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Executive Summary

Ontario's private sector has had zero productivity growth in the latest six year period. Ontario performed much worse than the rest of Canada or the United States. This is obviously a cause for concern. Productivity is an important measure of progress in the economy, as it is associated with rising standards of living in the long run.

The question is whether this observation about productivity is significant in its own right, or if it is more a symptom of the overall state of the economy. The Ontario economy has been hit by major external shocks, resulting in plunging exports and a declining private sector employment rate. Is productivity an independent causal factor, or merely the residual outcome of weak demand?

This paper examines the issue through detailed sectoral data. It examines the diversity of productivity performance in about 50 industrial sectors. The picture that emerges is that the overall productivity growth rate is not really representative. It is the random outcome of a wide range of underlying variation. There are some important sectors (e.g., retail trade and finance) that have maintained decent productivity growth. There are some sectors, especially in manufacturing, where the level of productivity is currently far below its previous *level*. This is not merely weak *growth*, but decline. In some industries (e.g., steel), some of the largest players have shut down, essentially changing the character of that sector even though the name remains the same.

Overall, the implication is that the weakness of productivity is caused by weak aggregate demand. Historically, productivity growth has been pro-cyclical, being positively correlated with demand growth. Strong demand creates economies of scale and distributes overhead costs over a larger base. The weakness of demand in recent years has also been associated with compositional shifts in the economy. Employment and output have plunged in manufacturing (whose level of productivity is above the economy-wide average), while it has grown in some service sectors with below average productivity. Such compositional shifts would reduce the average productivity of the economy even if there was no change in the productivity of any individual sectors.

Ontario had positive productivity growth in the service sector, but underperformed the strong growth found in the rest of Canada. Here, too, the explanation is likely found in diseconomies of scale due to weaker demand. For example, the higher productivity growth in retail and wholesale trade in the rest of Canada was associated with growth in sales that was two-thirds higher than in Ontario over the past six years.

The weakness of demand in Ontario is largely due to falling exports, caused by the high Canadian dollar and the weak US economy. This can be considered in a positive light. While a strong rebound in exports does not appear to be around the corner, the worst is probably behind us. There should be a continuing gradual improvement in exports in the coming years, leading to some increase in productivity growth. The Ontario government should focus its policy levers, which are admittedly constrained, on helping to further the upward trend in exports.

A Sectoral Analysis of Ontario's Weak Productivity Growth

One of the most widely discussed economic performance indicators in recent years has been labour productivity, which is real GDP per hour worked. This is considered to be an important indicator. It has been observed that, in the long run, increases in real wage rates and standards of living tend to depend on it.[1]

Ontario's performance in terms of labour productivity has been very poor over the past several years. This has caused a considerable amount of anxiety. Part of the reason for the anxiety is a lack of understanding of what these numbers mean. There is a widespread misconception among non-economists that productivity is something that exists as a common factor throughout the economy. Therefore, these people tend to attach a kind of moral significance to the lack of productivity growth, as a collective failing of the business leaders, policymakers, and/or workers of Ontario.

This paper will suggest that productivity is a series of very heterogeneous residual outcomes that depends on a wide variety of factors. From that point of view, productivity is not an independent causal factor that determines standards of living. It is a coincident indicator, rather than a leading indicator. While there are many reasons for anxiety about the Ontario economy, the excessive focus on productivity, as if it was a driving factor, is misplaced.

There is both a demand side and a supply side to productivity. There is a greater potential for output to grow per hour worked as workers become more educated, and they have more and better capital equipment to work with. However, this potential will not be realized if there is insufficient demand. If highly educated individuals are relegated to flipping hamburgers or selling shirts, their potential will not be realized. If more output cannot be sold, it will not make sense for companies to invest in more and better equipment to increase output.

Business commentators generally focus on the single average productivity rate for the whole economy. If most of the economy was clustered close to this average, it would be a meaningful indicator. In fact, this average provides very little insight, inasmuch as it is the random product of a huge range of different sub-components. In order to understand productivity, it is necessary to see what lies beneath, and look at its performance at the detailed sectoral level. The possibility of doing this has been facilitated by a new experimental database from Statistics Canada that provides detailed sectoral productivity by province.[2] As we peel away the layers, it will be possible to better understand why productivity has slowed so sharply in Ontario.

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[1] It should be noted, however, that there is no fixed relationship between productivity and real wage rates. This would only occur if the economy was characterized by a simple Cobb-Douglas type production function, and most empirical evidence does not support it. Changes in the relative prices of imports and exports can also play a significant role in the standard of living, and that is the main reason why Alberta has been doing so well. The important role of the terms of trade was recently emphasized by W. Erwin Diewert and Emily Yu, "New Estimates of Real Income and Multifactor Productivity Growth for the Canadian Business Sector," *International Productivity Monitor*, Fall 2012.

[2] The author is indebted to Hugh Finnigan for providing the data, and to earlier analysis of it in papers by Qaizar Hussain and Hugh Finnigan.

A Brief Historical Overview

Ontario has diverged very sharply from the performance of the rest of Canada (henceforth, ROC, which is the total for Canada minus Ontario) over the past ten years, both in productivity growth and in a host of other indicators such as employment growth and investment growth. This is related to the fact that Ontario's economy was the most open to international trade in general, and dependent in particular on exports of finished goods and services rather than raw commodities. It was therefore the most susceptible to both the sharp upward valuation of the Canadian dollar that began in 2003, and the deep recession among developed countries (and in particular the United States) that began in 2008.

Ontario had much more to lose than the rest of Canada, starting with a greater dependence on exports. The early 2000s were already weak because of the dot-com recession in the United States. Between 2002 and 2008, Ontario's international exports as a share of GDP fell by nearly 10 percentage points, compared to hardly any decline in the rest of Canada, where the rising dollar's effect was largely offset by rising international commodity prices. The recession took it down another 5 percentage points or so, but it bottomed in 2009 and there has been a modest recovery since then (Figure 3).

The loss in export sales fed through to weak overall demand and lost jobs. Export industries tend to have higher productivity than the average, and the loss of jobs there forced workers to take jobs in much less productive sectors.

Table 1 summarizes overall private sector productivity growth over several time periods for Ontario compared to the rest of Canada, and for the service sectors and manufacturing sectors.[3]

Table 1. Average annual percent change in real GDP per hour worked

	1985 to 2000	2001 to 2005	2006 to 2011
Ontario business sector	1.3	0.8	0.0
Ontario service sector	1.2	1.6	0.5
Ontario manufacturing	2.6	0.1	0.1
ROC business sector	1.2	1.4	0.9
ROC service sector	1.2	2.1	1.2
ROC manufacturing	2.4	1.6	2.0

It can be seen that, prior to 2000, Ontario's performance was quite similar to that of the ROC. Ontario's business sector enjoyed moderate productivity growth, averaging 1.3 percent per year from 1985 to 2000.

In the latest six year period of data, from 2006 to 2011, Ontario's overall business sector productivity growth was zero. While the ROC showed some weakness related to the recession, it was only modestly lower than its long-run historical average. When

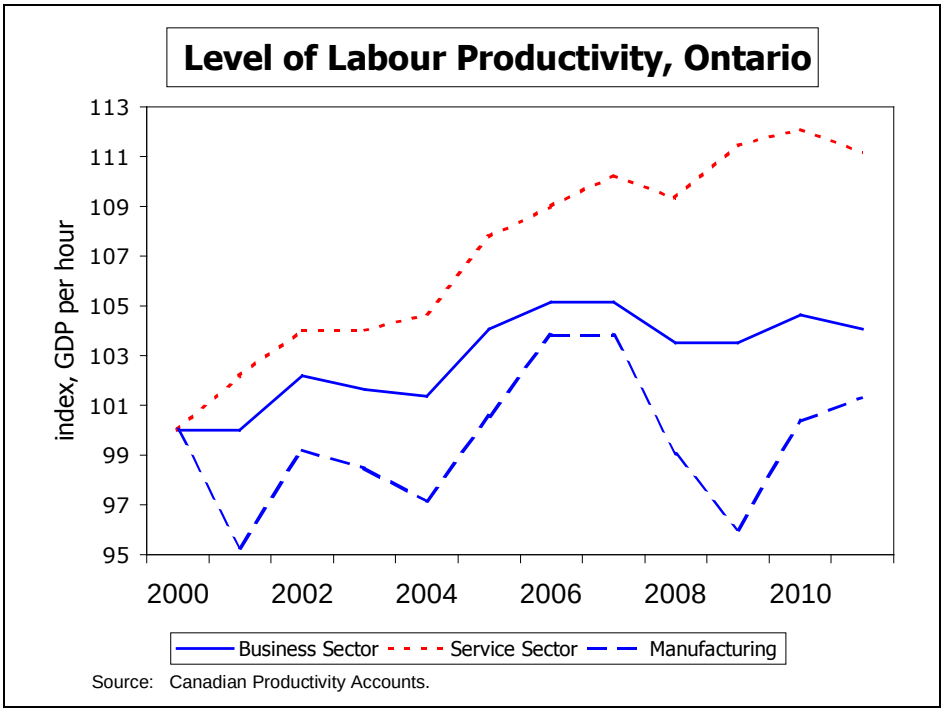
[3] The comparisons in this paper are mainly between Ontario and the ROC. There are serious statistical problems in comparing productivity in different countries, as noted in the recent paper by Diewert and Yu (note 1).

people speak about "Canada's abysmal productivity growth," which is a commonly seen phrase in business commentaries, they are talking (whether they know it or not) mainly about Ontario.[4]

It will be observed in the first column of Table 1 that manufacturing productivity growth was quite a bit stronger than service sector productivity growth in the 1985 to 2000 period. The 2.6 percent growth in manufacturing productivity combined with the 1.2 percent growth in service sector productivity produced an overall growth rate of only 1.3 percent. The overall growth was influenced by a rising share of service output in the economy. The service sector increased its share of total business sector output by 6 percentage points over this period. Not only did the service sector have lower annual productivity growth than manufacturing, but its level of output per hour worked was lower, bringing down the overall average as it increased its share of the economy. This is one example of how the composition of the economy can influence the overall average productivity growth rate.

Similarly, in the 2006 to 2011 period, overall business sector productivity growth was zero, in spite of non-zero growth in service sector productivity. The whole was less than the sum of its parts. This too is a function of the changing composition of output, as sectors with below-average levels of productivity increased their share of the total. The next section will discuss the issue of the effect of the distribution of output in more detail.

Figure 1



[4] Ontario's disproportionate contribution to the national decline has been noted by Andrew Sharpe and Eric Thomson. They coined the widely-quoted phrase, in "Insights into Canada's Abysmal Post-2000 Productivity Performance from Decompositions of Labour Productivity Growth by Industry and Province," *International Productivity Monitor*, Fall 2010. Their analysis covered the period up to 2007, and their conclusions were quite similar to those of this paper.

How the Composition of Output Affects Overall Productivity

The level of output per hour worked varies greatly across the different sectors of the economy. This reflects the earnings of both the physical and human capital of the sector. Some sectors have a very high GDP per worker because there is a lot of very expensive capital investment that has to earn a rate of return there. Some sectors have a higher GDP reflecting the high educational levels and incomes of their workers. Some sectors (such as mining and manufacturing) have a high GDP per hour worked because of the high return on the capital used, in spite of the relatively low human capital of their employees.[5] In some sectors, such as food services, there are relatively low levels of both educational requirement (although, anecdotally, many servers have post-secondary education) and physical capital, leading to a low level of value added per hour worked.

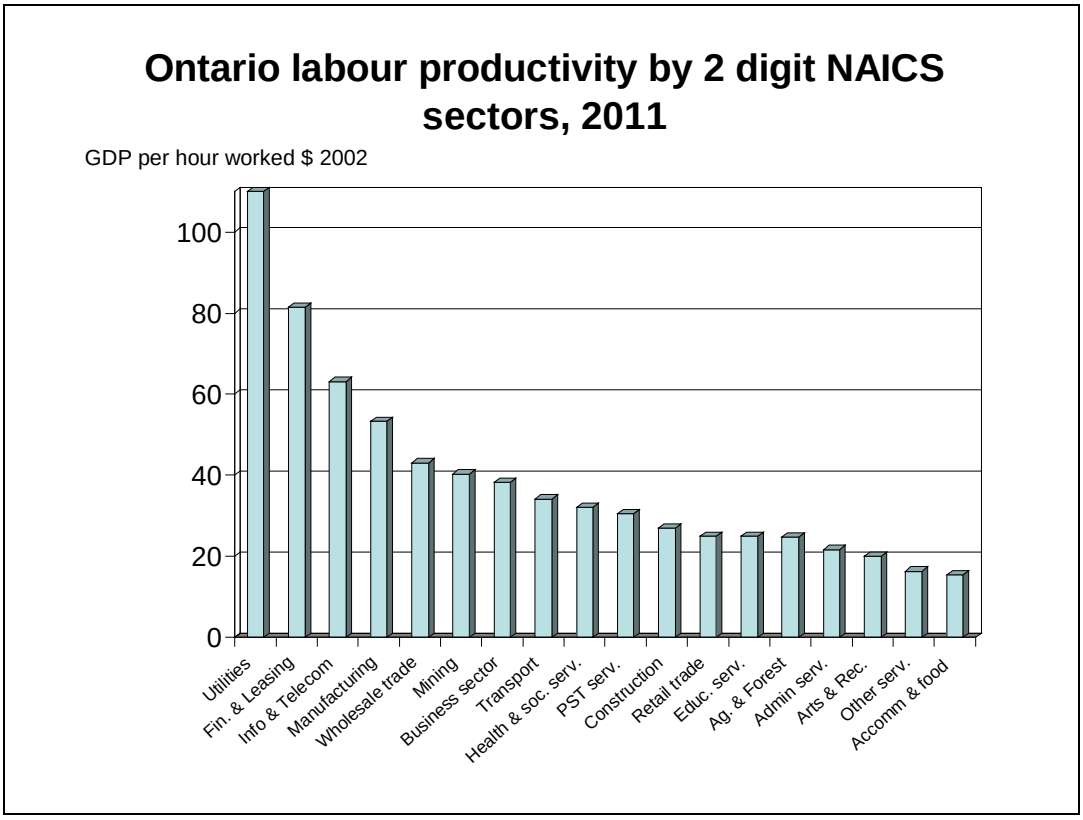
Figure 2 graphs the variation at the two digit level of fairly aggregated industries, and even here there is a very large range, from GDP of $120 per hour worked in utilities to less than $16 per hour in accommodation and food services.[6] In 2011 Ontario had 446,000 workers in the latter sector, but only 46,000 in the utilities sector.

If we drill down further, we find even larger variations. At the three digit level within the utilities sector, we find pipelines with GDP of about $1000 per hour worked. In the finance and leasing sector we find an average GDP of $81. However, if we go down to the four digit level within that sector, we find a range from $46 in real estate services to $295 in lessors of real estate (the companies that actually own the properties and earn the rent on them). These are very high levels of average productivity, but the marginal productivity from adding additional workers would be much lower than the average productivity. Likewise, the capital itself only has a high productivity if there is a use for it. Pipelines are very expensive, so if the pipeline earns its expected rate of return, the output per hour worked needed to maintain it will be very high. However, there would be no value in building a pipeline if there was no demand for its services, as it would earn a very low rate of return, and the marginal productivity would be far lower than average productivity of the existing pipelines.

[5] The average pay in manufacturing is only $5 per hour higher than in services, but the output per hour gap is about $17, reflecting the higher level of capital/labour in manufacturing.

[6] "PST" stands for professional, scientific, and technical and services. With a name like that, one would expect it to have fairly high income levels. In fact, it is a grab-bag of miscellaneous categories, with over 500,000 jobs, ranging all the way from lawyers to bookkeeping and market research services, and is weighted down by a large number of lower paid occupations in the latter categories.

Figure 2



In manufacturing, the average was $53 in 2011, but at the four digit level we find a range from $22 per hour in agricultural chemicals to $133 in automobile assembly. What is even more peculiar is that a few years ago the level for agricultural chemicals was over $80 per hour, and for auto assembly it was over $170 per hour.

Even the four digit level is highly aggregated, and obscures the considerable differences that can exist between one company and another. Different companies that fall into a category can be vastly different in what they produce and how they do it. Their productivity will fall if they are operating at below capacity because of weak demand, and have to keep on managerial and security employees even when the plant is idle.

A Hypothetical example: Assume an economy that consists of just two sectors, food services and manufacturing. Output per hour worked is $16 in food services, and $50 in manufacturing. As the number of hours worked in manufacturing declines due to lower exports, aggregate productivity (output per hour worked) declines in the economy.

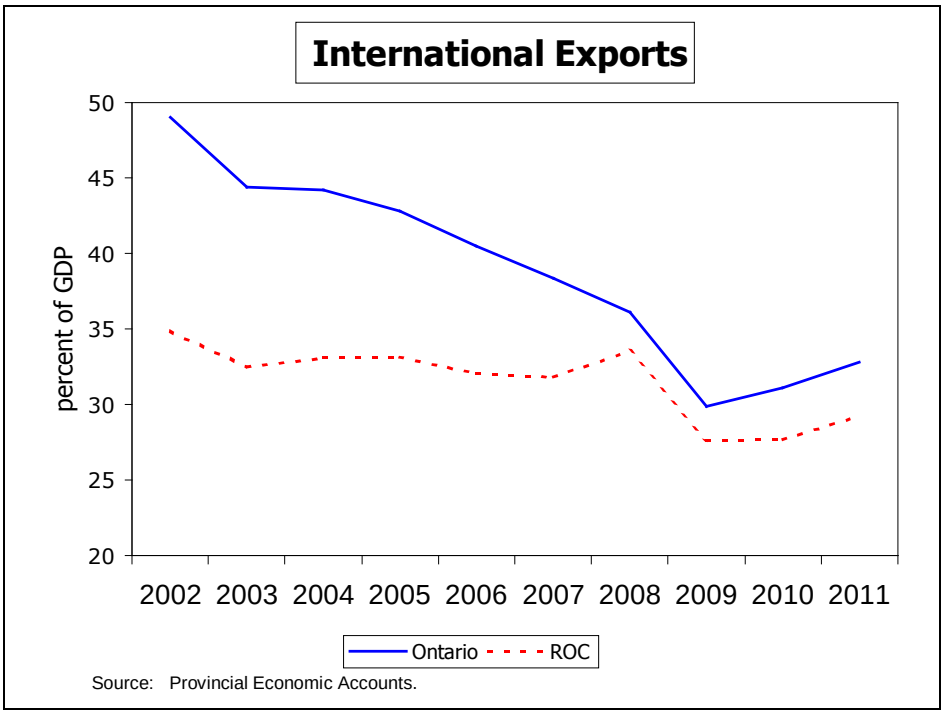
In this example, a large decline in aggregate measured productivity occurs, even though there has been no actual change in productivity at the plant level.

Table 2. A simple numerical example showing how a change in the composition of output can affect average measured productivity					
	Hours worked in food services	Hours worked in manufacturing	Total hours worked	Total GDP	Average productivity in the economy (output per hour worked)
2005	1,000,000	1,000,000	2,000,000	$66,000,000	$33
2006	1,000,000	800,000	1,800,000	$56,000,000	$31.1
2007	1,000,000	600,000	1,600,000	$46,000,000	$28.8

The Effect of Export Demand on Composition of Output

Ontario's exporting industries are among the ones that have the highest output per hour, such as auto manufacturing, with output per hour of well over $100. By contrast, local service producing firms and manufacturers that serve the domestic market tend to have lower productivity. The decline in exports has reduced the output of some of the higher productivity sectors in the Ontario economy. Therefore, it would have a negative impact on average productivity, for the reasons just discussed, even if there was no impact on productivity within any individual company.

Figure 3



In reality, even productivity at the plant level is often adversely affected, as some of the remaining operations would be operating at a smaller scale, spreading overhead costs over a smaller amount of production.

Many large operations with high absolute levels of GDP per hour worked (such as major steel mills at the former Stelco) have been shut down, not being able to compete due to the sudden appreciation of the Canadian dollar. This leaves a larger share of what is classed as manufacturing in less efficient firms that serve local markets, such as small firms processing scrap metal. Other examples include small-scale specialty food manufacturing and custom furniture makers.

It may seem paradoxical that more productive operations fail, while less productive ones remain, but there is considerable segmentation in markets, as some types of activities have a substantial service or perishable component, and have an advantage in being closer to markets. Their price elasticity of demand is relatively low. Other products which are very generic have to compete in global markets purely on price, and their price elasticity of demand is very high.

The tendency towards smaller scale operations over the past several years is evident in the data on Ontario employment by class and size of establishment. The employment changes in the Ontario economy over the past several years have been in the direction of smaller scale and less efficiency:

Table 3. Recent Ontario employment changes by type of employment

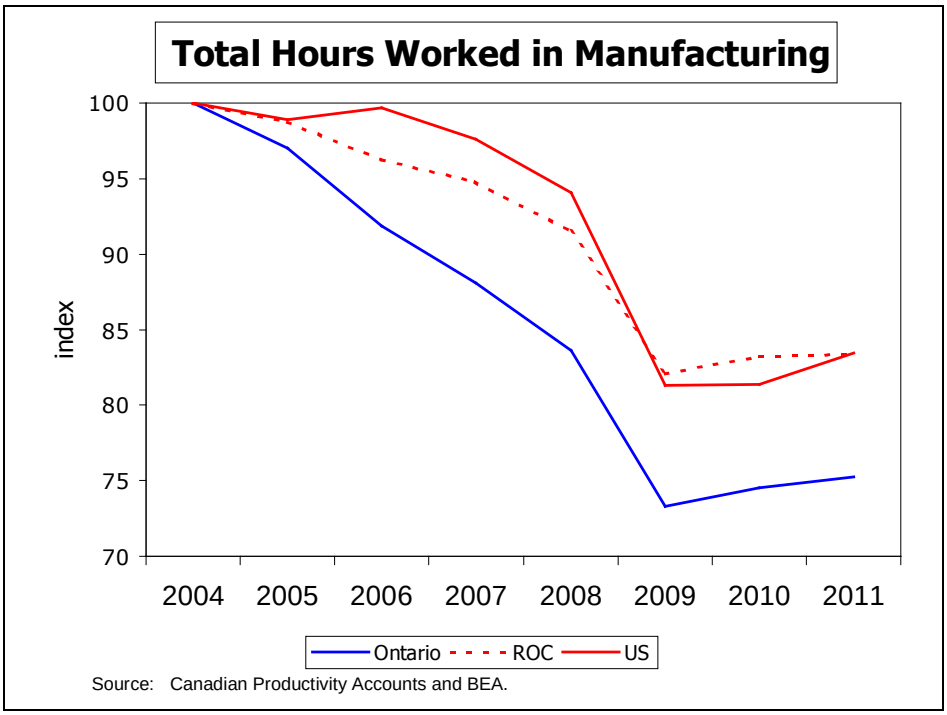
Class of worker	Thousands of jobs		Percent change
	2007	2011	
Total private sector employment	5365	5388	0.4
Total employees, firms with 500+ employees	547	472	-13.7
Self-employed with employees	317	309	-2.6
Self-employed without employees	653	719	10.1

The average annual GDP per person from unincorporated businesses is less than half of the business sector average. If the new participants in that sector since 2007 could instead have been employed at the economy-wide average, that by itself would have boosted real GDP by about half a percent. That is just the tip of the iceberg, as they happen to fall into a class of workers for which we have specific data. Overall, there has been a general shift throughout the economy towards firms of smaller size and less efficient scale.

A very detailed study of plant-level productivity by Statistics Canada looked specifically at manufacturing in the period from 2000 to 2006. They found that the higher dollar led to a shift away from export orientation, with a resultant weakening of productivity growth: "Export-market participants gain more in productivity growth from currency depreciation than non-participants... the dramatic increase in the value of the Canadian dollar during the post-2000 period almost completely offset the advantages enjoyed by export-market participants. Our counterfactual exercise shows that

fluctuations in real exchange rates explain almost all the shifts in productivity growth gaps between export-market participants and nonparticipants in this latter period."[7]

Figure 4



Between 2003 and 2011, total employment in manufacturing in Ontario fell by almost 30 percent, but the decline was greatest in the firms with the most employees, and hence the firms that would be expected to have the greatest economies of scale. The following table shows the percentage of manufacturing employees by size class:

Table 4. Percentage of Ontario manufacturing employees in firms of different size classes

	Fewer than 100 employees	100 to 500	More than 500
2003	40.5	37.2	22.3
2004	40.2	38.6	21.2
2005	41.4	38.2	20.4
2006	42.7	35.5	21.8
2007	42.5	35.7	21.8
2008	44.4	35.6	20.1
2009	49.0	33.8	17.2
2010	47.1	35.0	17.8
2011	46.9	34.5	18.6

[7] "Export Market Dynamics and Plant-level Productivity: Impact of Tariff Reductions and Exchange Rate Cycles," by John Baldwin and Beiling Yan, Economic Analysis Research Paper Series, Statistics Canada, 2010.

In Ontario, fewer than 20 percent of manufacturing workers are in firms with more than 500 employees. By comparison, about 50 percent work for firms of that size in the US.

The decline in manufacturing productivity growth was particularly large, from average annual growth of 2.6 percent per year prior to 2000, to near-zero after that. It appears that this can be fully explained by the decline in demand for Ontario's manufacturing output. It is possible to estimate the correlation between manufacturing productivity growth and output growth over the historical period with regression analysis, as described in Appendix 1. As discussed there, the relationship is quite stable, finding nearly identical coefficients in periods of output growth and output decline. This suggests that productivity growth in manufacturing rises about 0.64 percent with each 1 percent increase in output growth.

This coefficient is applied in Table 5, to calculate how much higher Ontario's manufacturing productivity growth might have been with higher output, matching that of the US or ROC.[8] Interestingly, the result is that Ontario would have closely matched productivity growth in those other jurisdictions. The implication is that Ontario's weak manufacturing productivity growth is fully explained by its weak output growth. That, in turn, is substantially explained by the high Canadian dollar. The other provinces managed to largely avoid the worst impacts of this. They export less of their manufactured products, and more of what they produce is of a specialized nature related to their resource industries. However, further detailed analysis would need to be undertaken to test whether this fully explains the much smaller drop in manufacturing production in the other provinces.

Table 5. Counterfactuals: How much would Ontario's manufacturing productivity growth have increased if Ontario's output growth had matched that of the ROC or the US?

	Manufacturing output, annual % change	Manufacturing productivity, annual % change
ROC, 2005 to 2011 actual	-0.3	2.2
US, 2005 to 2011 actual	0.6	3.3
Ontario, 2005 to 2011 actual	-3.4	0.6
If Ontario had matched ROC output growth	add 3.1 onto Ontario's output to raise it to -0.3	0.6 + 0.64*3.1=2.6
If Ontario had matched US output growth	add 4 onto Ontario's output to raise it to 0.6	0.6 + 0.64*4=3.2

The next section will seek to confirm these macroeconomic estimates by looking at how changes in the micro structure of production contributed to changes at the aggregate level.

[8] Table 5 covers the rates of change from 2005 to 2011, as data on US manufacturing value added are not available from the Bureau of Economic Analysis prior to that.

Why Has Service Sector Productivity Growth Underperformed?

The most dramatic weakness for Ontario's productivity growth in the past decade occurred in manufacturing. However, as seen in Table 1 above, Ontario also underperformed compared to the rest of Canada in service sector productivity growth, which was positive but weak in Ontario. Table 6 looks at the details behind this for the latest six year period.

The most important service sector category for Ontario is financial services, representing 29 percent of services output. Here, Ontario's productivity growth slightly outperformed the ROC average.

The next most important components are wholesale and retail trade, which together comprise 24 percent of service sector output. Here, Ontario's productivity growth was reasonably good, but substantially lower than the very strong ROC average growth. There does not appear to be much of a difference in trend between Ontario and the rest of Canada in this sector. The relative levels of productivity were not materially different in 2011 than they were ten or fifteen years earlier, in spite of the recent stronger growth in the rest of Canada. The differences in the recent growth rates likely reflect the weaker income growth and resulting weaker sales growth in Ontario rather than any fundamental differences. Over this period, the growth rate of combined nominal retail and wholesale sales in ROC was 66% larger than in Ontario. As well, one of the activities that people who become self-employed do is small scale, low productivity retailing, and self-employment was the largest area of employment growth in Ontario in this period.[9] (A quantitative analysis of the relationship between productivity and sales growth can be found in Appendix 3.)

There are a number of sectors that suffered negative productivity change. The most significant of these was the professional, scientific and technical service area. In spite of its grand name, it is a large sector with over 500,000 jobs that includes some low paying occupations such as bookkeeping services.[10] A surplus of workers willing to take low paying jobs may have boosted employment in the lower productivity segments of this classification. As will be discussed in the next section, absolute declines in productivity in particular sectors probably indicate a change in composition. This is often the result of weak demand for the higher productivity activities, that forces people to move into lower productivity ones for the lack of any better alternative.

[9] Over the period covered by Table 6, self-employed people with no employees increased 17.4 percent in Ontario, compared to only 7.8 percent in the ROC. Sadly, this was Ontario's only "booming" sector.

[10] Based on the difference between total employment and SEPH employment, it can be inferred that about 37 percent of the workers in that sector were self-employed in 2011, which is up about 5 percentage points since 2007. This is consistent with the view that people who cannot get paid jobs crowd into fields where they have self-employment opportunities, but they often have poor earnings, dragging down the average productivity of the sector.

Table 6. Detailed comparison of Ontario versus ROC productivity growth in services, 2006 to 2011				
NAICS code		This code's % share of Ontario services GDP in 2011	Ontario annual % change in productivity, 2006 to 2011	ROC annual % change in productivity, 2006 to 2011
410	Wholesale Trade	12.4	1.7	3.1
4A0	Retail Trade	11.7	1.5	2.8
484	Truck Transportation	2.3	-0.9	3.1
485	Transit and Ground Passenger Transportation	1.0	1.0	0.7
486	Pipeline Transportation	0.3	3.7	2.2
48A	Other Transportation	2.8	2.4	2.0
493	Warehousing and Storage	0.3	-2.3	-0.7
49A	Postal Service and Couriers and Messengers	1.2	-1.0	1.3
512	Motion picture and sound recording industries	0.5	x	-0.5*
51B	Publishing, broadcasting, telecommunications and other information services	6.9	x	0.0*
541	Professional, Scientific and Technical Services	11.3	-1.3	0.1
561	Administrative and Support Services	4.9	-1.0	0.1
562	Waste Management and Remediation Services	0.7	-0.5	0.5
5A0	Finance, Insurance, Real Estate and Rental and Leasing (excluding owner occupied dwellings)	29.3	1.7	1.3
610	Educational Services	0.5	1.0	-1.3
620	Health Care and Social Assistance	5.4	-0.6	-0.8
710	Arts, Entertainment and Recreation	1.5	-1.3	-1.4
720	Accommodation and Food Services	3.9	1.5	-0.1
811	Repair and Maintenance	1.2	-1.3	1.2
813	Civic and professional organizations	0.5	-2.0	-0.4
81A	Personal, household and laundry services	1.5	-1.9	-0.4
X = unavailable due to confidentiality; * denotes value for all of Canada, as ROC cannot be calculated				

Three Digit NAICS Sectoral Decomposition of the Weakness in Ontario's Productivity

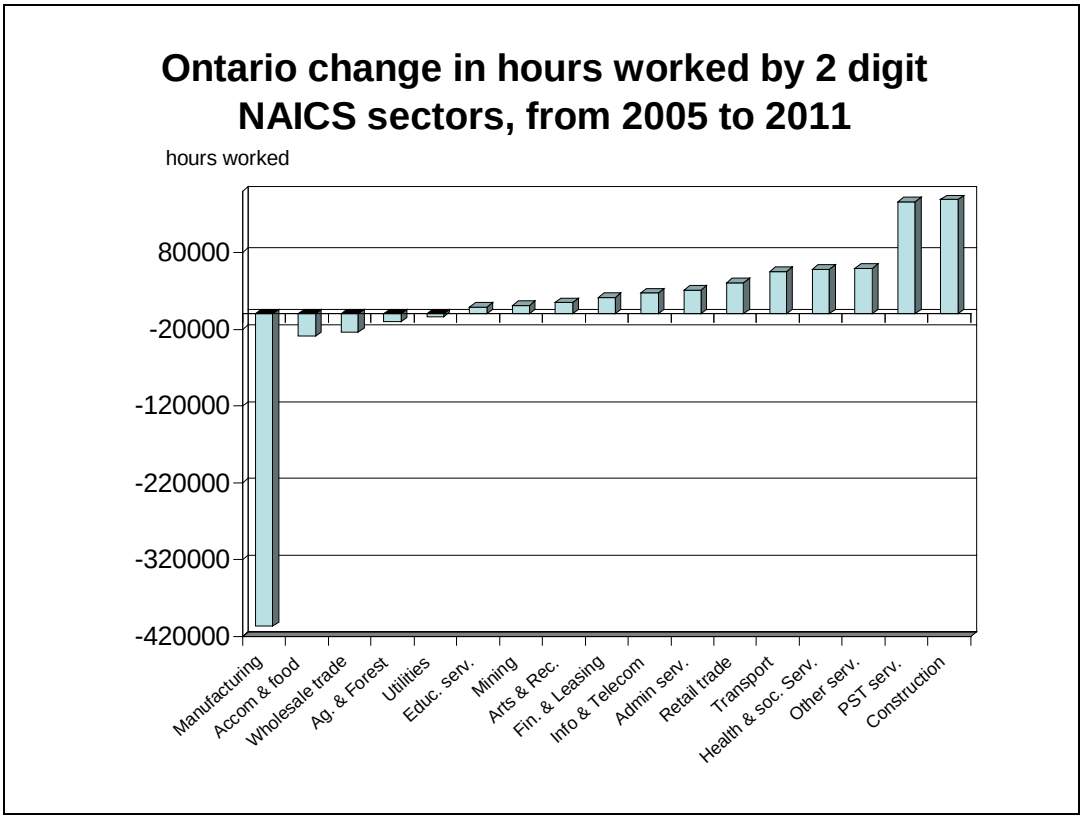
This section will look at the variations in the economy using the three digit NAICS code level, which breaks out about 50 private sector industries.[11] The purpose is to estimate the total impact of detailed compositional change and related factors in dragging down the average productivity figure for Ontario.

Two types of counterfactual analysis will be undertaken here. The first will be to look at how productivity would have differed if the growth in hours of employment in all sectors had been the same. In particular, employment in manufacturing dropped sharply, and its average productivity is higher than the economy-wide average. Some of the strongest growth areas in employment were in parts of the service sector that have relatively low productivity. The analysis will relate to the change in employment from 2006 to 2011, which was noted in Table 1 as being a period when Ontario had zero overall productivity growth.

Figure 5 highlights the wide variation. It shows the change in hours worked in terms of absolute numbers, rather than percentage change, as it is the absolute number that determines its weight in the impact on the overall productivity outcome. For example, mining is a relatively high productivity industry that had a strong percentage increase in hours worked. However, it started from a small base, and a large percentage change represents a relatively small number of jobs and a small amount of GDP. Therefore, it only had a small impact on the overall outcome. Figure 5 shows the variation for the 2 digit NAICS categories. There are too many sectors at the three digit level to easily fit into a chart, but the actual analysis will be carried out at the three digit level. At the three digit level, the outcome is worsened by the fact that the largest loss in hours in manufacturing was in auto assembly, which is also the sub-sector of manufacturing with the highest level of productivity.

[11] In principle, there are 51 categories at the three digit level of the Productivity Accounts. However, at this level, four of them are suppressed by Statistics Canada for Ontario to protect confidentiality, leaving 47 for the analysis.

Figure 5



The results of two types of recalculation are depicted in Table 8 below. The first one rebalances the hours worked to calculate the level of GDP that would have existed in 2011 if all sectors had hours growing at the same rate.

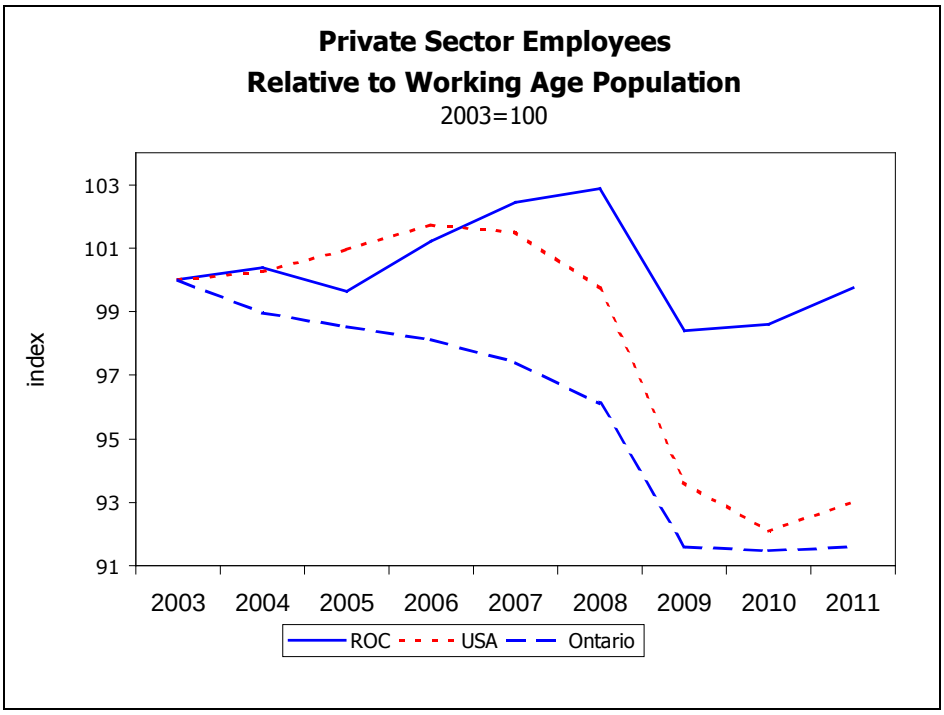
The second recalculation makes a more radical alteration. It recognizes the problem alluded to above, that even at the disaggregation that is provided at the three digit level,[12] much of the change in composition is hidden. One of the startling features of the sectoral productivity data, already alluded to above, is that for some sectors the level of productivity in 2011 is well below the peak. The low average productivity growth that occurred was not the result of all industries growing together at the same weak rate. It is the average of some sectors that had continuing positive productivity growth, and some others that had large declines not just in growth rate but in level. Sectors with substantial absolute declines in productivity are especially prevalent in manufacturing, as seen in Table 7. Out of 20 three-digit NAICS categories in manufacturing, all but two were below their previous peak level of productivity in

[12] The experimental Productivity Accounts also include a four digit NAICS level. That provides a theoretical 95 categories, but 11 of them are suppressed due to confidentiality. This makes analysis at that level problematic, as a larger proportion of the economy is missing.

2011.[13] In some cases they were far below their peaks, no doubt indicating that some major facilities that had high levels of productivity have been completely shut down.[14]

If weak productivity growth is meaningful as a concept, it must refer to sectors that are not investing enough, or are not innovative enough. These factors would reduce the growth rate, but they would not ordinarily cause a drop in the level far below what had been previously reached.[15] Mere lack of ambition or effort as the causal factors would imply a rate of zero as the floor for productivity growth in each sector. Therefore, if some sectors are showing large drops, it is likely because there are unfortunate compositional changes going on within those sectors that we cannot discern from the data, e.g., large companies that formerly competed in the export market, and had economies of scale, have gone out of business, and left a residue of smaller firms serving the domestic market because of some particular service niche that allows them to survive in spite of small scale and inefficiency from a global perspective.

Figure 6



[13] It is true that in the process of Schumpeterian "creative destruction," some sectors will be undergoing decline even in good economic times. However, 2011 was clearly atypical. Only two out of 20 sectors were not below their previous peak, with an average ratio of 0.85 (2011 productivity level divided by the previous peak level). By comparison, in 1999 it was eight out of 20, with an average ratio of 0.92.

[14] I have omitted petroleum and coal products (code 324) from the table, pending verification of a data anomaly. Its productivity in 2011 displays a remarkable 66 percent decline from its peak. There was one major refinery closure in 2005, but this does not appear to be sufficient to explain such a large decline.

[15] One could think of some extreme examples where productivity would drop due to a lack of investment. For example, this might happen if a company hired more workers without adding more capital, and forced the existing workers to share their equipment with the new workers. Such behaviour is likely to be rare, particularly in manufacturing, where there has been a large decline in total employment.

Table 7. Manufacturing Productivity levels in 2011 compared to the peak in the previous decade

NAICS code	Name	Level of productivity in 2011 relative to previous peak (percent difference)
311	Food Manufacturing	-3.1
312	Beverage and Tobacco Product Manufacturing	-25.4
31A	Textile and Textile Product Mills	-15.1
315	Clothing Manufacturing	-22.1
316	Leather and Allied Product Manufacturing	-4.6
321	Wood Product Manufacturing	-9.1
322	Paper Manufacturing	-6.1
323	Printing and Related Support Activities	-18.2
325	Chemical Manufacturing	-22.1
326	Plastics and Rubber Products Manufacturing	0.0
327	Non-Metallic Mineral Product Manufacturing	-7.0
331	Primary Metal Manufacturing	-12.7
332	Fabricated Metal Products Manufacturing	-8.4
333	Machinery Manufacturing	-0.6
334	Computer and Electronic Product Manufacturing	0.0
335	Electrical Equipment, Appliance and Component Manufacturing	-25.6
336	Transportation Equipment Manufacturing	-9.9
337	Furniture and Related Product Manufacturing	-23.1
339	Miscellaneous Manufacturing	-10.6

The sectors that are showing absolute declines in the level of productivity can be regarded as noise in the data. In some instances, the composition of plants within the sector may have changed so much that in essence it has become a different sector than it was before. The second recalculation in Table 8 takes this view into account. It shows

what the level of GDP in Ontario would have been in 2011 if the sectors for which declining productivity is found in the data had instead stayed at the previous highest level that they attained before the decline. When both of these calculations are combined, the result is that the level would be 11.2 percent higher than the actual. The zero productivity change actually recorded in the 2006 to 2011 period would instead have been 1.8 percent per year. This is higher than the historical average, but not out of the range of variation for a period of six years.[16] What this highlights is that there were some sectors in which companies were making considerable efforts, in the face of adversity, to achieve productivity growth.

Table 8. Alternative scenarios of Ontario private sector productivity growth, based on reversing adverse changes at the three digit NAICS level

	GDP in 2011, $billions (2002 constant dollars)	Implied annual average % productivity growth, 2006 to 2011
Actual private sector GDP in 2011	347.1	0.0
Hypothetical GDP if all sectors had the same percentage change in hours worked from 2006 to 2011 (total hours remaining the same for the whole economy)	359.6	0.6
Hypothetical GDP if no sector had suffered a decline in 2011 relative to its previous maximum absolute level of productivity	371.7	1.1
Combined effect of both of the above adjustments	386.0	1.8

Conclusions and Directions for Further Research

The analysis in this paper has found that the productivity behaviour of the sub-sectors of the Ontario economy is very diverse. There is not a low rate of productivity growth that is found throughout the Ontario economy, like a pervasive miasma of mediocrity.

The aggregate productivity growth rate for Ontario's private sector happened to average zero in the past six years. That does not mean that all parts of the Ontario economy had approximately zero productivity growth. A few have had quite strong growth, while others have suffered not weak growth, but absolute declines in the level of productivity.

By and large, it is possible to explain the overall weak productivity with reference to weak demand growth. Weak demand for Ontario's production has resulted in various adverse effects on productivity. It leads to lower capacity utilization, and overhead expenses being spread over a smaller base. It leads people who have lost jobs in higher productivity sectors to try to shift into whatever jobs they can get, and these are often at lower productivity levels. Many of the higher productivity sectors in Ontario have been dependent on exports, and exports have been very hard hit by external shocks.

[16] E.g., the average productivity growth for the six years ending in 2002 was 2.6 percent.

The situation has been particularly acute in manufacturing, where 18 out of 20 sub-sectors are at a lower level than their previous peak, in some cases much lower. It is ironic that many analysts call for increased productivity as a way to increase Ontario's competitiveness. The causality tends to run the other way. It is the lack of competitiveness of some major facilities, that previously had high productivity levels (as measured by GDP per hour worked), that has caused them to be shut down, and reduced the average level of productivity in the economy.

If weak productivity is the result of weak exports, that is not something that can be easily or quickly remedied by provincial government policies. On the plus side, it is likely that the worst is behind us and there will be a gradual improvement in the coming years. Indeed, exports have bottomed out and have already turned up as a share of GDP. There is some hope for stronger growth in the US in the coming years, boosting exports further. It is hard to predict what will happen to the Canadian dollar. While a high dollar will likely continue, it is something that the economy gradually adjusts to, partly through downward adjustments to wage rates that can eventually (albeit slowly and painfully) restore competitiveness.

One thing that emerges is the importance of ensuring that the current obstacles to exporting from Ontario are minimized, and if possible reversed. The Ontario government should continue to try to influence the federal government's position on the exchange rate and on international trade treaties. It is possible that some tax levers could be used to provide greater benefits to exporting industries.[17] It is likely that infrastructure and border issues have had a negative impact on Ontario's exports over the past several years. Some remedial action has been taken on that, but some aspects of it (such as the new bridge and road infrastructure at Windsor) will not be available for many years.

Further research is needed to understand why Ontario's exports and manufacturing production have suffered so much more than that of the ROC or the United States. The exchange rate is no doubt the largest part of the story, but without further analysis, we cannot be certain that it explains all of it. It is important to understand what might be different in terms of structure and the regulatory environment in Ontario as compared to the rest of North America that might have worsened Ontario's performance. If it is found that Ontario has its own peculiar adverse institutional factors, it may be possible to fix those and achieve a more favourable outcome.

Capital investment has not been discussed in this paper, and it is clearly also an important factor that can affect productivity growth. Business leaders, when criticized by the Bank of Canada governor for sitting on cash rather than investing, pointed out that they have little incentive to invest in a risky environment when they also have excess capacity. It would be useful to investigate how well investment at the detailed sector level correlates with such factors, and what the prospects are for improvement of investment in key sectors as the economic recovery continues.

[17] The prevailing philosophy in taxation in recent years has been a "level playing field" view that does not favour one sector over another. However, this approach is not supported by economic theory, which implies that lower tax rates should apply to sectors that face a higher price elasticity of demand.

Appendix 1: Regression analysis looking at the relationship between output growth and productivity growth in manufacturing.

The dependent variable DLP is the year-to-year percent change in real value added per hour worked, and the explanatory variable is the percent change in value added. A pooled cross-section regression was done using data for all 20 three digit sub-sectors of manufacturing.

In the regressions shown below, the sample is split into two parts. The first regression covers the period from 1985 to 1999, and the second one from 2000 to 2011. The former corresponds to a period of strong positive output growth, while the latter consists mainly of a period of falling output in manufacturing. In spite of the marked difference in the periods, the coefficient on the output variable is virtually identical. This allows us to have considerable confidence that there is a stable structural relationship between productivity growth and output growth.

This does not address the question of causality. Did weak output growth in the post-2000 period cause the weak productivity growth? Or was there some exogenous negative shock to Ontario's technology or work attitudes that caused weak productivity growth, which in turn made Ontario companies unable to compete, and led to reduced productivity growth? The crude nature of the data does not allow us to address the issue through the usual econometric methods of causality testing. However, this is a situation where extrinsic knowledge provides a ready answer. There were two obvious and very large negative demand shocks in the post-2000 period: a more than 60 percent appreciation in the value of the Canadian dollar, and the worst recession in the industrialized world since the 1930s. (See Appendix 2.) In this context, any special factors originating in Ontario that might have independently reduced productivity growth must be very minor by comparison.

Dependent Variable: DLP
Method: Panel Least Squares
Date: 12/26/12 Time: 16:28
Sample: 1985 1999
Periods included: 15
Cross-sections included: 20
Total panel (balanced) observations: 300

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.067673	0.588254	1.814987	0.0705
DIFQA	0.675747	0.065985	10.24090	0.0000

R-squared	0.260318	Mean dependent var	2.255729
Adjusted R-squared	0.257836	S.D. dependent var	11.59475
S.E. of regression	9.988753	Akaike info criterion	7.447441
Sum squared resid	29733.01	Schwarz criterion	7.472133
Log likelihood	-1115.116	Hannan-Quinn criter.	7.457323
F-statistic	104.8761	Durbin-Watson stat	2.435739
Prob(F-statistic)	0.000000		

Dependent Variable: DLP
Method: Panel Least Squares
Date: 12/26/12 Time: 16:29
Sample: 2000 2011
Periods included: 12
Cross-sections included: 20
Total panel (balanced) observations: 240

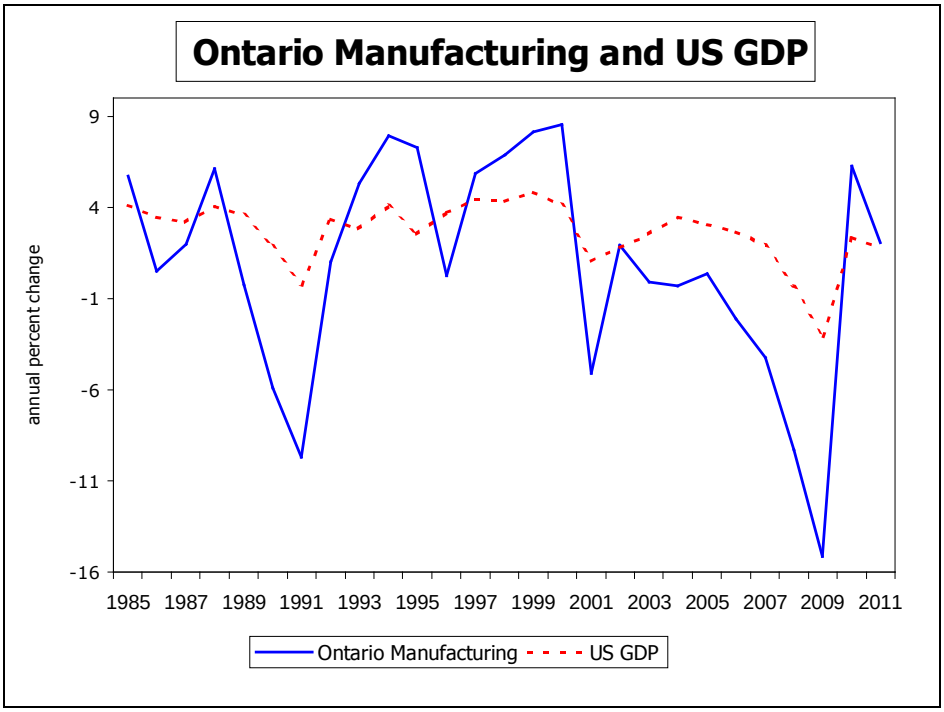
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.050007	0.492711	4.160666	0.0000
DIFQA	0.641056	0.043392	14.77351	0.0000

R-squared	0.478364	Mean dependent var	0.968702
Adjusted R-squared	0.476172	S.D. dependent var	10.42937
S.E. of regression	7.548360	Akaike info criterion	6.888836
Sum squared resid	13560.70	Schwarz criterion	6.917841
Log likelihood	-824.6603	Hannan-Quinn criter.	6.900523
F-statistic	218.2565	Durbin-Watson stat	2.253605
Prob(F-statistic)	0.000000		

Appendix 2. Factors Explaining Manufacturing Output

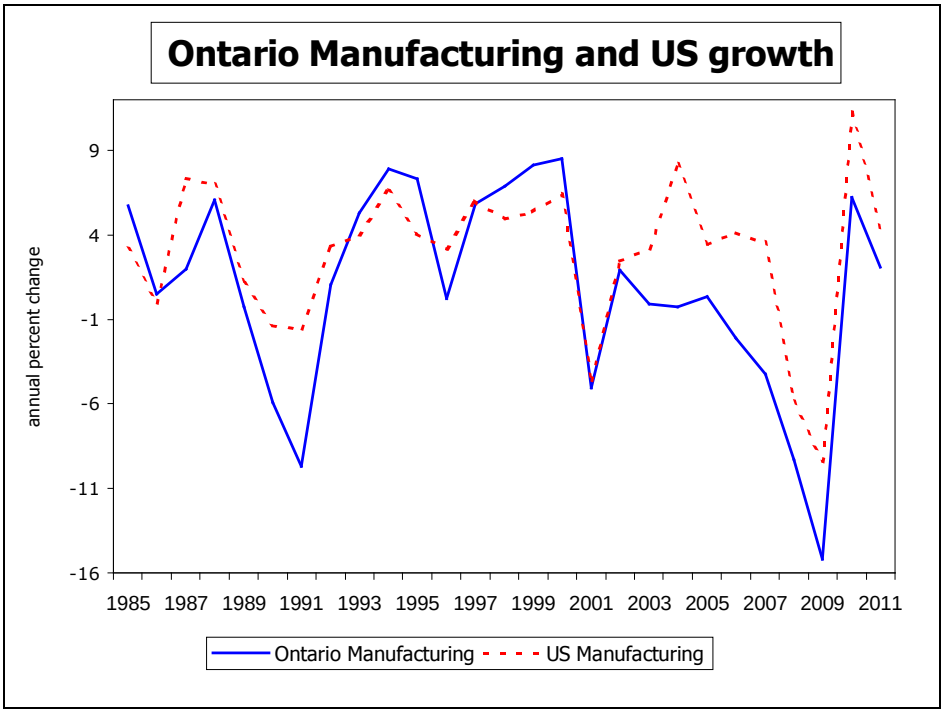
At the aggregate level, growth in manufacturing output in Ontario is quite well explained by US growth and the deviation of the exchange rate from its purchasing power parity value. It can be seen that the peaks and troughs of the rate of change of Ontario manufacturing output growth roughly corresponds with US real GDP growth, but manufacturing output is far more volatile.

Figure 7



There is a much closer correlation between Ontario manufacturing output and US manufacturing, reflecting a close integration of the sectors:

Figure 8



In the following regression:

DIFQAMFG is the annual percentage change in real value added in Ontario manufacturing.

USMFG is the annual percentage change in US manufacturing output.

DPPRAT is the change from the previous year in the ratio of the actual exchange rate to its PPP value (from the OECD). A rising value implies overvaluation. A distributed lag from t(-1) to (t-4) was found to provide the best fit.

The high coefficient on US manufacturing indicates the high degree of integration of Ontario with the US economy under the Canada-US FTA.

Experiments with alternative distributed lag structures on the exchange rate found that the best fit was obtained by only two lags, t-1 and t-4, which gives the favourable outcome that the adjustment to the exchange rate is completed after four years. If this can be relied on, it implies that Ontario is over the worst of the adjustment. The effect of the exchange rate on the ***rate of change*** of output has almost completed its adjustment. Note that the dependent variable is the rate of change of manufacturing output. A negative rate of change cumulates to a lower level. This implies a permanent loss in the ***level*** of output as long as the exchange rate remains at its elevated level.[18]

[18] A high degree of temporal stability was found. When the regression was estimated over the shorter sample from 1985 to 2001, which leaves out the latest upward trend of the exchange rate, the sum of coefficients was little changed, at -0.73. However, the t-stat was also lower, at -2.6.

The coefficient on US growth is slightly larger than on the exchange rate, but that does not tell the whole story in terms of magnitude of impact. The standard deviation of the US growth rate is only 4.5, while the standard deviation of the exchange rate variable was 6 over the historical sample period. The implication of the distributed lag formulation is that the exchange rate takes about years to be fully passed through, but the bulk of the impact is felt within three years.

Dependent Variable: DIFQAMFG
Method: Least Squares
Date: 01/03/13 Time: 19:41
Sample: 1985 2011
Included observations: 27

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.244734	0.654701	-1.901223	0.0705
USMFG	0.862068	0.127188	6.777901	0.0000
PDL01	-0.173666	0.071558	-2.426932	0.0239
PDL02	0.059116	0.062713	0.942655	0.3561
PDL03	-0.032336	0.054834	-0.589706	0.5614

R-squared	0.844206	Mean dependent var	0.892461
Adjusted R-squared	0.815880	S.D. dependent var	6.074356
S.E. of regression	2.606457	Akaike info criterion	4.919437
Sum squared resid	149.4596	Schwarz criterion	5.159407
Log likelihood	-61.41240	Hannan-Quinn criter.	4.990793
F-statistic	29.80308	Durbin-Watson stat	1.867104
Prob(F-statistic)	0.000000		

Lag Distribution of DPPPRAT(-1)	i	Coefficient	Std. Error	t-Statistic
* .|	0	-0.26512	0.08727	-3.03796
* .|	1	-0.17367	0.07156	-2.42693
* .|	2	-0.14689	0.06559	-2.23955
* .|	3	-0.18478	0.10012	-1.84563
	Sum of Lags	-0.77045	0.15938	-4.83417

It is interesting to compare ROC manufacturing with Ontario. In the following regression, everything is the same, except that the dependent variable is the rate of change of manufacturing value added in the rest of Canada. The coefficient on US growth is almost the same. While the ROC provinces export products related to natural resources, the demand for these appears to be highly correlated with the US manufacturing cycle.

What is remarkably different is the exchange rate, which is just barely statistically significant, and has a much lower impact. This does not change even when a shorter sample period is used, leaving out the latest upsurge of the exchange rate. The sum of coefficients on the exchange rate distributed lag is -0.77 for Ontario, compared to only -0.27 for ROC.

This probably reflects the greater reliance of the rest of Canada on exports of natural resource commodities, whose prices are set internationally in US dollars, and tend to be

correlated with the exchange rate. Much of what is classed as manufacturing in those provinces consists of processing of those commodities, or providing inputs into the commodity production. Strong commodity prices encourage natural resource production in those provinces, and resource-related manufacturing activities. If certain inputs and equipment need to be customized, there is an advantage to being close to the customer, and it would make the demand relatively impervious to the exchange rate.

Dependent Variable: DIFQAMFGROC
Method: Least Squares
Date: 12/30/12 Time: 12:24
Sample: 1985 2011
Included observations: 27

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.207272	0.689373	0.300667	0.7665
USMFG	0.715764	0.133924	5.344565	0.0000
PDL01	-0.095323	0.075347	-1.265110	0.2191
PDL02	-0.086962	0.066034	-1.316926	0.2014
PDL03	0.046494	0.057738	0.805259	0.4293

R-squared	0.691579	Mean dependent var	2.208898
Adjusted R-squared	0.635503	S.D. dependent var	4.545843
S.E. of regression	2.744490	Akaike info criterion	5.022643
Sum squared resid	165.7089	Schwarz criterion	5.262613
Log likelihood	-62.80568	Hannan-Quinn criter.	5.093999
F-statistic	12.33278	Durbin-Watson stat	1.537357
Prob(F-statistic)	0.000021		

Lag Distribution of DPPPRAT(-1)	i	Coefficient	Std. Error	t-Statistic
. *|	0	0.03813	0.09189	0.41498
* . |	1	-0.09532	0.07535	-1.26511
* . |	2	-0.13579	0.06906	-1.96626
* . |	3	-0.08327	0.10542	-0.78992
	Sum of Lags	-0.27625	0.16782	-1.64617

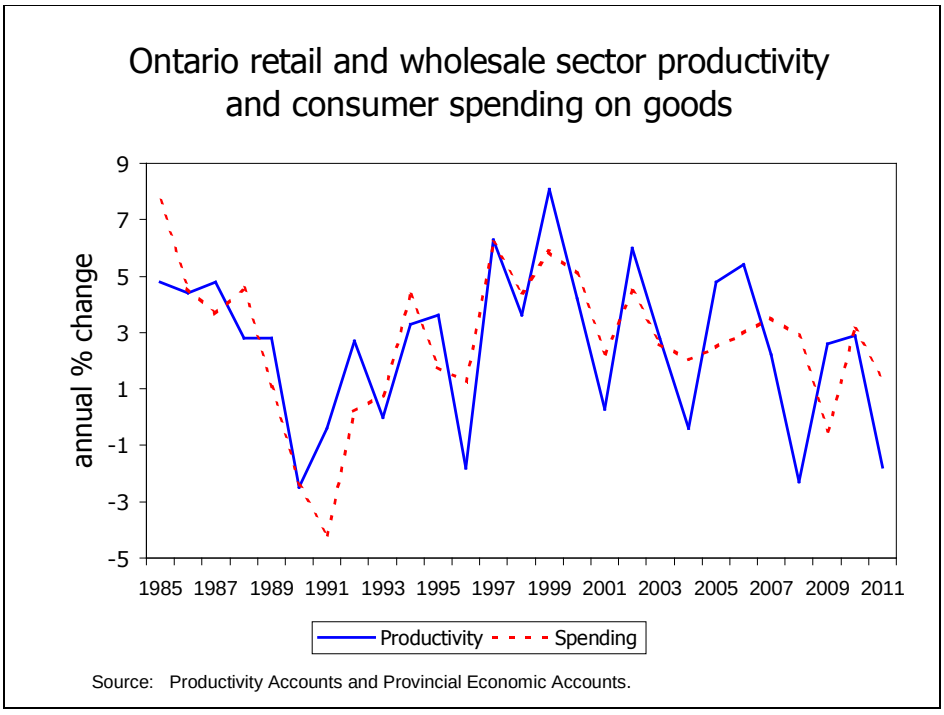
Appendix 3. Analysis of Productivity Growth in Wholesale and Retail Trade

As was noted above in the discussion of Table 6, productivity growth in the distribution services provided by wholesalers and retailers increased considerably more in the ROC than in Ontario over the last several years.

For the purpose of the analysis below, retail and wholesale trade have been combined into one sector. In Statistics Canada's definition, "wholesale" includes many big box stores selling to the public. The historical distinction between wholesale and retail has largely vanished.

Intuitively, one would expect that productivity in this sector is quite cyclical. Stores can vary the number of staff they have on hand to some extent, depending on the amount of volume. However, even when customers are few and far between, they have to keep a certain minimum number of staff in each store. Therefore, in periods of slack, sales clerks will be standing around not making many sales. Productivity in terms of service provided per hour of work will be relatively low. The strong cyclical association between this sector's productivity growth and consumer spending is seen in Figure 9.

Figure 9



The spending variable in Figure 9 is real consumer spending on goods (that is, total consumer spending minus spending on services).

This relationship was used in a regression equation, pooling data for both Ontario and the ROC. A strong and statistically significant relationship was found, with productivity rising about 0.86 percent for each percentage increase consumer spending.

Dependent Variable: PROD
Method: Panel Least Squares
Date: 01/03/13 Time: 19:36
Sample: 1985 2011
Periods included: 27
Cross-sections included: 2
Total panel (balanced) observations: 54

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.149123	0.493590	-0.302118	0.7638
SPEND	0.860094	0.144990	5.932093	0.0000

R-squared	0.403599	Mean dependent var	2.079074
Adjusted R-squared	0.392130	S.D. dependent var	3.018173
S.E. of regression	2.353149	Akaike info criterion	4.585720
Sum squared resid	287.9402	Schwarz criterion	4.659386
Log likelihood	-121.8144	Hannan-Quinn criter.	4.614130
F-statistic	35.18972	Durbin-Watson stat	2.073680
Prob(F-statistic)	0.000000		