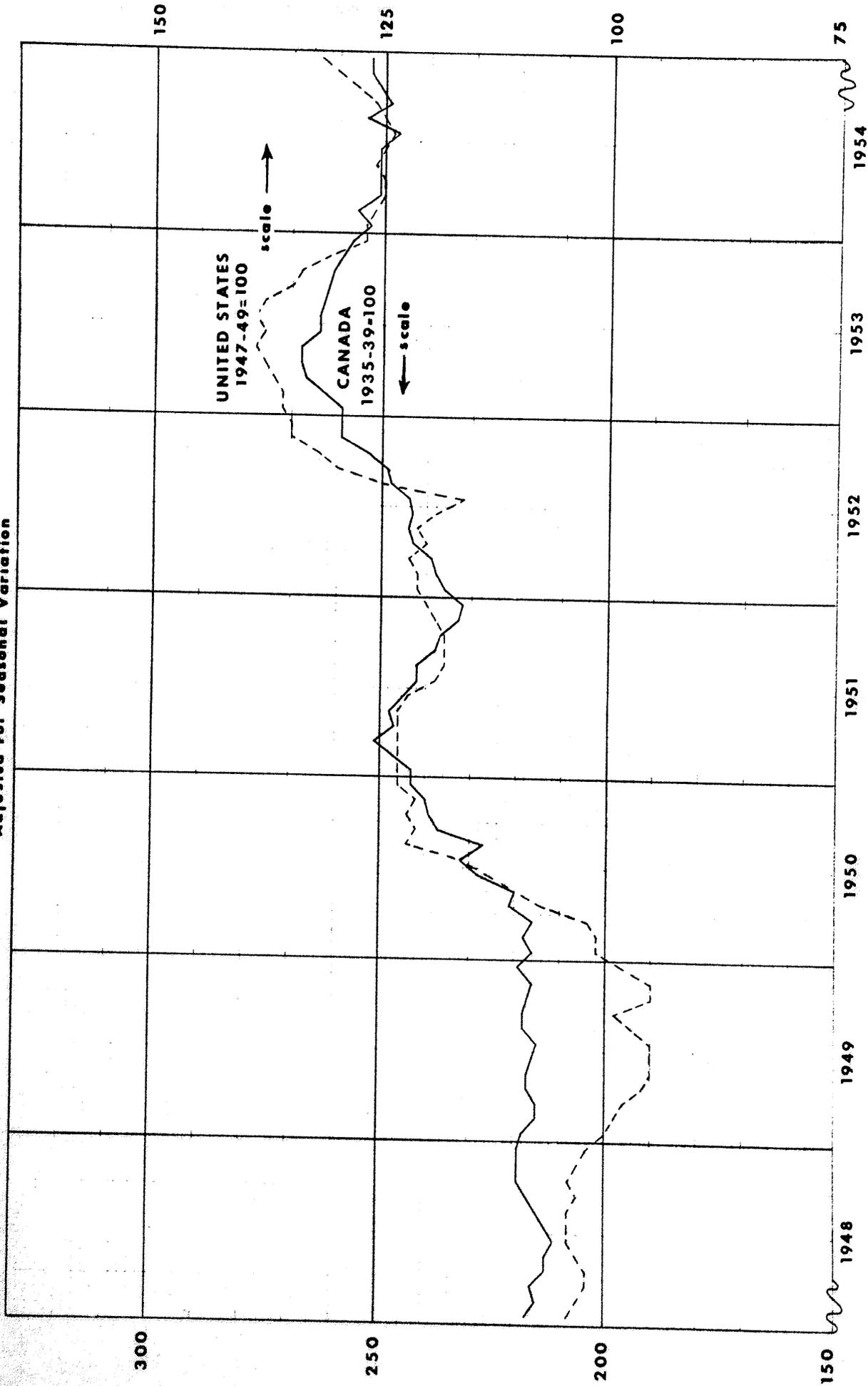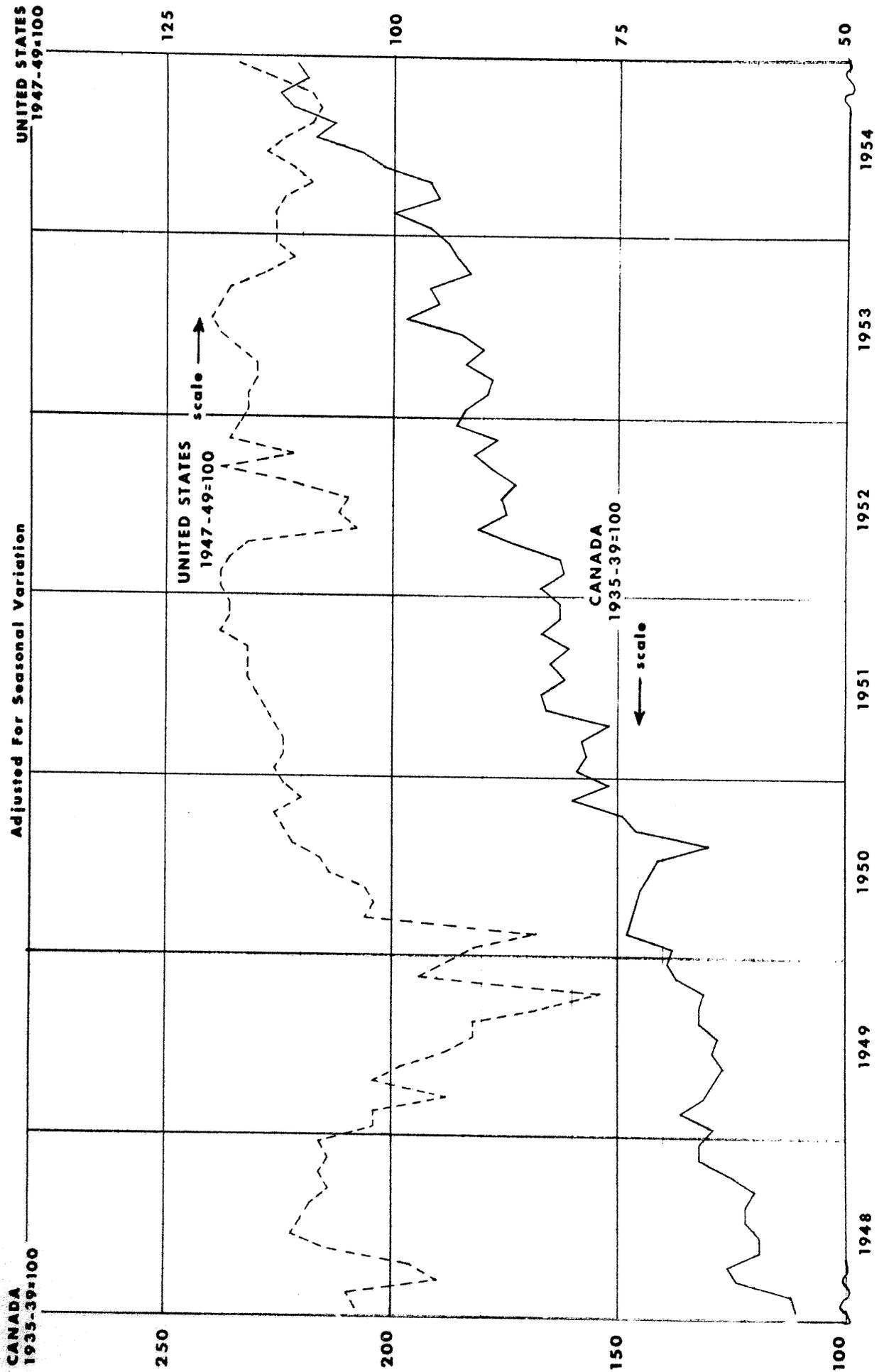
100

production had been rising strongly in the summer and autumn of 1952, it was actually declining -- on a seasonally adjusted basis -- in the late summer and autumn of 1953 from the peak reached in the spring or early summer, even though it had not yet fallen below 1952 levels.

The method of seasonal adjustment

The Canadian industrial production index as published by the Dominion Bureau of Statistics is adjusted for the number of working days in the month, except that holidays other than Good Friday are considered to be a seasonal influence and are not taken into account. The Bureau's decision as of 1952 not to adjust the monthly index for seasonal variations was based on two main considerations: (1) many series influenced by significant seasonal factors did not become available on a monthly basis until after the second world war, thus affording but a short period on which to base an index of seasonal behavior, and (2) the seasonal patterns of other series which cover longer periods were considerably disrupted after the end of the war. Also, the extra work involved in working out a seasonal adjustment would have seriously delayed publication of the new index. 1/

Postwar series are now available for a period two years longer than when the revised Canadian index was first published in 1952, and the author of this paper has found that a useful adjustment can be made by fairly simple methods.

The same method was used to adjust separately each of the three main components of the total index: manufacturing, mining, and electricity and gas. The adjustment was carried out in five steps as follows:

1. Compute 13-month moving averages, centered, for each month during the period 1948-53.

2. Compute for each month during the period the ratio of the unadjusted figure to the 13-month moving average centered on that month.

3. Tabulate the six ratios for January, for February, etc., disregard the two extreme ratios in each set of six, and compute the average of the remaining four ratios in each set.

4. Adjust these twelve average ratios so that their sum equals 1200.

5. Compute the seasonally adjusted series by using these adjusted average ratios (the seasonal factors, shown in the table on the next page) as divisors of the unadjusted series.

1/ See footnote on page 1.

Seasonal Factors for Adjusting the Canadian Index of Industrial Production (1935-39=100), Computed for the Period 1948 - 1953

	Total Index[1]	Manufactures[2]	Mining[2]	Electricity and Gas[2]
Base period industry weight	100.0	75.67	16.75	7.58
January	94.9	95.0	89.4	102.5
February	97.7	98.1	90.7	104.0
March	98.6	99.5	89.9	103.3
April	100.6	100.9	95.4	106.0
May	101.4	101.3	100.1	104.5
June	103.5	103.5	106.0	100.0
July	98.7	98.1	105.0	93.6
August	100.0	99.7	106.0	92.7
September	103.3	102.9	110.8	94.6
October	103.3	102.9	109.0	97.9
November	102.0	101.9	104.3	99.7
December	96.2	96.2	93.4	101.2
Range from 100	+ 3.5 to - 5.1	+ 3.5 to - 5.0	+ 10.8 to - 10.6	+ 6.0 to - 7.3

1/ The implied 1953 factors are derived by dividing the monthly index without seasonal adjustment by the corresponding seasonally adjusted index derived from the component adjusted indexes.

2/ These are the adjusted average ratios which result from step four in the process described in the text.

This adjustment process is much shorter than, for example, the method used by the Federal Reserve Board which involves fifteen steps. 1/ It is purely mechanical and makes no use of freehand curves and detailed graphical checking and adjustment of results. The major shortcomings and sources of error in it, by comparison with more refined methods, are noted in the following section.

The period 1948-53 was chosen so as to omit the immediate postwar years while retaining a long enough span to avoid serious distortion as a result of erratic movements in a single year. A six-year period is probably long enough to provide a reliable indication

1/ Federal Reserve Bulletin, June 1941, "Adjustment for Seasonal Variation" by H. C. Barton, Jr.

of seasonal variations. The Federal Reserve, for example, used a period of six and one half years in computing revised postwar seasonal adjustment factors for its revised industrial production index.

Sources of error

The use of a 13-month moving average, rather than the 12-month average usually recommended, proved unfortunate, since it did not much reduce the amount of calculation involved and introduced minor errors. 1/ The 13-month moving average retains a degree of seasonal variation, since one of the twelve calendar months is included twice. It can be shown that the 13-month average differs from the more appropriate 12-month average, "centered" on the same month 2/, by 11/156ths of the difference between the average of the two end months and the average of the middle eleven months. In the case of the Canadian index of manufacturing output, the fact that the January seasonal factor is about 95 (the average seasonal factor for the year being 100) means that the 13-month moving averages centered on July are about 0.4 per cent lower than 12-month moving averages would be. As a result, the seasonally adjusted July figures for manufacturing may be 0.4 per cent too low on this account, assuming for the moment no other sources of error. The error is smaller for other months in the case of manufacturing, but for mining the adjusted index may be as much as 0.8 per cent too low in July-September and 0.8 per cent too high in March and April as a result of using 13-month moving averages rather than 12-month averages.

Theoretically, a much more serious source of error arises from the fact that a twelve-month moving average itself eliminates not only seasonal variations but also some non-seasonal movements that should be included in the base from which seasonal variations are measured. In particular, the moving average tends to flatten out cyclical peaks and valleys. In Canadian manufacturing output, for example, the non-seasonal peaks reached in the second quarter of 1951 and 1953 were higher than the moving averages indicate, while the

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1/ Errors from this source did not appear large enough to justify the work involved in repeating the whole calculation at this time using 12-month averages.

2/ The center of a 12-month period lies between the sixth and seventh months. To obtain averages centered on the months, rather than between them, adjacent pairs of 12-month moving averages are averaged. Or, what amounts to the same thing, 13-month moving averages centered on the seventh month are computed with the first and last months given only half as much weight as the other eleven.

averages for the latter part of 1951 and 1949 are too high because they are influenced by the upswings which followed. 1/ The ratios of the unadjusted monthly figures to the moving averages are therefore too high in peak periods and too low at the troughs.

Much of this potential error is removed by throwing out the two extreme ratios for each calendar month and averaging only the remaining four (step 3). Thus, in the case of Canadian manufacturing, the high ratio discarded for each of the months February through June was either a 1951 or a 1953 figure, and the low ratio discarded for each of the months September through December was the 1951 figure.

Furthermore, it happens that in the Canadian manufacturing index the two kinds of errors described somewhat cancel each other out. The seasonally adjusted figures for April and May may tend to be a shade (0.2 per cent) too high because a 13-month rather than a 12-month moving average was used, but they are almost certainly lowered (by 1/2 to 1 per cent) as a result of the tendency of moving averages to flatten out cyclical peaks. It appears that for this series the two errors operate significantly in the same direction only in June and July, when together they may unduly depress the seasonally adjusted figures by as much as one per cent. 2/

A third possible source of error should be noted. Fixed seasonal factors are probably not entirely appropriate. <u>A priori</u> one would expect the seasonal pattern to change over a period of years. However, a close inspection of the ratios of the unadjusted manufacturing index to the 13-month moving averages suggests that such changes in this series have been very small. The range on either side of their average of the four ratios used (in step 3) is less than 1 per cent in each of the last seven months of the year and less than 2 per cent in January through May. Some of this variation results from the second source of error discussed above -- the flattening of

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1/ It is to get around this difficulty that freehand curves are introduced at this stage in a more thorough analysis of seasonal variation.

2/ Throughout this paragraph, the estimation of the degree to which moving averages misrepresent the main non-seasonal movements, owing to their smoothing effect, is based on a graphical examination of the moving averages and the unadjusted data. The author is confident that a careful drawing of freehand curves, and ensuing computations, would support the assertion that the maximum error in the seasonally adjusted manufacturing index is less than one per cent, but this is not easily demonstrated mathematically.

the base curve by the long moving average. What remains looks as if it were more the result of erratic movements than of a gradually changing seasonal pattern, although this conclusion can be only tentative in the absence of more detailed reworking of the adjustment.

Fourth, there is the possibility that adjustment of the index for total manufacturing by fixed seasonal factors (as opposed to aggregation of the various component indexes after adjusting them individually, using shifting seasonals if necessary) may have produced smoother movements than those which might be found by the longer route, particularly if full use could be made of information about abnormal events affecting particular industries. It is difficult to assess the magnitude of this type of error; for a test we shall have to wait for the work of Canadian statisticians.

The conclusion of this whole discussion is that the manufacturing index as adjusted here is unlikely to be in error by more than one per cent in any month, and in most months the error is probably considerably less than one per cent. In the months of April through July, the adjusted figures are almost certainly too low. In other months, they are therefore slightly too high on the average. With respect to the 1953-54 recession in Canadian manufacturing industry, the possible errors in the seasonally adjusted index apparently could not alter the conclusion that the peak quarter was the second quarter of 1953, and that the decline continued into the second quarter of 1954. However, the peak month may possibly have been later than April (shown in the table, page 10, and in the charts as the peak), though it was certainly no later than July. Probably manufacturing output fell off a little more rapidly in the second half of 1953 than the adjusted series shows.

For the adjusted mining index, all the possibilities of error described above are greater than for manufacturing. They might well total as much as 3 per cent in some months. Errors in the adjusted index of electricity and gas production are probably smaller than in mining, but larger than in manufacturing.

In the adjusted index of total industrial production in Canada, which is constructed here by combining the three adjusted sector indexes, the manufacturing component predominates with a base period weight of 75.7 (and a weight of 80.1 in 1953). If maximum possible errors occurred in the same months and in the same direction in all three adjusted component indexes, the total index for such months would probably still be in error by less than 1 1/2 per cent. It seems more likely that the total index, like the manufacturing component, remains generally within a 1 per cent margin of error. And as in the manufacturing index, the peak quarter of 1953 was

undoubtedly the second quarter, and the peak month no later than July, as in the United States. The possibility of errors, however, makes it uncertain whether the 1954 low was reached in the first quarter or the second.

<u>Conclusions</u>

A practical test of any seasonal adjustment is its usefulness in revealing movements which take place for non-seasonal reasons. The adjusted Canadian indexes stand up to this test fairly well. Apparently the purely seasonal variations in Canadian industrial output in recent years have been sufficiently large and sufficiently regular so that their removal, even by short-cut methods, results in adjusted data which are much more easily read as indicators of cyclical developments, as can be seen at once if the results are examined in graphical form. While seasonal patterns may have changed during the 1948-53 period, and presumably are changing still, the changes appear to have been small enough and slow enough to make it fruitful to apply the 1948-53 seasonal factors in analyzing the data for more recent months.

Canada: Indexes of industrial production (1935-39=100), adjusted for seasonal variation

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Total													
1948	195	194	197	194	194	192	195	197	197	200	201	200	196.3
1949	199	198	197	200	199	199	198	201	201	200	200	203	199.6
1950	200	203	202	206	205	212	214	208	218	221	224	225	211.5
1951	226	229	233	228	232	229	226	227	223	224	221	220	226.5
1952	224	224	225	229	231	230	231	234	236	240	243	245	232.9
1953	245	248	250	253	251	249	250	249	249	246	246	245	248.4
1954	242	246	240	241	243	244	242	247	246	248	249p	250p	244.8p
Mining													
1948	111	112	124	126	119	119	122	122	120	125	132	132	122.2
1949	129	136	131	129	127	129	128	132	132	131	137	139	131.7
1950	138	148	147	146	145	143	141	130	146	149	160	152	145.4
1951	159	157	158	152	166	167	162	165	161	167	163	163	161.8
1952	167	162	163	173	181	175	176	173	178	182	177	186	174.7
1953	184	179	178	184	180	185	197	190	192	183	186	188	185.8
1954	192	200	190	192	202	207	217	213	222	225	219	221p	209.2p
Manufactures													
1948	217	215	216	213	213	211	213	215	217	219	219	219	215.5
1949	218	215	215	217	217	216	215	218	218	217	216	219	217.0
1950	216	218	216	221	220	228	232	227	237	239	240	243	228.1
1951	243	247	251	247	248	245	242	242	238	237	233	232	242.1
1952	236	238	239	243	244	243	244	248	249	253	259	259	246.3
1953	259	263	267	268	268	264	264	263	262	261	259	257	263.0
1954	253	256	251	251	251	251	247	254	249	251	253p	253p	251.7p
Electricity and Gas													
1948	165	162	168	162	173	171	172	176	174	171	169	163	168.6
1949	162	163	169	185	180	183	175	179	180	179	180	177	176.1
1950	177	180	179	183	186	195	196	197	197	197	203	204	190.9
1951	206	206	215	210	215	213	216	216	210	220	224	222	214.2
1952	226	225	222	222	222	224	225	231	236	240	236	239	228.8
1953	241	245	243	251	239	236	239	236	240	243	245	245	241.9
1954	240	241	243	248	245	253	252	252	259	269	277	279p	254.6p

p = Preliminary

Note: Four significant digits are shown in the unadjusted indexes published by the Dominion Bureau of Statistics, and hence in the annual figures reproduced here. This degree of accuracy was maintained throughout the calculation of the adjusted series, but the final results have been rounded to the nearest whole percent to avoid giving a misleading impression of the accuracy of the adjustment.