Capital Investment Comparison – Ontario vs. US

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This paper describes the methodology used in the Institute for Competitiveness & Prosperity's Second Annual Report to estimate the impact on Ontario's GDP per capita due to capital under investment versus the US.

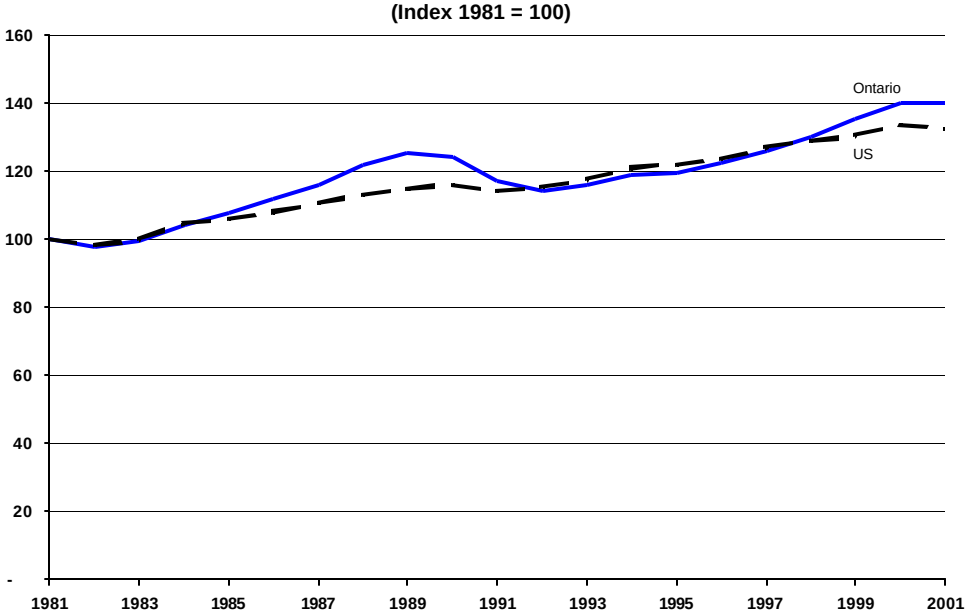
Capital Investment and its Relationship to GDP

GDP growth is considered to be driven by three main factors: growth in labour, growth in capital, and growth in multifactor productivity. Labour growth is measured in change in total labour hours, capital growth is measured in change in total capital stock (net of depreciation), and growth in multifactor productivity (MFP)[1]. Labour growth is weighted by its share of total growth (usually the share of labour compensation in total income) while capital growth is weighted by the balance. This can be shown as follows:

Growth in GDP = (**Growth in Labour Hours** x **Labour Share**) + (**Growth in Capital $** x **Capital Share**) + **Growth in MFP**

Exhibit 1 displays the historical results for labour hours showing the slight advantage Ontario has had over the US. Exhibit 2 shows trends in total capital investment and for the important private sector machinery and equipment investment. It indicates that Ontario's

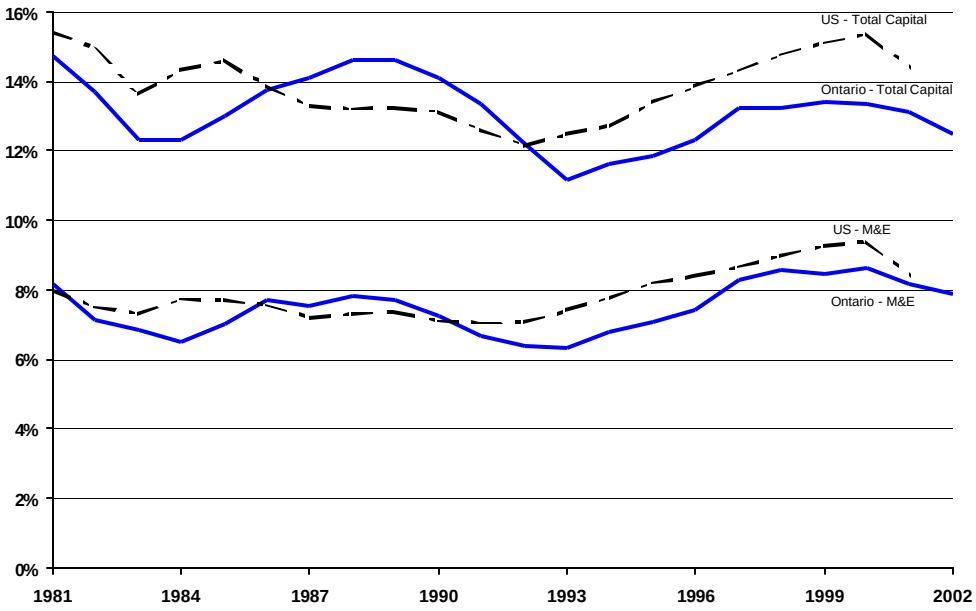
Exhibit 1: Growth in Labour Hours
(Index 1981 = 100)



Source: Institute for Competitiveness & Prosperity based on Statistics Canada; Bureau of Economic Analysis

investment in total capital has trailed the US by about 6 percent annually on a percent-of-GDP basis since 1991. In machinery and equipment the gap is even larger, averaging almost 10 percent of GDP annually.

Exhibit 2: Capital Investment as % GDP



Source: Institute for Competitiveness & Prosperity based on Statistics Canada; Bureau of Economic Analysis

The Importance of Machinery & Equipment

Investment in physical capital helps drive growth by enabling workers to be more productive, giving them newer and better tools to do their work.

Capital investments can be broken into two components – machinery and equipment (including computers and software) and structures. Both can be further sub-divided into investments made by the private and public sectors.

Examples of machinery and equipment investment include: a company building a new factory assembly line or retooling an existing one, a company investing in robotics and software, or the government buying new computers for itself or an agency, like an airport. Structural investment comprises non-residential infrastructure - including the building of a new factory or a warehouse, and public infrastructure investment like highways, railways, and bridges.

According to research conducted by De Long and Summers,[2] there is a positive and statistically significant relationship between investment in machinery and equipment and

[1] MFP is an estimate of the interaction of growth in labour and capital and other factors such as improved management practices and technological advances.

[2] J. Bradford Delong, Lawrence H. Summers, "Equipment Investment and Economic Growth" 1995, Source: http://www.j-bradford-delong.net/pdf_files/QJE_Equipment.pdf

growth in GDP per worker – our standard measure of productivity. Machinery and equipment embodies innovative technology. As of 2002, 63 percent of all new capital investment in Ontario was in machinery and equipment by the private sector, up from 55 percent in 1981. The balance of capital investment was in public sector machinery and equipment (7%), private sector structural (18%), and public sector structural (12%).

Clearly the most significant component of capital investment is the private sector's investment in machinery and equipment. However, Ontario comes up short in all aspects of capital investment[3]. By substituting the US's capital growth rate for Ontario's we estimate what the effect would be on GDP growth.

Methodology:

A breakout of the analysis for "M&E Investment – Private Sector Only" is listed in the attached spreadsheet, along with the summary results for the other three analyses. The analysis is split into four sections; Section A contains the original Ontario data, Section B the US data, Section C is where the US data is substituted into the Ontario data, and Section D is where the new capital stock numbers are used to calculate the new GDP.

In Section A, the original data for Ontario is listed in constant dollars for years 1981 – 2001. This includes GDP, Annual Investment, Depreciation, and End of Year (EOY) Net Stock for both M&E and Structural Capital. End of Year (EOY) Net Stock for any year is equal to the prior year's Net Stock plus the current year's Investment minus the current year's Depreciation.

In Section B, the US Investment Rates are listed in constant dollars and on a percentage GDP basis as well. The US Private Sector M&E Investment Rate (highlighted in blue) is then used in Section C as the New Private Sector Ontario M&E Investment Rate.

In Section C, the US Investment rate is used for the new Ontario EOY Stock calculations. Depreciation is recalculated using the same rate (% of prior EOY Stock) found in rows 33, 34, 38, 39. In Row 90, the new total Ontario EOY Stock is listed and split out into M&E and Structural Stocks. Rows 100 – 106 list the change between the Original Ontario EOY Stocks and the New Ontario EOY Stocks.

In Section D, the new GDP numbers for Ontario are calculated using the annual change in New Ontario EOY Stocks (Row 114). Using the GDP formula listed in the opening paragraph, the New % Change in GDP is calculated (Row 120) and then used to determine

[3] For all comparisons involving the public sector, US military expenditures are excluded as they increased US public sector capital investment during the 80's and early 90's (by about 30 percent). It is a relatively safe and conservative argument that capital investment in the military can be excluded as it does not directly add to productivity in the US economy. Ontario's military expenditures have not been split out due to a lack of available data, thereby overstating Ontario's expenses versus the US and making our calculations even more conservative.

the New GDP value (Constant 1997). Using the Ontario population (Row 126) the Net Change in GDP (between the Original and New) per capita is calculated (Row 128). Finally, this is then converted to current dollars (Row 132) using the constant-current ratios found in row 130.

Summary of Results:

To summarize, if Ontario were to have assumed the higher US rate of Total (both Structural and M&E) capital investment for Public and Private over the period of 1981 - 2001, GDP per capita would have increased by $892. If Ontario were to have increased just its M&E investment rate for the private sector, Ontario's GDP would still have seen an increase of $562 per person (Exhibit 3).

Emulating the US M&E investment rate, for both public and private, would have resulted in $600 per person increase. Finally, using the US Total (M&E and structural) investment rates for just the private sector would have yielded a $623 increase.

If Ontario had matched the US investment rate in machinery and equipment its capital stock in that component would be $28.5 billion or 15.9% higher than actually experienced. This $28.5 billion increase would cause total capital stock to rise by 4.7%. Since capital's share of GDP growth is about 30%, the growth in capital investment would translate to 1.4% in additional GDP which translates to $562 per capita in 2001.

Exhibit 3 - Changes to Capital Stock and GDP Using US Investment Rate: 1981 - 2001

	Capital Stock – 2001$			GDP per capita – 2001$		
	Actual	**Projected**	**% Change**	**Actual**	**Projected**	**$ Change**
M&E Private	$178,464	$206,917	**15.9%**	$37,315	$37,877	**$562**
Total Private and Public	$604,184	$656,748	**8.7%**	$37,315	$38,207	**$892**

These could be considered conservative estimates as it excludes the potential increases to GDP due to the multiplier effect. By increasing demand, through higher capital investment, in one industry there is typically a spillover effect on other industries.

Another Approach Yields Even Higher Results:

Using a method developed by Andrew Sharpe[4] at the Centre for the Study of Living Standards, we can estimate what percentage of the labour productivity gap is due to lower

[4] Andrew Sharpe, "Why are Americans More Productive Than Canadians?" 2003, Centre for the Study of Living Standards (CSLS).

total capital levels. Taking the relative capital labour ratio for all components of capital stock between the US and Canada there is an approximate 7.4% gap[5]. With capital's 30% share of GDP growth this translates to 2.2% of the total productivity gap. In 2001, Ontario's productivity gap (measured in GDP per labour hours) with the US stood at about 7.6%. Thus 29% of the productivity gap can be attributed to lack of capital. Based on the Institute's estimation of Ontario's GDP gap of $4118 this translates to a loss of $1,195 in GDP per capita.

[5] The Canada-US relative capital labour ratio was used due to a lack of data at the US state level.