INVESTMENT PATTERNS

AND

COMPETITIVENESS

IN CANADIAN MANUFACTURING

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INTRODUCTION

For some time now, the issue of competitiveness has been an important concern to both business and policy makers. In the 1980's major structural changes occurred in the Canadian economy whose effects are still reverberating through the boardrooms of the business world. The dominance of resource based companies waned, and many branch plant manufacturing operations vanished as globalization and restructuring prompted many multinational companies to consolidate and relocate their international operations. Moreover, the revolution in technology was changing the way business was conducted.

How has Canadian manufacturing emerged out of this upheaval of the 1980's and can it compete in today's world? In this analysis, we start from the premise that industrial competitiveness depends on productivity growth and that to achieve and sustain productivity growth, our economy must continually upgrade itself. This upgrading takes the form of investment in new technology and in efficient production processes.

In Section I, we review the investment patterns of manufacturing industries over the past two decades. In Section II, we develop indicators of competitiveness by industry based on particular aspects of investment behaviour, export performance, spending on research and development and the rate of industrial renewal. In Section III, we compare our rankings with other indicators of performance and consider some of the implications for the high and low performers in Canadian manufacturing. In Section IV, we summarize our findings and offer some conclusions.

I INVESTMENT PATTERNS SINCE THE 1970'S IN CANADIAN MANUFACTURING

As Figures 1 and 2 show, investment expenditures in manufacturing began to increase dramatically in the 1980's. Whereas total investment grew at an average rate of 3.1% a year from 1971 to 1979, from 1979 to 1981, the rate jumped to 24.0%. Although investment declined during the recession of the early 1980's, by 1989 it was again well above the 1981 pre-recession peak. In fact, average growth from 1981 to 1989 was 6.0% a year, nearly twice the rate of the 1970's, in spite of the recession. As the graphs also show, investment grew rapidly between 1984 and 1989 - an average of 14.9% a year - and even though it began to decline at that point as the economy moved into the most recent recession, it has not declined as rapidly as after the 1980's recession. From 1981 to 1984, the average rate of growth was -14.4% whereas from 1989 to 1992 it was -6.2%.

Figure 1.

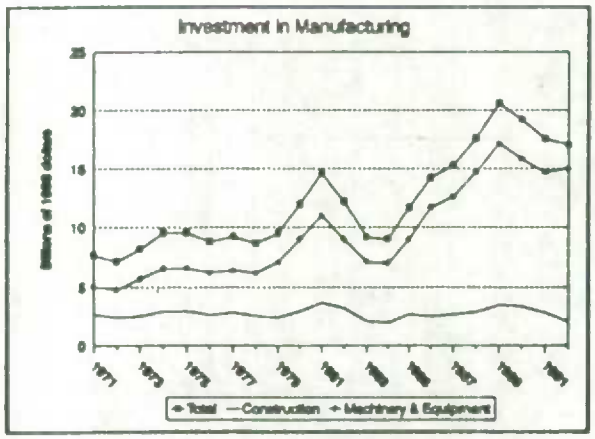
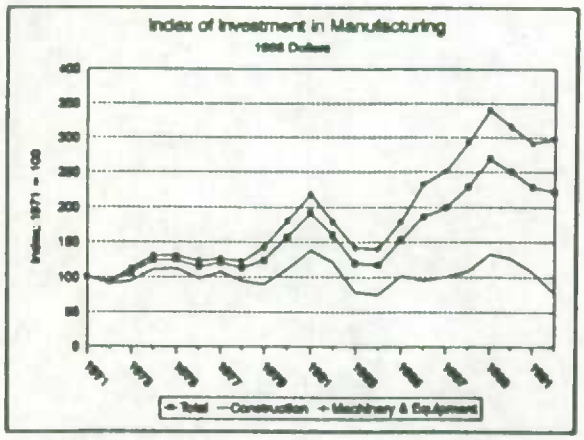
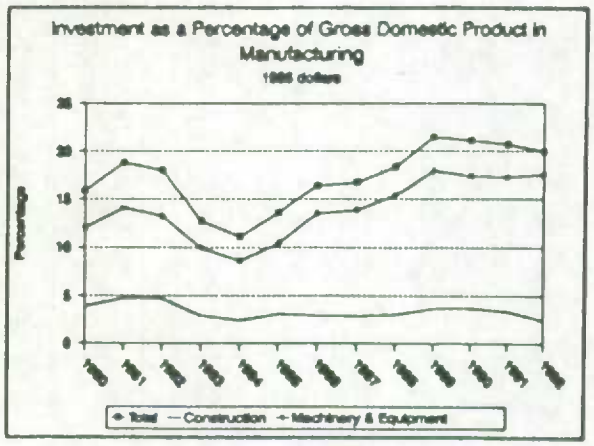


Figure 2.



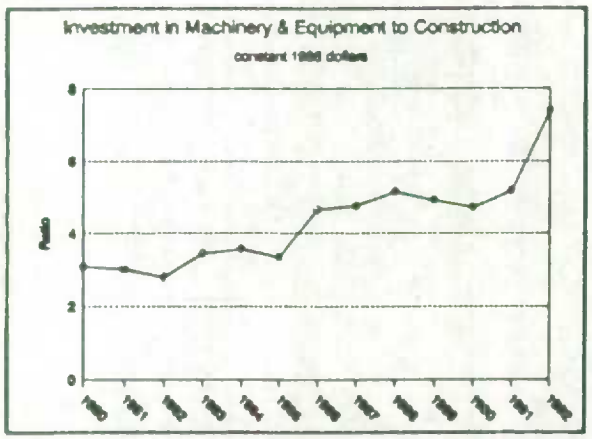
If we now consider investment in relation to gross domestic product (GDP) in manufacturing, we can see from Figure 3 that total investment has grown from 15.9 % of GDP in 1980 to 20.0 % in 1992. Furthermore, although the 1991 level is somewhat lower than the overall peak of 21.5 % in 1989 prior to the most recent recession, it is still higher than the previous peak of 18.8 % recorded in 1981, prior to the 80's recession.

Figure 3



On the whole, then, investment in manufacturing seems quite robust. As an indicator of the Canadian business community's efforts to adapt to changing economic circumstances, however, the composition of capital investment may be as significant as actual levels of investment. As can be seen in Figure 4, since the mid-1980's, there has been a pronounced shift towards spending on machinery and equipment, as opposed to construction, as firms seek to realize productivity gains by modernizing and upgrading plant capacity. The ratio of expenditures on machinery and equipment to those on construction has risen from 3.3 : 1 in 1985 to 7.4 : 1 in 1992.

Figure 4



II DERIVATION OF INDICATORS OF INDUSTRIAL COMPETITIVENESS

Our analysis now turns to an examination of various characteristics of individual industries in manufacturing to try to get a grip on how investment behaviour may be used, in conjunction with other relevant factors, in determining competitiveness. We chose the following series (all in constant 1986 dollars) to use as indicators:

- total investment as a percentage of gross domestic product
- investment in machinery and equipment as a percentage of gross domestic product
- investment in computers as a percentage of investment in machinery and equipment
- investment in computer-assisted processing equipment as a percentage of investment in machinery and equipment
- exports as a percentage of shipments
- expenditures on research and development as a percentage of gross domestic product
- change in age of capital stock[1].

Since data for some of the variables being considered only became available starting in 1985, all the above series cover the period from 1985 to 1991. The following set of bar graphs shows the average over the period for each indicator, per industry in descending order of size. The vertical solid line indicates the overall manufacturing average.

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[1] This is the year-to-year change in the age of assets in the capital stock. As an indicator, therefore, it behaves in an opposite manner to the other measures in that "lower" is considered "better". A negative value indicates that the age of the capital stock is decreasing, which implies efficiency gains for the purchaser since new assets presumably incorporate at least some technological improvement over older assets.

Figure 5.

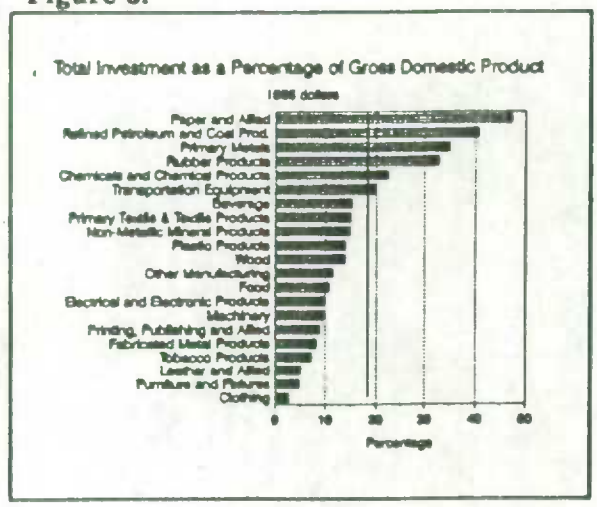


Figure 6.

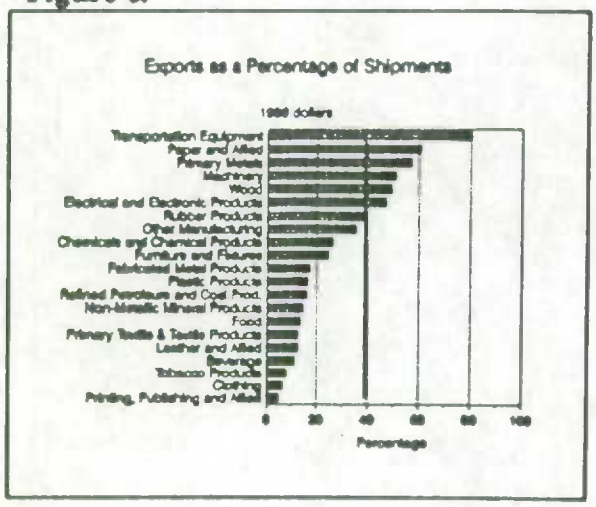
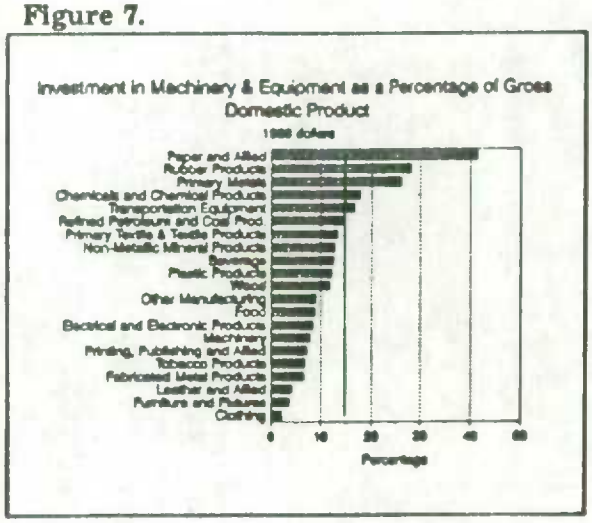


Figure 7.



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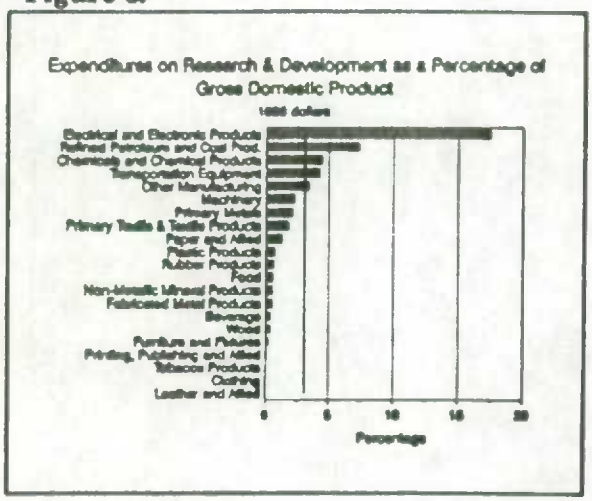


Figure 9.

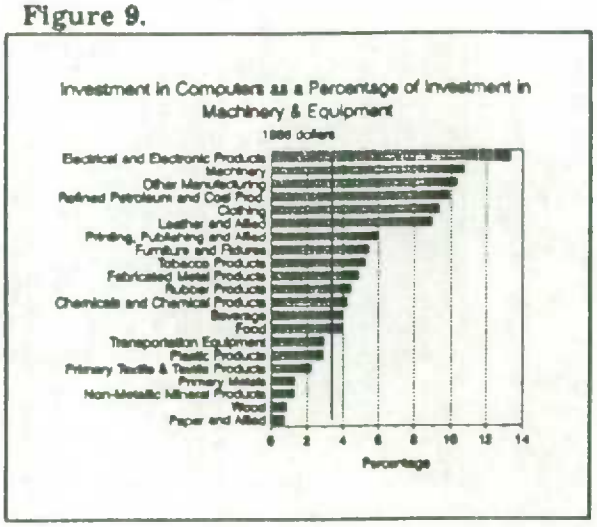


Figure 10.

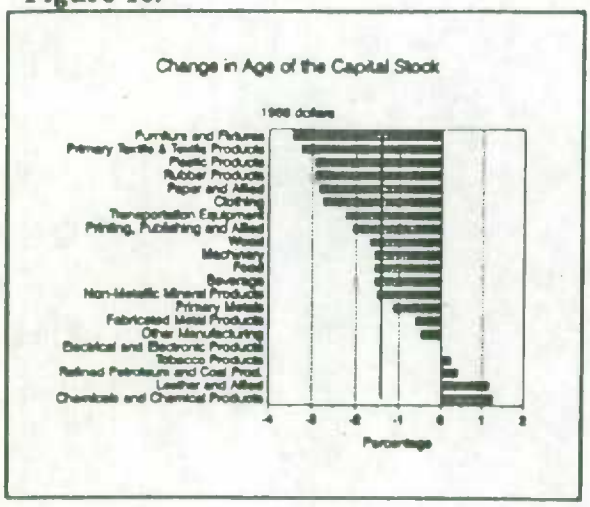
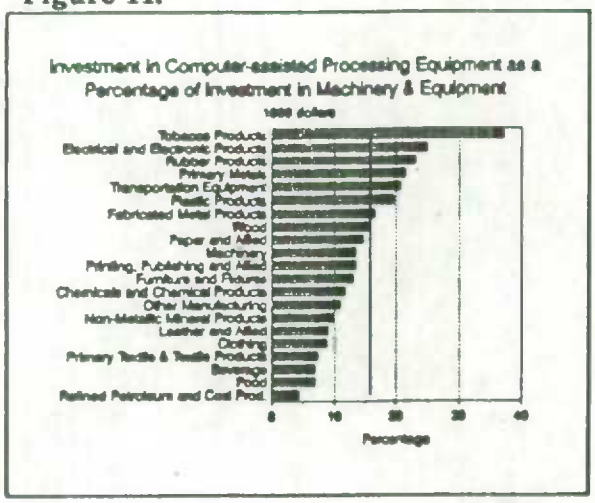


Figure 11.



Each industry's average for each indicator was compared to the manufacturing average for that indicator, and given a qualitative designation: negligible, very low, low, low-medium, high-medium, high or very high (see Table 1). The qualitative designations were assigned points as follows:

negligible	0
very low	25
low	50
low-medium	75

high-medium	150
high	200
very high	250

Calculating the total points for each industry enabled us to produce a ranking of industries which reflects their performance according to all seven indicators combined. Table 2 shows the industries, ranked from highest to lowest, with the points assigned. For an exact description of the criteria used, please see Appendix Table A1.

Table 1.

Qualitative Assessment of Industry Averages								
1980 SIC Major Group Code	Title	Total Investment to Gross Domestic Product	Exports to Shipments	Investment in Machinery & Equipment to Gross Domestic Product	Research & Development Expenditures to Gross Domestic Product	Investment in Computers to Investment in Machinery & Equipment	Investment in Computer-assisted Processing Equipment to Investment in Machinery & Equipment	Change in Age of Capital Stocks
10	Food	LOW	VERY LOW	LOW	NEGLIGIBLE	HIGH-MEDIUM	VERY LOW	HIGH-MEDIUM
11	Beverages	LOW-MEDIUM	VERY LOW	LOW-MEDIUM	NEGLIGIBLE	HIGH-MEDIUM	VERY LOW	HIGH-MEDIUM
12	Tobacco Prod.	VERY LOW	NEGLIGIBLE	VERY LOW	NEGLIGIBLE	HIGH	VERY HIGH	NEGLIGIBLE
15	Rubber Prod.	HIGH	HIGH-MEDIUM	HIGH	NEGLIGIBLE	HIGH-MEDIUM	HIGH-MEDIUM	VERY HIGH
16	Plastic Prod.	LOW-MEDIUM	VERY LOW	LOW-MEDIUM	NEGLIGIBLE	LOW-MEDIUM	HIGH-MEDIUM	VERY HIGH
17	Leather and Allied	VERY LOW	VERY LOW	VERY LOW	NEGLIGIBLE	VERY HIGH	LOW	NEGLIGIBLE
18,19	Primary textile and Textile Prod.	LOW-MEDIUM	VERY LOW	LOW-MEDIUM	LOW	LOW	VERY LOW	VERY HIGH
24	Clothing	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	VERY HIGH	LOW	HIGH
25	Wood	LOW-MEDIUM	HIGH-MEDIUM	LOW-MEDIUM	NEGLIGIBLE	NEGLIGIBLE	LOW-MEDIUM	HIGH-MEDIUM
26	Furniture and Fixtures	VERY LOW	LOW	NEGLIGIBLE	NEGLIGIBLE	HIGH	LOW-MEDIUM	VERY HIGH
27	Paper and Allied	VERY HIGH	HIGH	VERY HIGH	VERY LOW	NEGLIGIBLE	LOW-MEDIUM	VERY HIGH
28	Printing, Publishing and Allied	VERY LOW	NEGLIGIBLE	VERY LOW	NEGLIGIBLE	HIGH	LOW-MEDIUM	HIGH-MEDIUM
29	Primary Metals	HIGH	HIGH-MEDIUM	HIGH	LOW	VERY LOW	HIGH-MEDIUM	LOW-MEDIUM
30	Fabricated Metal Prod.	VERY LOW	VERY LOW	VERY LOW	NEGLIGIBLE	HIGH-MEDIUM	HIGH-MEDIUM	VERY LOW
31	Machinery	LOW	HIGH-MEDIUM	LOW	LOW	VERY HIGH	LOW-MEDIUM	HIGH-MEDIUM
32	Transportation Equipment	HIGH-MEDIUM	VERY HIGH	HIGH-MEDIUM	HIGH-MEDIUM	LOW-MEDIUM	HIGH-MEDIUM	HIGH
33	Electrical and Electronic Prod.	LOW	HIGH-MEDIUM	LOW	VERY HIGH	VERY HIGH	HIGH	NEGLIGIBLE
35	Non-metallic Mineral Prod.	LOW-MEDIUM	VERY LOW	LOW-MEDIUM	NEGLIGIBLE	VERY LOW	LOW	HIGH-MEDIUM
36	Refined Petroleum and Coal Prod.	VERY HIGH	VERY LOW	LOW-MEDIUM	VERY HIGH	VERY HIGH	VERY LOW	NEGLIGIBLE
37	Chemicals and Chemical Prod.	HIGH-MEDIUM	LOW	HIGH-MEDIUM	HIGH-MEDIUM	HIGH-MEDIUM	LOW	NEGLIGIBLE
39	Other Manufacturing	LOW	LOW-MEDIUM	LOW	HIGH-MEDIUM	VERY HIGH	LOW	VERY LOW

Table 2.

Industry Rankings After Assigning Points
(Descending Order of Total Points)

1980 SIC Major Group Code	Title	Total Investment to Gross Domestic Product	Exports to Shipments	Investment in Machinery & Equipment to Gross Domestic Product	Research & Development Expenditures to Gross Domestic Product	Investment in Computers to Investment in Machinery & Equipment	Investment in Computer-assisted Processing Equipment to Investment in Machinery & Equipment	Change in Age of Capital Stocks	Total Points
32	Transportation Equipment	150	250	150	150	75	150	200	1125
15	Rubber Products	200	150	200	0	150	150	250	1100
27	Paper and Allied	250	200	250	25	0	75	250	1050
33	Electrical and Electronic Products	50	150	50	250	250	200	0	950
36	Refined Petroleum and Coal Prod.	250	25	75	250	250	25	0	875
29	Primary Metals	200	150	200	50	25	150	75	850
31	Machinery	50	150	50	50	250	75	150	775
37	Chemicals and Chemical Products	150	50	150	150	150	50	0	700
16	Plastic Products	75	25	75	0	75	150	250	650
39	Other Manufacturing	50	75	50	150	250	50	25	650
26	Furniture and Fixtures	25	50	0	0	200	75	250	600
18,19	Primary Textile & Textile Products	75	25	75	50	50	25	250	550
25	Wood	75	150	75	0	0	75	150	525
12	Tobacco Products	25	0	25	0	200	250	0	500
11	Beverage	75	25	75	0	150	25	150	500
24	Clothing	0	0	0	0	250	50	200	500
28	Printing, Publishing and Allied	25	0	25	0	200	75	150	475
10	Food	50	25	50	0	150	25	150	450
30	Fabricated Metal Products	25	25	25	0	150	150	25	400
35	Non-Metallic Mineral Products	75	25	75	0	25	50	150	400
17	Leather and Allied	25	25	25	0	250	50	0	375

III APPLICATION OF INDICATORS OF INDUSTRIAL COMPETITIVENESS

We compared our ranking of industries with one based on the use of advanced technology and with another based on total factor productivity. We felt that this was an appropriate choice since there is an assumed causal relationship among investment, use of technology and total factor productivity. Since total factor productivity measures output per unit of all factors of production (labour, capital, materials and services used as inputs in the production of goods), it reflects the joint effects of economies of scale, technical progress and other effects not directly measurable. Investment in machinery and equipment is another key indicator of technical change in that new technologies are embedded in new capital investment.

The 1989 Survey of Manufacturing Technologies recognizes that the contribution of technology to economic growth does not depend only upon the development of new products and processes but also on their use. Some of the highlights of the survey were:

- 88% of Canadian manufacturing shipments were made by establishments using at least one of the 22 technologies surveyed.

- Three of the five most used technologies form part of the communication and control group.

- The rate of use of at least one technology is highest in the transportation equipment industry.

- Firms in manufacturing which are large exporters use technology in a greater proportion than the manufacturing industry as a whole.

Table 3 shows the comparison of the three systems of ranking. The group of top ten industries according to the competitiveness indicators have been shaded for all three. This approach to assessing competitiveness appears to be supported by the other two measures, since eight of the top ten according to "the use of at least one technology", and seven of the top ten according to "total factor productivity" belong to the group.

According to our analysis, most of the top industries are producers of high technology outputs. This seems to indicate a significant shift away from traditional areas of activity in Canadian manufacturing.

Table 3.

Alternative Rankings of Industries					
Competitiveness Indicators		Use of at Least One Technology		Total Factor Productivity	
Rank	Industry	Rank	Industry	Rank	Industry
1	Transportation Equipment	1	Transportation Equipment	1	Refined Petroleum and Coal Products
2	Rubber Products	2	Rubber Products	2	Transportation Equipment
3	Paper and Allied	3	Primary Metals	3	Plastic Products
4	Electrical and Electronic Products	3	Electrical and Electronic Products	4	Electrical and Electronic Products
5	Refined Petroleum and Coal Products	5	Beverages	5	Primary Textiles and Textile Products
6	Primary Metals	5	Chemicals and Chemical Products	6	Chemicals and Chemical Products
7	Machinery	7	Machinery	7	Wood
8	Chemicals and Chemical Products	8	Refined Petroleum and Coal Products	8	Rubber
9	Plastic Products	9	Paper and Allied	9	Fabricated Metal Products
9	Other Manufacturing	10	Non-metallic Minerals	10	Primary Metals
11	Furniture and Fixtures	11	Primary Textiles	11	Non-metallic Minerals
12	Primary Textiles and Textile Products	12	Plastic Products	12	Tobacco
13	Wood	13	Food	13	Machinery
14	Tobacco Products	14	Tobacco	14	Beverages
14	Beverages	15	Wood	15	Food
14	Clothing	15	Fabricated Metal Products	16	Printing, Publishing and Allied
17	Printing, Publishing and Allied	17	Printing, Publishing and Allied	17	Other Manufacturing
18	Food	18	Clothing	18	Furniture and Fixtures
19	Fabricated Metal Products	18	Other Manufacturing	19	Paper and Allied
19	Non-metallic Mineral Products	20	Furniture and Fixtures		
21	Leather and Allied	21	Textile Products		
		22	Leather and Allied		

Characteristics of Higher and Lower Ranking Industries

If we divide the industries into those belonging to the top ten in terms of the competitiveness indicators, and the remaining industries, some interesting differences become apparent. Table 4 shows employment and gross domestic product for the two groups, and Figures 12 and 13 plot the indexes for the same series.

Table 4.

Employment and Gross Domestic Product at Factor Cost
Higher vs Lower Ranking Industries

	Employment				Gross Domestic Product			
	Ten Highest Ranking Industries		Lower Ranking Industries		Ten Highest Ranking Industries		Lower Ranking Industries	
Years	Thousands of Persons	Index (1985 = 100)	Thousands of Persons	Index (1985 = 100)	Millions of 1986 Dollars	Index (1985 = 100)	Millions of 1986 Dollars	Index (1985 = 100)
1985	996.6	100.00	963.3	100.00	48,056.7	100.00	38,185.6	100.00
1986	967.2	97.05	1,021.5	106.04	47,996.2	99.87	38,793.1	101.59
1987	987.5	99.09	1,031.0	107.03	50,555.7	105.20	40,411.7	105.83
1988	1,058.2	106.18	1,044.7	108.45	54,751.9	113.93	40,847.6	106.97
1989	1,077.4	108.11	1,048.7	108.87	55,211.6	114.89	40,578.3	106.27
1990	1,017.9	102.14	982.6	102.00	52,719.5	109.70	38,187.6	100.01
1991	951.0	95.42	909.9	94.46	50,121.9	104.30	34,767.1	91.05

Figure 12.

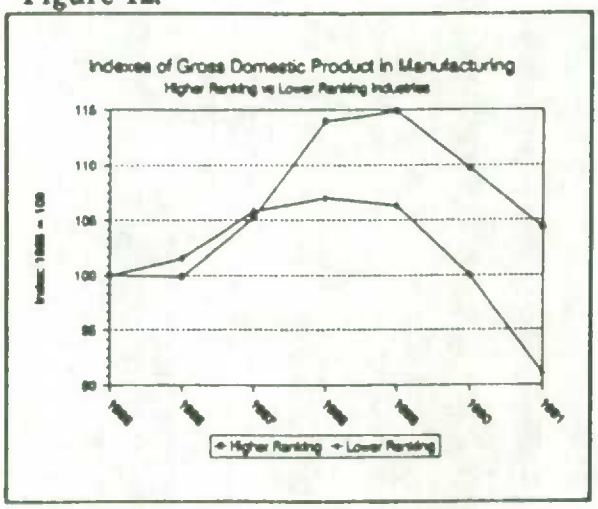
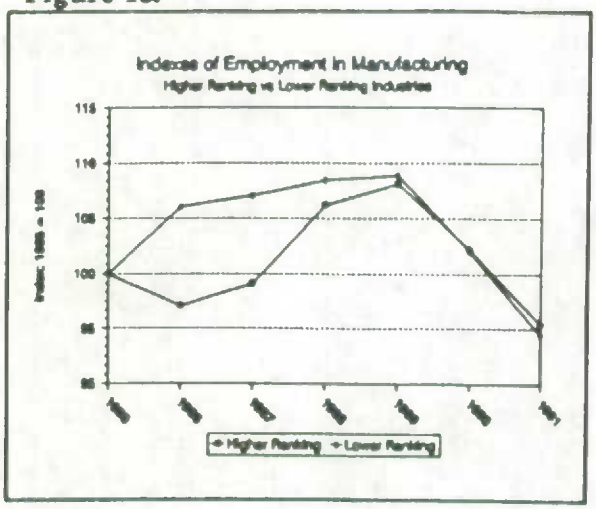


Figure 13.



As can be seen from Figure 12, the level of gross domestic product reached by 1989 by the higher-ranking group was much higher and did not drop off as steeply. In other words, the two groups responded differently to the most recent recession. On the other hand, Figure 13 shows that the employment indexes for both groups also grew until 1989 and then declined, but the index of the lower-ranking group was above that of the higher-ranking for almost all of the period - the higher-ranking group was more productive. To give a clearer picture of the performance of each group, Figures 14 and 15 show the employment and gross domestic product indexes plotted on the same graph. It is very evident that the output of the higher-ranking group is increasing relative to employment, whereas employment has grown more than output in the lower-ranking group.

Figure 14.

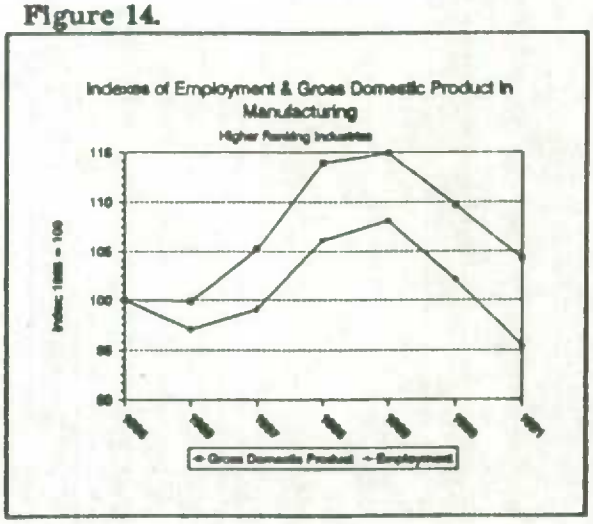
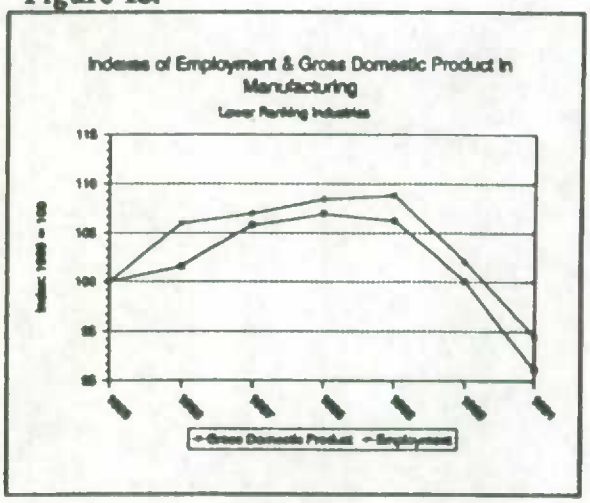


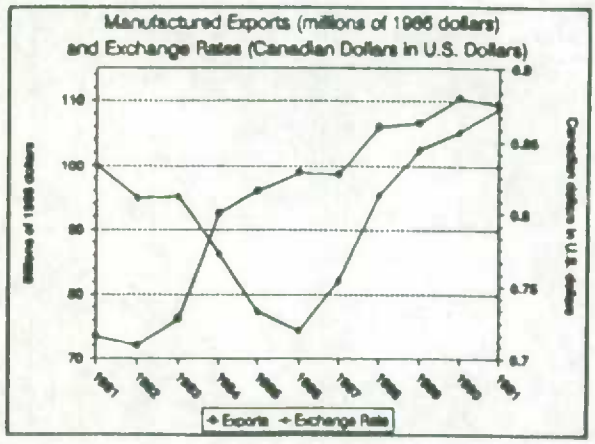
Figure 15.



Export Performance of Canadian Manufacturing

If the recent surge in investment did make Canadian firms more competitive, then we should see a robust export picture also. From Figure 16, we can see that, indeed, exports have been climbing quite dramatically from 1981 to 1991. This growth is even more striking when we consider that the exchange rate was also rising steadily between 1986 and 1991.

Figure 16



Our group of ten most competitive industries accounted for over 80% of manufactured exports from 1981 to 1991. Our analysis shows too, that in most cases, industries with strong investment patterns also had high export performance.

IV CONCLUSIONS

The change in the composition of investment reflects fundamental structural changes in the manufacturing sector. The surge in spending on machinery and equipment which presumably embodied new technology has very positive implications for Canada's productive capacity and future competitive position. Canadian manufacturing appears to have positioned itself to meet the competitive challenges of FTA and NAFTA. Technological innovation coupled with low inflation could form the basis for robust growth in the future.

The only grey area is the labour market where unemployment in mamufacturing averaged 12.6 % in 1992. However, as consumers and business overcome their current hesitancy to spend, the employment picture might improve considerably.

Since competitiveness is so crucial in today's globalized economy, it is important to try to find measures which enable us to assess Canada's position. We feel that the competitiveness indicators discussed in this paper provide a reliable and straightforward approach to assessing which manufacturing industries are among the most competitive in Canada. Further research is underway to try to assess how our industries are faring on an international level.

APPENDIX

Table A1.

Method of Ranking Industries							
Indicator Average for Industry i = m_i							
Overall Indicator Average for Manufacturing = m							
Indicator	**Ranking Criteria and Points Assigned** (Note: "Change in Age of Capital Stock" is an exception)						
	Negligible (0 Points)	**Very Low (25 Points)**	**Low (50 Points)**	**Low-medium (75 Points)**	**High-medium (150 Points)**	**High (200 Points)**	**Very High (250 Points)**
	$m_i \le m/4$	$m/4 < m_i \le m/2$	$m/2 < m_i \le 3m/4$	$3m/4 < m_i \le m$	$m < m_i \le 3m/2$	$3m/2 < m_i \le 2m$	$m_i > 2m$
Total investment to Gross Domestic Product	$m_i \le 4.60$	$4.60 < m_i \le 9.21$	$9.21 < m_i \le 13.82$	$13.82 < m_i \le 18.42$	$18.42 < m_i \le 27.63$	$27.63 < m_i \le 36.84$	$m_i > 36.84$
Exports to Shipments	$m_i \le 9.76$	$9.76 < m_i \le 19.53$	$19.53 < m_i \le 29.30$	$29.30 < m_i \le 39.06$	$39.06 < m_i \le 58.59$	$58.59 < m_i \le 78.12$	$m_i > 78.12$
Investment in Machinery & Equipment to Gross Domestic Product	$m_i \le 3.70$	$3.70 < m_i \le 7.40$	$7.40 < m_i \le 11.10$	$11.10 < m_i \le 14.80$	$14.80 < m_i \le 22.20$	$22.20 < m_i \le 29.60$	$m_i > 29.60$
Research & Development Expenditures to Gross Domestic Product	$m_i \le 0.78$	$0.78 < m_i \le 1.56$	$1.56 < m_i \le 2.35$	$2.35 < m_i \le 3.13$	$3.13 < m_i \le 4.70$	$4.70 < m_i \le 6.26$	$m_i > 6.26$
Investment in Computers to Investment in Machinery & Equipment	$m_i \le 0.85$	$0.85 < m_i \le 1.70$	$1.70 < m_i \le 2.54$	$2.54 < m_i \le 3.39$	$3.39 < m_i \le 5.08$	$5.08 < m_i \le 6.78$	$m_i > 6.78$
Investment in Computer-assisted Processing Equipment to Investment in Machinery & Equipment	$m_i \le 3.96$	$3.96 < m_i \le 7.92$	$7.92 < m_i \le 11.88$	$11.88 < m_i \le 15.84$	$15.84 < m_i \le 23.76$	$23.76 < m_i \le 31.68$	$m_i > 31.68$
Change in Age of Capital Stock	$m_i \ge m/4$ $m_i \ge (0.35)$	$m/2 \le m_i < m/4$ $(0.70) \le m_i < (0.35)$	$3m/4 \le m_i < m/2$ $(1.06) \le m_i < (0.70)$	$m \le m_i < 3m/4$ $(1.41) \le m_i < (1.06)$	$3m/2 \le m_i < m$ $(2.12) \le m_i < (1.41)$	$2m \le m_i < 3m/2$ $(2.82) \le m_i < (2.12)$	$m_i < 2m$ $m_i < (2.82)$