

Preliminary
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Comparative Economic Impacts of
Improved Labour Productivity in Three Sectors

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What are the effects on the Canadian economy of an improvement in labour productivity? How does this differ across sectors? Three cases presented in this paper compare the effects of productivity improvements in the primary, secondary, and tertiary sectors. The results are expected to vary between the three because of different price behaviors and transmission mechanisms. For example, the primary and, to some extent, the secondary sector rely on export markets in which Canada is primarily a price taker, not a price setter.

In each case, (primary, secondary, and tertiary), we have increased labour productivity growth one percentage point per year relative to the Base Case by lowering employment requirements. Informetrica's Post Workshop I-84 forecast, produced in June 1984 using The Informetrica Model (TIM), was used as the Base Case. In defining our three impact cases, no special assumptions were made regarding capital-labour ratios, there was no special industry investment, nor were there increases in government spending on research and development, or education, to facilitate the more rapid growth of productivity. Further, we have assumed no policies were invoked to deal with the short-term negative effects on employment. In essence, the increase in productivity is assumed to occur without any investment. Alternatively, the exercise can be thought of as a deus ex machina increase in the rate of technical change by one percentage point per year.

The cumulative reduction in employment required to produce the productivity increases for the three cases, over 1985 to 1994 in thousands of person years, is: 359 in the primary

Table 1
Direct Changes in Employment Necessary to
Achieve One Per Cent Increase in Productivity
(Thousands)

Primary Case	1985	1986	1987	1988	1989	...	1994
<u>Total</u>	-6.4	-13.0	-19.3	-25.8	-32.3		-66.4
Agriculture	-4.8	-9.7	-14.6	-19.5	-24.3		-49.3
Forestry	-0.8	-1.5	-2.2	-2.9	-3.5		-7.1
Fishing	-0.3	-0.6	-1.0	-1.3	-1.7		-3.5
Metal Mining	-0.5	-1.1	-1.6	-2.2	-2.8		-6.4
<u>Manufacturing Case</u>							
<u>Total</u>	-19.8	-40.0	-60.0	-80.6	-101.6		-212.5
Non-durables	-10.2	-20.8	-31.6	-42.7	-53.9		-110.1
Durables	-9.6	-19.2	-28.4	-37.9	-47.7		-102.4
<u>Services Case</u>							
<u>Total</u>	-51.5	-105.9	-160.7	-217.2	-274.8		-577.1
Transportation	-4.9	-10.1	-15.3	-20.9	-26.9		-59.7
Air	-0.5	-1.0	-1.6	-2.2	-2.8		-6.2
Rail	-0.7	-1.5	-2.2	-3.0	-3.8		-9.0
Pipeline	-0.1	-0.2	-0.2	-0.4	-0.4		-0.8
Urban	-0.7	-1.5	-2.4	-3.3	-4.2		-9.7
Water	-0.3	-0.6	-0.9	-1.2	-1.5		-3.0
Motor	-2.6	-5.2	-8.0	-10.9	-14.1		-30.9
Storage	-0.1	-0.3	-0.4	-0.5	-0.6		-1.2
Communication	-2.6	-5.2	-7.7	-10.4	-13.1		-27.4
Trade	-18.9	-38.5	-58.0	-77.7	-97.4		-193.0
Finance	-6.3	-12.8	-19.6	-26.6	-33.8		-70.3
Commercial Services	-18.7	-39.2	-59.5	-81.0	-102.9		-225.5
Non-Profit	-0.6	-1.3	-1.9	-2.5	-3.1		-6.5
Amusement	-1.5	-3.2	-4.9	-6.8	-8.7		-19.5
Business	-4.9	-10.0	-15.5	-20.8	-26.3		-56.2
Private household	-1.5	-3.0	-4.6	-6.1	-7.8		-16.8
Other personal	-10.2	-21.7	-32.7	-44.8	-56.9		-126.4

sector; 1134 in the manufacturing sector; and 3077 in the service sector. Table 1 details the direct changes required in these cases.

In all cases, increased labour productivity results in a larger economy. Gross National Product and all its components are larger in the long term. Only in the primary case are there negative short term effects; business investment is slightly lower in the first two years and import expansion marginally exceeds export expansion in the first seven years, leading to a decline in net exports. Real disposable income is higher for all years in all cases reflecting the fact that labour gains some part of the productivity gains and that inflation is reduced. Improving labour productivity lowers unit labour costs and, thereby, lowers industry prices.

Lower employment is one of two major negative impacts on the economy. This can be attributed partially to our methodology. Direct employment losses were the means for achieving increased labour productivity rather than through increased spending. Even so, because of a resulting larger economy, the direct losses are offset to some extent by increases in employment in other sectors of the economy, in response to higher final demand.

The second major negative impact on the economy is a weaker government financial position. The government balance deteriorates as unemployment insurance benefits rise in response to the larger number of people unemployed, and together with other rising expenses, offset increases in government revenue.

Table 2
Change in Real and Current Dollar Indicators
(Primary Case)

	1	2	3	4	5	...	10
(Millions of 1971 Dollars)							
Gross National Product	9.9	23.3	36.6	51.5	69.4	173.6	
Consumption	9.4	12.4	13.5	16.8	25.4	53.4	
Business Investment	-0.4	-0.9	-0.5	0.5	2.0	3.7	
Change in Inventory	2.1	2.3	3.1	4.8	5.9	9.1	
Government Expenditure	2.7	8.6	14.7	20.8	26.6	61.9	
Net Exports	-3.0	-3.5	-2.4	-2.4	4.3	17.5	
Exports of Goods	0.4	1.3	2.5	4.3	6.2	24.2	
Exports of Services	0.0	0.0	0.1	0.2	0.4	1.7	
Imports of Goods	3.1	1.8	0.5	0.2	0.5	-20.8	
Imports of Services	1.6	2.9	4.2	6.8	10.7	29.5	
Real Disposable Income	16.7	17.3	14.8	18.2	30.1	53.1	
Real Domestic Product	7.4	20.7	33.8	51.2	69.8	186.6	
Employment (in thousands)	-5.9	-11.5	-16.9	-22.3	-27.3	-51.8	
(Millions of Current Dollars)							
Current Account Balance	-19.1	-27.3	-36.0	-59.5	-90.1	-190.2	
Government Balance	-65.8	-97.3	-120.2	-166.6	-246.8	-676.8	
Government Revenue	23.8	109.6	205.6	286.4	352.6	753.6	
Government Expenditure	89.5	208.3	329.3	459.1	608.8	1465.7	

Table 3
Change in Real and Current Dollar Indicators
(Manufacturing Case)

	1	2	3	4	5	...	10
(Millions of 1971 Dollars)							
Gross National Product	170.4	287.2	430.1	606.0	824.1		2242.2
Consumption	55.6	99.8	141.6	190.5	254.9		568.7
Business Investment	8.1	26.6	42.7	59.9	76.3		200.6
Change in Inventory	43.1	46.1	50.5	61.9	73.3		112.9
Government Expenditure	6.6	21.9	40.0	60.0	80.5		224.0
Net Exports	56.1	80.0	131.0	198.4	291.9		1034.0
Exports of Goods	60.2	63.1	77.4	92.6	115.2		308.2
Exports of Services	0.7	0.0	-0.8	-1.2	-0.9		7.9
Imports of Goods	2.1	-20.5	-55.8	-103.8	-163.8		-560.1
Imports of Services	3.4	4.5	2.0	-3.2	-13.6		-157.1
Real Disposable Income	97.7	147.5	188.6	243.7	324.0		691.0
Real Domestic Product	154.1	260.0	388.3	546.9	738.0		1946.9
Employment (in thousands)	-14.1	-27.4	-39.2	-49.9	-58.9		-89.2
(Millions of Current Dollars)							
Current Account Balance	101.4	149.3	267.2	435.5	690.4		3331.3
Government Balance	-109.0	-124.5	-83.6	-890.0	-141.6		137.5
Government Revenue	163.5	498.4	863.6	1171.4	1382.4		2325.7
Government Expenditure	274.3	631.4	965.2	1290.3	1568.0		2324.8

Table 4
Change in Real and Current Dollar Indicators
(Services Case)

	1	2	3	4	5	...	10
(Millions of 1971 Dollars)							
Gross National Product	97.3	223.1	372.3	541.9	757.0		2080.3
Consumption	67.7	85.2	91.6	107.5	159.5		346.2
Business Investment	-11.4	-10.8	-4.8	0.4	8.5		46.4
Change in Inventory	26.6	31.3	43.1	52.8	66.2		97.7
Government Expenditure	21.9	67.8	117.9	169.1	222.1		535.6
Net Exports	-11.2	20.8	71.6	139.3	207.9		864.4
Exports of Goods	9.2	23.4	45.0	72.2	106.0		359.8
Exports of Services	2.8	6.5	11.5	17.5	24.0		65.4
Imports of Goods	20.5	10.6	-4.7	-25.0	-41.0		-267.9
Imports of Services	2.3	-3.0	-13.0	-26.0	-37.4		-173.2
Real Disposable Income	131.6	130.7	124.3	153.8	251.0		568.9
Real Domestic Product	92.7	225.6	381.6	551.7	759.2		2006.1
Employment (in thousands)	-46.9	-93.5	-138.5	-183.2	-226.3		-432.9
(Millions of Current Dollars)							
Current Account Balance	-68.2	-19.7	84.4	209.6	330.6		2320.9
Government Balance	-495.3	-702.7	-877.2	-1189.9	-1664.1		-3791.6
Government Revenue	34.3	470.6	914.0	1254.8	1472.3		2884.8
Government Expenditure	528.8	1178.0	1804.2	2468.4	3172.8		6791.8

Tables 2, 3 and 4 detail the impact on major indicators for the three cases. The scale of the shock is different in each case because of the different sizes of the sectors, and as a result, employment losses necessary to bring about a one percentage increase in productivity differ across sectors. For example, over the 1985-1994 period, employment must be lowered by 3077 thousand in the service sector to bring about a one percentage point increase in productivity growth in this sector compared to a drop of 359 thousand in the primary sector to bring about the same percentage increase in productivity. Tables 5, 6 and 7 compare the three cases on an equal scale, which is per 1000 change in employment. For an equal loss in employment the effects on the economy can be measured.

Looking first at Tables 2, 3 and 4, the primary sector has the smallest impact due to the scale of the shock and to the transmission mechanism. Productivity was improved in agriculture, forestry, fishing, and metal mining. These sectors total a relatively small share of output, and therefore do not have a major impact on the economy. In addition, a large portion of these products are exported. In markets in which Canada is not a price taker, foreigners share in the benefits of lower prices resulting from lower costs, and increase their purchases of Canadian products. When Canada is a price taker in the export market, the volume of exports should not change and the productivity gain may be either passed onto the wage earner or kept by the corporation in the form of higher profits. Comparing the primary sector with the others on a per 1000 change in employment (Tables 5, 6 and 7), it

Table 5
 Change in Real and Current Dollar Indicators
 per 1000 change in Employment
 (Primary Case)

	1	2	3	4	5	...	10
(Millions of 1971 Dollars)							
Gross National Product	1.5	1.8	1.9	2.0	2.2		2.6
Consumption	1.5	1.0	0.7	0.6	0.8		0.8
Business Investment	-0.1	-0.1	0.0	0.0	0.1		0.1
Change in Inventory	0.3	0.2	0.2	0.2	0.2		0.1
Government Expenditure	0.4	0.7	0.8	0.8	0.8		1.0
Net Exports	-0.5	-0.3	-0.1	-0.1	-0.1		0.3
Exports of Goods	0.1	0.1	0.1	0.2	0.2		0.4
Exports of Services	0.0	0.0	0.0	0.0	0.0		0.0
Imports of Goods	0.5	0.1	0.0	0.0	0.0		-0.3
Imports of Services	0.2	0.2	0.2	0.3	0.3		0.4
Real Disposable Income	2.6	1.3	0.8	0.7	0.9		0.8
Real Domestic Product	1.1	1.6	1.8	2.0	2.2		2.8
Employment (in thousands)	-0.9	-0.9	-0.9	-0.9	-0.9		-0.8
(Millions of Current Dollars)							
Current Account Balance	-3.0	-2.1	-1.9	-2.3	-2.8		-2.8
Government Balance	-10.3	-7.5	-6.2	-6.5	-7.6		-10.2
Government Revenue	3.7	8.4	10.7	11.1	10.9		11.3
Government Expenditure	14.0	16.0	17.3	18.0	18.9		22.1

Table 6
 Change in Real and Current Dollar Indicators
 per 1000 change in Employment
 (Manufacturing Case)

	1	2	3	4	5	...	10
(Millions of 1971 Dollars)							
Gross National Product	8.6	7.2	7.2	7.5	8.1		10.6
Consumption	2.8	2.5	2.4	2.4	2.5		2.7
Business Investment	0.4	0.7	0.7	0.7	0.7		0.9
Change in Inventory	2.2	1.2	0.8	0.8	0.7		0.5
Government Expenditure	0.3	0.5	0.7	0.7	0.8		1.1
Net Exports	2.8	2.0	2.2	2.5	2.8		4.9
Exports of Goods	3.0	1.6	1.3	1.2	1.1		1.5
Exports of Services	0.0	0.0	0.0	0.0	0.0		0.0
Imports of Goods	0.1	-0.5	-0.9	-1.3	-1.6		-2.6
Imports of Services	0.2	0.1	0.0	0.0	-0.1		-0.7
Real Disposable Income	4.9	3.7	3.1	3.0	3.2		3.3
Real Domestic Product	7.8	6.5	6.5	6.8	7.3		9.2
Employment (in thousands)	-0.7	-0.7	-0.7	-0.6	-0.6		-0.4
(Millions of Current Dollars)							
Current Account Balance	5.2	3.7	4.5	5.4	6.8		15.7
Government Balance	-5.5	-3.1	-1.4	-1.1	-1.4		0.6
Government Revenue	8.3	12.5	14.4	14.5	13.6		10.9
Government Expenditure	13.9	15.8	16.1	16.0	15.4		10.9

Table 7
Change in Real and Current Dollar Indicators
per 1000 change in Employment
(Services Case)

	1	2	3	4	5	...	10
(Millions of 1971 Dollars)							
Gross National Product	1.9	2.1	2.3	2.5	2.8		3.6
Consumption	1.3	0.8	0.6	0.5	0.6		0.6
Business Investment	-0.2	-0.1	0.0	0.0	0.0		0.1
Change in Inventory	0.5	0.3	0.3	0.3	0.2		0.2
Government Expenditure	0.4	0.6	0.7	0.8	0.8		0.9
Net Exports	-0.2	0.2	0.4	0.6	0.8		1.5
Exports of Goods	0.2	0.2	0.3	0.3	0.4		0.6
Exports of Services	0.1	0.1	0.1	0.1	0.1		0.1
Imports of Goods	0.4	0.1	0.0	-0.1	-0.1		-0.5
Imports of Services	0.0	0.0	-0.1	-0.1	-0.1		-0.3
Real Disposable Income							
Real Domestic Product	1.8	2.1	2.4	2.5	2.8		3.5
Employment (in thousands)	-0.9	-0.9	-0.9	-0.8	-0.8		-0.8
(Millions of Current Dollars)							
Current Account Balance	-1.3	-0.2	0.5	1.0	1.2		4.0
Government Balance	-9.6	-6.6	-5.4	-5.5	-6.1		-6.6
Government Revenue	0.7	4.4	5.7	5.8	5.4		5.0
Government Expenditure	10.3	11.1	11.2	11.4	11.6		11.8

has the lowest impact on GNP. For each 1000 decline in employment in the primary sector in 1994 for example, GNP increases \$2.6 million. Total employment declines 800 as increases in employment in other sectors offsets the decline in the primary sector by 200.

Productivity gains in the manufacturing sector have the biggest impact on the economy. The decline in employment in manufacturing is much smaller than the decline necessary in the service sector yet the impact on GNP is larger in the manufacturing sector. On a per 1000 change in employment, the manufacturing case produces \$10.6 million higher GNP compared to the service sectors \$3.6 million increase.

The major impetus in this sector is the increase in exports of manufactured goods. Lower unit labour costs and resulting lower prices make Canadian goods more competitive. The volume of exports increases and the volume of imports drops and pushes up demand for output. Real disposable income rises and pushes up demand for domestic consumption.

In this case, real disposable income is up three times relative to the services case. Employment gains in other sectors in the manufacturing case almost offset the direct employment loss required to increase productivity. For 1000 jobs lost in employment in manufacturing, total employment only declines 400 in 1994. In the services case, total employment is lower by 800 in 1994 with a 1000 jobs lost in the service sector.

The government balance is actually strengthened by the end of the ten years in the manufacturing case as employment losses are not as great as in the other cases, reducing U.I.B., and a larger economy produces a larger tax base.

In summary, our model transmits price effects differently for each sector, but in all instances, a major beneficiary is corporate profits. If the productivity benefit were transmitted with more force to the consumer (through reduced final demand prices) then the positive benefits on demand, output, and employment would likely be much higher than reported here. As well, the impact on business investment could be larger increasing the impact and further enhancing productivity gains.

Finally, no changes were made to nominal interest rates or the exchange rate. With a lower price level in all cases there would be some room for exchange appreciation and/or lower nominal interest rates. In the next version of this paper some of the issues will be addressed.

Table 8
Changes in Inflation Indicators
(per cent deviation from Base Case)

	1	2	3	4	5	...	10
<u>Primary Case</u>							
GNP Deflator	-.003	-.008	-.015	-.025	-.037		-.123
CPI	-.001	-.003	-.006	-.013	-.020		-.075
Wage Rate	+.004	.088	.126	.159	.185		.253
Labour Productivity	.058	.117	.172	.228	.280		.524
Private Unit Labour Costs	-.016	-.036	-.057	-.082	-.112		-.305
<u>Manufacturing Case</u>							
GNP Deflator	-.015	-.024	-.056	-.117	-.214		-.929
CPI	-.028	-.058	-.099	-.158	-.241		-.862
Wage Rate	.133	.268	.368	.421	.417		0.001
Labour Productivity	.247	.442	.632	.828	1.026		1.934
Private Unit Labour Costs	-.142	-.224	-.337	-.502	-.726		-2.145
<u>Services</u>							
GNP Deflator	-.125	-.294	-.496	-.737	-1.011		-2.468
CPI	-.146	-.330	-.543	-.787	-1.061		-2.521
Wage Rate	.219	.383	.494	.554	.560		.257
Labour Productivity	.494	1.003	1.502	1.996	2.488		4.806
Private Unit Labour Costs	-.324	-.724	-1.162	-1.638	-2.161		-4.875