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A DETAILED ANALYSIS OF PRODUCTIVITY TRENDS IN THE FOREST PRODUCTS SECTOR IN ONTARIO, 2000-2013: SUNSET INDUSTRY OR INDUSTRY IN TRANSITION?

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A Detailed Analysis of Productivity Trends in the Forest Products Sector in Ontario, 2000-2013: Sunset Industry or Industry in Transition?

Abstract

Ontario's forest products sector was hit by a near perfect storm in the first decade of the twenty-first century, when a multitude of structural and cyclical factors came together to devastate the sector. Despite this, the Ontario forest products sector has had an above-average productivity performance, driven in particular by the wood product manufacturing subsector. This report provides a detailed analysis of output, input and productivity trends in the Ontario forest products sector. It also looks at the key drivers of productivity in the sector, investigating potential barriers to productivity growth and discussing policies that could enable faster growth. Given the increasing role of countries with low-labour costs in several forest product markets, maintaining robust productivity growth is an imperative for Ontario's forest products sector if it wants to remain competitive internationally. In this vein, the report recommends a renewed focus on human and physical capital investment, as well as on R&D spending and the introduction of new innovative products.

A Detailed Analysis of Productivity Trends in the Forest Products Sector in Ontario, 2000-2013: Sunset Industry or Industry in Transition?

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A Detailed Analysis of Productivity Trends in the Forest Products Sector in Ontario, 2000-2013: Sunset Industry or Industry in Transition?

Executive Summary

Ontario's forest products sector was hit by a near perfect storm in the first decade of the twenty-first century, when a multitude of structural and cyclical factors came together to devastate the sector. With the combination of demand-reducing factors, the forest products sector was forced to take drastic measures to reduce production costs in order to survive. Closing plants and reducing employment levels through layoffs was the most obvious way to reduce costs and Ontario's forest products firms were particularly aggressive in this regard. Indeed, employment and hours worked fell at a greater rate than output in 2000-2013, leading to labour productivity growth of 1.0 per cent per year in the forest products sector compared to 0.6 per cent per year in the total economy.

The report examines productivity trends and drivers in Ontario's forest products sector since 1997, with a particular focus on the 2000-2013 period. The report provides a detailed statistical analysis of trends in output, hours worked and labour productivity in Ontario's forest products sector, as well as a discussion of the drivers of the sector's performance.

A. Trends in Real GDP, Hours Worked and Labour Productivity

The economic context in the first decade of the twenty-first century was not favourable for the forest products sector. The global recession stemming from the financial crisis in the United States affected demand for Ontario's forest products in the late 2000s. Even worse, the U.S. housing market – a major source of demand for the Ontario's forest products – crashed after 2005, as manifested by a dramatic decline in housing starts, and has remained weak since then. However, the decline in demand for Ontario's forest products was more structural than cyclical.

There has also been a continuous structural shift from paper products to electronic media and devices, a development which gained speed in the 2000s. The displacement of forest products by electronic devices and electronic media, colloquially referred to as "iPadization", has severely reduced demand for forest products, especially pulp and paper products.

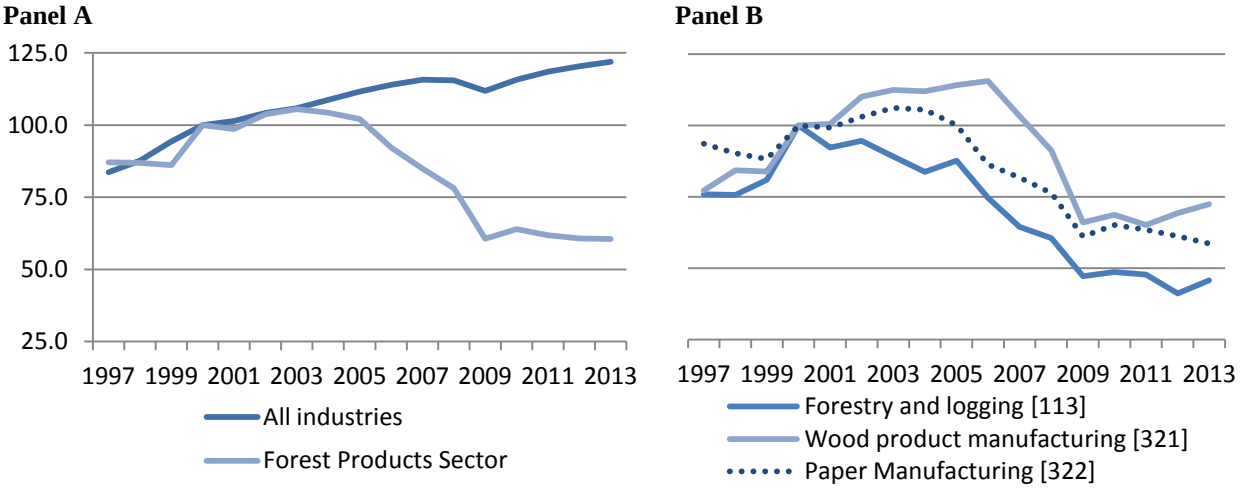
The negative demand effects of the U.S. housing crisis and the structural shift away from paper have been exacerbated in the 2000s by an appreciation of the Canadian dollar, which led to a deterioration of cost competitiveness and reduced demand further for Ontario's forest product

exports. In particular, the Canadian dollar increased from a low of US$0.62 in January 2002 to a high of US$1.03 in November 2007. The emergence of low-cost forest product producers in emerging economies is yet another factor in reducing demand for Ontario's forest products.

Between 1997 and 2013, real GDP in the Ontario forest products sector has grown much more slowly than total economy real GDP (-2.3 versus 2.4 per cent per year). In Ontario, trends in real GDP growth in the forest products sector were in line with trends in the total economy from 1997 to 2004 (Chart i, Panel A). However, the real GDP of Ontario's forest products sector trended rapidly downward from 2004 to 2009, reflecting the near perfect storm afflicting the sector, before stabilizing from 2009 to 2013.

Real GDP in forestry and logging has been in decline since 2000, while paper and wood product manufacturing started to decline in 2004 and 2006, respectively (Chart i, Panel B). After experiencing large declines in the 2000s, real GDP in all sub-sectors was stable in 2009-2013.

Chart i: Real GDP in the Forest Products Sector, Ontario, 2000=100, Per Cent, 1997-2013



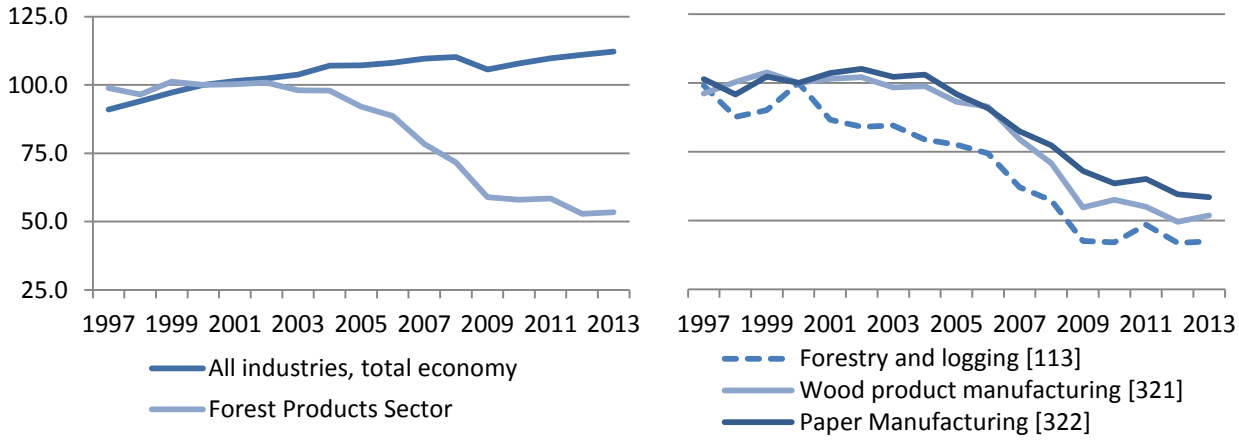
Source: CSLS calculations based on Statistics Canada data.

Hours worked in Ontario's forest products sector have also fallen significantly since 1997, with much stronger declines in 2007-2013. In line with trends in real GDP, hours worked in Ontario's forest products sector declined from 2002 to 2009 before stabilizing from 2009 to 2013 (Chart ii, Panel A). In contrast, hours worked in the total economy have been increasing fairly steadily since 2000, excluding a minor decline in 2009.

Hours worked in forestry and logging have been in decline since 2000, while both paper and wood product manufacturing started to decline in 2004 (Chart ii, Panel B). After experiencing large declines in the 2000s, hours worked in all three sub-sectors were stable from 2009 to 2013.

Chart ii: Hours Worked in the Forest Products Sector, Ontario, 2000=100, Per Cent, 1997-2013

Panel A **Panel B**



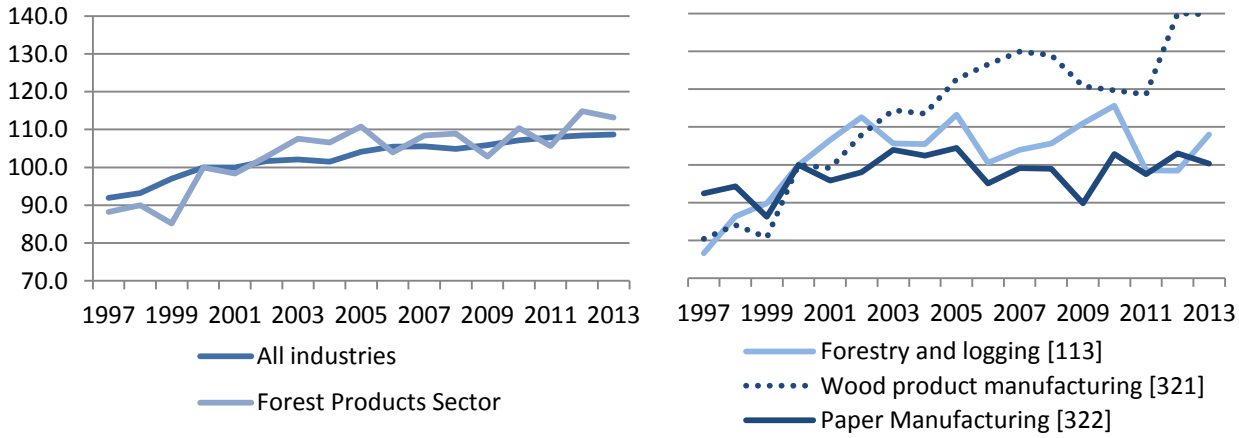
Source: CSLS calculations based on Statistics Canada data.

As a result of the aforementioned trends in real GDP and hours worked, labour productivity growth in Ontario's forest products sector has been unstable, with labour productivity repeatedly rising and falling in 1997-2013 (Chart iii, Panel A). Despite this, labour productivity in Ontario's forest products sector increased 13.2 per cent from 2000 to 2013 as hours worked fell more than real GDP. In contrast, the total economy only saw labour productivity growth of 8.7 per cent in 2000-2013. Despite negative output growth after 2004, the forest products sector maintained positive labour productivity growth by cutting hours worked.

However, labour productivity growth was much slower in 2004-2013 than in 1997-2004, as weaker demand conditions dragged on labour productivity growth in the forest products sector. The forest products sector was clearly hit hard by the 2008-09 recession and the collapse of the U.S. housing market in 2006-2009, which is reflected in the weaker growth after 2004.

Chart iii: Labour Productivity in the Forest Products Sector, Ontario, 2000=100, Per Cent, 1997-2013

Panel A **Panel B**

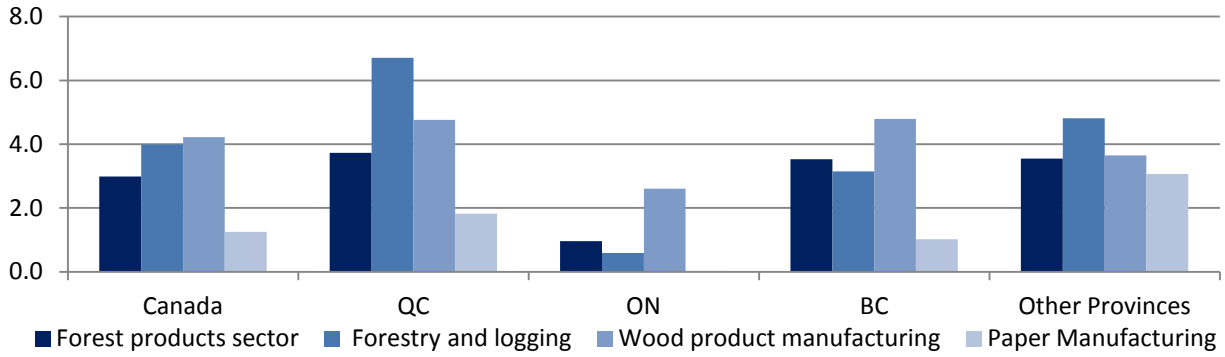


Source: CSLS calculations based on Statistics Canada data.

Labour productivity in wood product manufacturing has been on an upward trend since 2000, while labour productivity growth has been volatile in both paper manufacturing and forestry and logging since the early 2000s (Chart iii, Panel B).

Between 2000 and 2013, Ontario's forest products sector was the weakest performer in terms of labour productivity growth among the provinces for which data are available (Chart iv). In particular, labour productivity in Ontario's forest products sector grew at an average annual rate of 1.0 per cent in 2000-2013, while labour productivity in Canada, Quebec and British Columbia's forest products sectors grew at average annual rates of 3.0, 3.7 and 3.5 per cent, respectively. However, Ontario's forest products sector outperformed the all-industry average for Canada (0.9 per cent) as well as the all-industry average for Ontario (0.6 per cent), ranking eighth among eighteen two-digit NAICS industries in terms of labour productivity growth.

Chart iv: Labour Productivity, Forest Products Sector, Canada and Selected Provinces, Compound Average Annual Growth, Per Cent 2000-2013



Source: CSLS calculations based on Statistics Canada data.

Despite keeping pace with the all-industry average, labour productivity growth in Ontario's forest products sector was below that of the two other major forest products producing provinces and the Canadian average for all three subsectors in 2000-2013. The magnitude of the difference in labour productivity growth between Canada and Ontario was the largest in forestry and logging (3.4 percentage points), while there were slightly less pronounced differences in wood product and paper manufacturing (1.6 and 1.3 percentage points, respectively).

B. Drivers of Labour Productivity Growth

The report discusses possible explanations for the aforementioned productivity trends in Ontario's forest products sector. In particular, it aims to explain the mild labour productivity growth in Ontario's forest products sector after 2000, despite the dramatic fall in output, which is often associated with negative labour productivity growth.

Simple growth accounting procedures show that the main driving force behind the rapid labour productivity growth in Ontario's forest products sector was multifactor productivity (MFP) growth, as opposed to capital intensity growth. MFP growth contributed 0.9 percentage point to labour productivity growth in the forest products sector compared to 0.4 percentage point for the total economy. In contrast, capital intensity contributed more to labour productivity growth in the total economy than it did in the forest products sector (0.3 versus 0.04 percentage point).

By definition, MFP growth is a residual, representing output growth that is not accounted for by measured input growth. It is often seen as a proxy for disembodied technological change, but the reality is that it encompasses a variety of different factors, including technical and organizational improvements, capacity utilization, returns to scale, economies of scale, and labour quality. MFP growth also embeds errors due to mismeasurement of inputs and outputs.

One element embodied in MFP growth is human capital improvements. In the forest products sector, there is evidence that the workforce is becoming increasingly educated over time. However, there is no evidence that superior MFP growth in the forest products sector was due to faster growth in human capital. For example, at the national level, changes in human capital improvements played a very small role in labour productivity growth in the sector.[1]

A second element embodied in MFP growth is innovation and technological change. A good proxy for innovation and technological change is business enterprise R&D spending. In 2011, firms in the forest products sector in Ontario spent $48 million in R&D, down from $140 million in 2004. Furthermore, R&D intensity and investment in physical capital have been declining in recent years. This suggests that a number of firms in Ontario are using outdated capital assets that do not embody the latest technologies.

These changes may have put downward pressure on productivity growth in Ontario's forest products sector. However, we found no evidence that the decline in R&D investment had a significant impact on labour productivity growth in the forest products sector. There are two reasons for this. First, there tends to be a long lag between R&D spending and the associated productivity gains. Second, firms in Ontario's forest products sector can simply adopt new technologies developed in other jurisdictions.

In addition to human capital, innovation and investment, other supply-side factors – such as changes in the quality and size of natural resources, industrial and intersectoral shifts, and changes in the microeconomic environment – cannot explain recent productivity trends in Ontario's forest products sector (Table i).

[1] Due to data restrictions, the contribution of human capital accumulation to labour productivity growth could not be studied at the provincial level.

Table i: Drivers and their Potential Impact on Productivity Growth in Ontario's Forest Products Sector

Driver	Impact	Reasoning
Human capital	Unlikely	The contribution of changes in labour composition to labour productivity growth is small at the national level. Hence, productivity increased due to human capital, but only marginally. It is unlikely that the story is different at the provincial level.
Innovation	Unlikely	Research and development expenditures and investment figures were either stagnant or decreasing, which may have put downward pressure on productivity growth in Ontario's forest products sector.
Profits	Likely	The composition, survival and investment effects can be used to explain productivity trends for the forest products sector. In particular, the composition and survival effects explain why productivity growth was positive despite declining output and employment, while the investment effect explains why productivity growth was so weak.
Industrial and intersectoral shifts	Unlikely	Industrial and intersectoral shifts explain only a small portion of productivity growth at the national level, so it is unlikely that they would explain a large portion at the provincial level.
Quality and size of natural resources	Unlikely	We found no evidence of a significant change or a reduction in the quality or size of the natural resources available.
Macroeconomic environment	Likely	Weak foreign demand – influenced by exchange rates, unit labour costs, and other cyclical and structural factors – reduced the profits of firms in the forest products sector and, in turn, drove firms to reduce investment, cut employment and shutter establishments. This weak macroeconomic environment likely hampered productivity growth *à la* Verdoorn's law.
Microeconomic environment	Unlikely	Marginal effective tax rates have declined in recent years, which should encourage investment. However, there was no accompanying increase in investment. Regulation may have impacted productivity in the past, but it is unlikely that it has impacted current productivity trends.

Overwhelmingly, labour productivity appears to have been driven by demand-side factors in recent years. In particular, the dramatic slowdown in output growth between 1997-2004 and 2004-2013 appears to explain the coincident falloff in labour productivity.

Periods of weak or negative output growth are generally associated with weak or negative labour productivity growth, just as periods of strong output growth are associated with robust productivity gains; this relationship is known in the literature as Verdoorn's law. As suggested by Verdoorn's law, there was a positive relationship between output growth and labour productivity growth in the Ontario forest products sector between 1997 and 2013. In particular, both labour productivity growth and output growth were strong from 1997 to 2004, while both labour productivity growth and output growth were considerably weaker from 2004 to 2013.

Weak foreign demand for Ontario's forest products, as manifested by steep declines in foreign exports, explains much of the falloff in real GDP growth in the forest products sector. In Ontario, 35.8 per cent of gross output in the forest products sector is exported. The remainder is

used for domestic consumption or as intermediate inputs in domestic production. From 2000 to 2013, Ontario's exports in the forest products sector declined by almost two-thirds. This was entirely explained by falling exports to the United States.

The decline in exports of forest products to the United States was driven by many factors. First and foremost, the negative demand effects associated with the U.S. housing and financial crises and the structural shift away from pulp and paper products toward electronic media and electronic devices contributed to the decline in exports to the United States. However, these factors were exacerbated by the appreciation of the Canadian dollar, which reduced foreign demand for Ontario's forest products by making them more expensive for U.S. customers and contributing to an increase in unit labour costs.

Another potential explanation for a declining competitiveness and thereby declining exports is increased energy costs. The pulp and paper industry is extremely energy intensive, and as such, high energy costs can deeply dampen competitiveness by increasing overall operating costs. Energy prices in Ontario are extremely high in comparison to other Canadian provinces and likely extremely high in comparison to other international operations.

Weak demand conditions can reduce productivity growth through various mechanisms. The positive relationship between output growth and productivity growth is typically attributed to the existence of greater opportunities economies of scale and scope and learning-by-doing when output expands and a loss of these sources of productivity gains when output contracts. However, weak demand conditions also affect productivity growth by reducing profits.

Falling profits can affect productivity through three main paths: 1) by forcing low-productivity establishments out of business, raising the average productivity of the sector (the "composition effect"); 2) by forcing firms to cut costs and improve the overall efficiency of their production processes, thereby raising productivity growth (the "survival effect"); and 3) by making it harder for firms to invest in R&D, or new capital, thereby slowing down productivity growth (the "investment effect"). In any sector, it is difficult to determine the total effect of profits on productivity, since these channels push in different directions. Nevertheless, profits in the forest products sector in Canada fell fairly consistently from 2000 to 2009 in all three subsectors. After the recession of 2009, profits began to rise again, although there were signs that they were dipping in 2011, especially in wood product manufacturing.

Estimated operating surpluses, a measure of profitability, in Ontario's paper and wood products manufacturing sectors declined from 2004 to 2008. The wood products manufacturing sector remained relatively stable from 1999 to 2003 but substantial declines occurred from 2004 to 2008. Operating surpluses in paper manufacturing have steadily declined since 2000.

Since profits have been falling for such an extended period of time, it is likely that the positive contributions from the composition effect and the survival effect have waned, while the negative investment effect is starting to take precedence. The data on the number of establishments in the forest products sector only corroborates this suggestion, since the number of establishments has been falling quite steadily in all three industry groups since the mid-2000s. Hence, profits may have been a significant contributor to productivity growth in 2000-2013.

In sum, the period since the mid-2000s has been the most difficult in the forest products sector's recent history. This crisis is largely a demand-side, not a supply-side, phenomenon, reflecting deterioration in demand for Ontario's forest products for both structural and cyclical reasons. High-cost firms became unprofitable and laid off workers and closed operations.

Given the massive downturn in the forest products sector, one might have expected a poorer productivity performance in 2000-2013. However, sharp decreases in demand can still be associated with labour productivity gains if the least productive operations are shuttered and firms respond to changing demand by eliminating inefficiencies. This appears to have been the situation in Ontario's forest products sector, although less than in Quebec (Thomas, 2015).

C. The Outlook for Ontario's Forest Products Sector

There have been signs that a number of the non-structural factors reducing demand for Ontario's forest products are beginning to disappear. For instance, the value of the Canadian dollar experienced a significant depreciation by July 2015, falling to about $0.80 U.S. dollars per Canadian dollar, and the U.S. economy and housing starts in particular have started to recover. As a result, the economic outlook for the Ontario forest products sector has improved considerably. Nevertheless, the future path of the forest products sector in Ontario relies on an awareness of the continually evolving macroeconomic environment and an ability to adapt to changing conditions.

The industry has undergone a significant transformation in recent years it. Capacity has been shed, leaving behind an industry that is much smaller than in the past. It remains to be seen whether the forest products sector in Ontario can remain competitive by improving productivity growth in the future. The sector will likely never return to what it used to be, but the forest products sector in Ontario is not likely to disappear.

Since the mid-2000s, the Ontario forest products industry has been largely an industry in decline or a sunset sector, although there has been some transition, with the development of new products. It is likely that the decline is now largely over and transition will assume much greater importance. Going forward, strong labour productivity growth will be essential for the Ontario forest products sector to make the transition to vibrant and growing sector.

A Detailed Analysis of Productivity Trends in the Forest Products Sector in Ontario, 2000-2013: Sunset Industry or Industry in Transition?[2]

In 2012, the Forest Products Association of Canada (FPAC) outlined a four-pronged strategy to transform Canada's forest products sector called the *Vision 2020 Challenge* (FPAC, 2012). The elements of this challenge included: 1) increasing productivity and competitiveness; 2) diversifying markets and products; 3) growing and capitalizing on green credentials; and 4) maximizing fibre value. Last year, FPAC (2014) supported "a renewed focus on leveraging productivity gains through investment and innovation" to bolster labour productivity growth in the forest products sector.

The Centre for the Study of Living Standards (CSLS), a not-for-profit economic research organization focusing on productivity issues, has produced this report to inform future FPAC policies, with particular attention paid to productivity issues in Ontario's forest products sector.[3] In the past, the CSLS has produced several studies for FPAC.[4] The most recent report, entitled "A Detailed Analysis of Productivity Trends in the Canadian Forest Products Sector", was released in 2014 (De Avillez, 2014). That study provided a comprehensive analysis of productivity trends in the forestry and logging, wood products, and pulp and paper industries primarily at the national level in Canada.

This report narrows the focus of the previous report by examining productivity trends and drivers in Ontario's forest products sector since 1997, with a particular focus on the 2000-2013 period.[5] This report will provide data and analysis that will support and guide future FPAC policies that are aimed at reaching the *Vision 2020 Challenge*. The two main objectives of the report are: 1) to deepen our understanding of productivity developments in Ontario's forest products sector since 2000 and the factors explaining these developments; and 2) to identify possible policies and actions for both the public and private sector to improve the province's

[2] This report was written by Evan Capeluck and Jasmin Thomas under the supervision of Andrew Sharpe. The author would like to thank Jack Mintz, Duanjie Chen and Philip Bazel for information on marginal effective tax rates, as well as Bert Waslander for his contributions to the exports section. The author would also like to thank Jean-François Larue and Nancy Tupper at the Forest Products Association of Canada (FPAC) for their comments. The CSLS would like to thank the FPAC for financial assistance.

[3] The CSLS has created a comprehensive database on the forest products sector in Ontario and Quebec between 1997 and 2013. The CSLS has also released a report on the productivity performance of the forest products sector in Quebec. Both the Quebec report and the database are available at www.csls.ca/res_reports.asp.

[4] See De Avillez (2014), Harrison and Sharpe (2009), CSLS (2003a) and CSLS (2003b).

[5] Productivity growth estimates in this report are based on real values to ensure that price changes are not affecting productivity growth estimates. It is important to note that there is an issue with measuring real values when new products are introduced to a market. Since the forest products sector has been innovating quite heavily and exploring new products (mainly in pulp and paper), the use of real value productivity estimates could skew results.

productivity performance. The report provides a detailed statistical analysis of trends in output, hours, employment and labour productivity in Ontario's forest products sector, as well as a discussion of the drivers of the sector's performance.

This report will proceed as follows. The first section provides an overview of the forest products sector. The second section evaluates the productivity performance of Ontario's forest products sector relative to Canada as a whole and the three other Canadian provinces for which data are available – namely, British Columbia, Alberta, and Quebec. The third section examines the productivity performance of Ontario's forest products sector at a detailed industry level. The fourth section discusses the drivers of labour productivity growth in the forest products sector, including investment, human capital, and innovation, among others. The fifth section discusses the outlook for Ontario's forest products sector, as well as potential future directions for the sector in terms of both public policy and private sector initiatives. A brief conclusion follows.

I. Overview of the Forest Products Sector

A. The Perfect Storm

Canada's forest products sector was hit by a near perfect storm in the first decade of the twenty-first century, when both structural and cyclical factors came together to devastate the sector. The global recession stemming from the financial crisis in the United States affected many industries in the late 2000s, including the forest products sector. Even worse, the U.S. housing market – a major source of demand for the Canadian forest products – crashed after 2005, as manifested by a dramatic decline in housing starts, and has remained weak since then.

The Senate Standing Committee on Agriculture and Forestry (2009:10), however, makes a point of emphasizing that this "decline in demand is more structural than cyclical". There has been a continuous structural shift away from paper products to electronic media and devices, a development which gained speed in the 2000s. Unlike demand for lumber in the housing sector, there likely will not be a rebound in the demand for traditional paper products such as newsprint.

The negative demand effects of the U.S. housing crisis and the structural shift away from paper have been exacerbated in the 2000s by an appreciation of the Canadian dollar, which led to a deterioration of cost competitiveness and reduced demand further for our forest product exports. The emergence of low-cost forest product producers in developing countries has been yet another factor in reducing demand for Canadian forest products and contributing to the perfect storm afflicting Canada's forest products sector.

With the combination of demand-reducing factors, the forest products sector was forced to take drastic measures to reduce production costs in order to survive. Closing plants and reducing employment levels through layoffs was the most obvious way to reduce costs and Canada's forest products firms were particularly aggressive in this regard. Indeed, employment fell at a greater rate than output, leading to labour productivity gains.

These decisions to close plants and reduce employment may have been well overdue. According to the Senate Standing Committee on Agriculture and Forestry (2009:21-22), "the weakened state of the industry had been hidden for many years by a low Canadian dollar, low energy costs and a relatively healthy demand for products made from Canadian wood. Once these factors were reversed, the industry's inherent weaknesses were revealed, creating a systemic crisis." The Senate Standing Committee on Agriculture and Forestry stated that "the structure of the industry at the start of this crisis can be explained by a variety of reasons, [but] they likely stem from a combination of historical factors, such as an inflated sense of confidence in the future given the relative prosperity the industry had experienced for years, public policies that did not adapt to the new reality and poor business decisions."

Periods of weak or negative output growth are generally associated with weak or negative labour productivity growth, just as periods of strong output growth are associated with robust productivity gains. For example, Ontario's manufacturing sector experienced negative output growth and saw weak labour productivity growth in the 2000s, both at the aggregate and industry level (Sharpe 2015). The positive relationship between output growth and productivity growth, known in the literature as Verdoorn's law, is caused by greater economies of scale and scope and learning-by-doing when output expands and a loss of these sources of productivity gains when output contracts.

As suggested by Verdoorn's law, there was a positive relationship between output growth and labour productivity growth in the Ontario forest products sector between 1997 and 2013. In particular, both labour productivity growth and output growth were strong (4.7 and 4.3 per cent per year, respectively) from 1997 to 2000, while both labour productivity growth and output growth were weak (-3.8 and 1.0 per cent per year, respectively) from 2000 to 2013. However, it is important to note that labour productivity growth still grew by 1.0 per cent per year in 2000-2013 despite large declines in real output.

Given the massive downturn in the forest products sector one might have expected a poorer productivity performance for the sector. However, sharp decreases in demand can still be associated with positive labour productivity growth if firms respond to changing demand by lowering hours worked faster than output is falling. This is especially likely to occur if firms face dramatic price or demand "shocks", which force firms to reduce inefficiencies in order to survive. In such circumstances, firms have no choice but to cut costs drastically by laying off workers and removing inefficiencies. The existence of slack and inefficiencies can allow firms to continue to produce more output per worker while employment falls. This appears to have been the situation in Ontario's forest products sector, although less than in Quebec (Thomas, 2015). Essentially, the forest products sector has exhibited that it is entirely possible to sustain positive productivity growth despite falling employment and declining real output.

In sum, the period since the mid-2000s has been the most difficult in the forest products sector's recent history in Ontario. This crisis is largely a demand-side, not a supply-side, phenomenon, reflecting a downward shift in the demand curve for forest products for both structural and cyclical reasons. High-cost firms became unprofitable and laid off workers and closed operations. The crisis was not precipitated by poor productivity growth as the labour productivity performance of the forest products sector has historically exceeded the business sector average. While productivity estimates for the forest products sector are not available before 1997 at the provincial level, national data show that output per hour in the forest products sector advanced at over 3 per cent per year between 1981 and 2000, double the business sector average of 1.6 per cent per year (De Avillez 2014).

B. Characteristics of the Forest Products Sector

The forest products sector is composed of three three-digit North American Industry Classification System (NAICS) industry groups: forestry and logging (NAICS code 113), wood product manufacturing (NAICS code 321), and paper manufacturing (NAICS code 322). The main exclusions from the forest products sector as defined in this report are support activities for the forestry industry group (NAICS code 1153), local forest product trucking (NAICS code 484223), and long distance forest product trucking (NAICS code 484233).

The forest products sector is a natural resource sector. As such, it has a number of unique characteristics that distinguish it from other sectors. In particular, these characteristics include: high capital intensity, highly competitive international markets, homogeneous goods production, output price volatility, high degrees of regulation, vertical linkages, high degrees of foreign ownership, adverse environmental impacts from production, periods of high profitability, and a growing demand for technical skills (Sharpe and Long, 2012). Some of these characteristics are more influential in some natural resources sectors than in others.[6] From the perspective of the forest products sector alone, one of the most prominent characteristics is the highly competitive international market, which leaves firms as price takers. With little control over prices, firms in the forest products sector behave accordingly in times of crisis by reducing costs, which in the short run implies layoffs or low replacement demand.

C. Economic Context in Detail

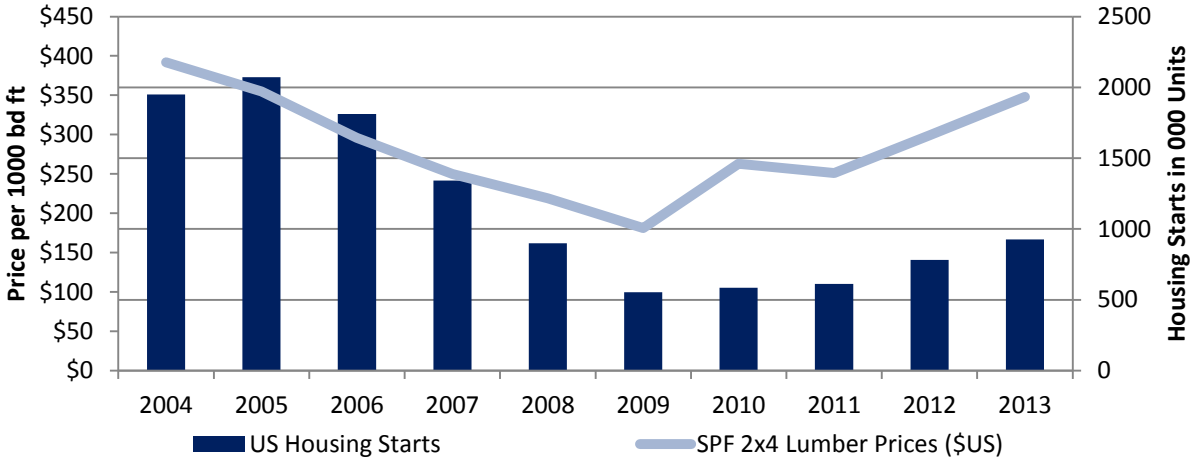
As briefly discussed above, the economic context in the first decade of the twenty-first century was not favourable for the forest products sector. Below is a more detailed accounting of the phenomena that contributed to such a dismal macroeconomic environment:

- Following a long boom in the U.S. housing market, housing starts began to decline in 2006, falling from 2.1 million units in 2005 to 0.6 million units in 2009 (Chart 1). As a result, demand for Canadian wood products (lumber in particular) collapsed, as reflected in lower lumber prices.

- The value of the Canadian dollar rose with crude oil prices in the first decade of the twenty-first century, from a low of $0.62 U.S. dollars per Canadian dollar in January 2002 to a high of $1.03 U.S. dollars per Canadian dollar in November 2007. This great appreciation of the Canadian dollar led to a massive deterioration in the demand for Canada's non-energy exports.[7]

[6] De Avillez (2014) provides a more detailed discussion of these unique characteristics of the forest products sector.
[7] The Bank of Canada provides a publicly available instrument that is capable of looking up highest and lowest CAD-USD exchange rates by date: http://www.bankofcanada.ca/rates/exchange/cad-usd-rate-lookup/.

Chart 1: Lumber Prices and Housing Starts, 2004-2013



Source: Madison Lumber Reporter, Statistics Canada, US Census Bureau (Larue, 2014)

- In 2008-09, the global recession sparked by the financial crisis in the United States hit Canada, reducing aggregate demand in the economy.

- The sector had been affected by a structural shift due to the displacement of forest products by electronic devices and electronic media, colloquially referred to as "iPadization". This shift severely reduced demand for forest products, especially pulp and paper products.

- With the high Canadian dollar making imports relatively cheap, firms across Canada could have engaged in high levels of investment, especially in foreign-sourced machinery and equipment (M&E) and information and communications technology (ICT). However, despite the high Canadian dollar, investment levels were relatively low in most sectors, including the forest products sector, reflecting the weak demand conditions undermining profitability. This may have significant implications for future productivity performance.

Similar to the aforementioned narrative, in an overview of Ontario's forest products sector, the Ontario Ministry of Natural Resources (2012) found that the following factors contributed to the downturn in the sector: 1) the higher value of the Canadian dollar; 2) access restrictions to the U.S. market under the 2006 Softwood Lumber Agreement; 3) the U.S. housing crisis; 4) expansion of digital media resulting in a weakened demand for pulp and newsprint; 5) the emergence of low-cost competitors in the global marketplace; 6) higher production costs including energy costs; and 7) the global economic recession. The downturn in the forest sector was apparent in harvesting levels, employment levels, and profit levels.

There have been signs that a number of the non-structural factors reducing demand for Ontario's forest products are beginning to disappear. For instance, the value of the Canadian

dollar experienced a significant depreciation by July 2015, falling to about $0.80 U.S. dollars per Canadian dollar, and the U.S. economy and housing starts in particular have started to recover. As a result, the economic outlook for the Canadian forest products sector has improved considerably. As a whole, the forest products sector's macroeconomic context looks promising, especially given the perfect storm from which it has just emerged. Nevertheless, the future path of the forest products sector in Canada relies on an awareness of the continually evolving macroeconomic environment and an ability to adapt to changing conditions.

D. The Role of Productivity in the Forest Products Sector[8]

FPAC's *Vision 2020 Challenge* highlights three main goals for the Canadian forest products sector in the next seven years (FPAC, 2012): 1) reduce the sector's environmental footprint by 35 per cent; 2) generate an additional $20 billion in economic activity with new innovations and new markets; and 3) renew the workforce, hiring 60,000 recruits, including women, Aboriginals, and immigrants.

Productivity gains can help the Canadian forest products sector achieve these three objectives. First, productivity growth can reduce the forest products sector's dependency on energy input, therefore reducing its environmental footprint. De Avillez (2014) notes how this is already happening in the Canadian forest products sector.

Second, productivity improvements allow firms to produce the same quantity of output by using fewer inputs, which reduces unit costs.[9] Therefore, productivity gains can help by reducing the sector's need for labour input, thus reducing production costs. This means, however, that employment in the sector might *fall* in the short-run. In the medium- and long-run, however, productivity gains in the sector can prove to be an important boon.

Finally, by lowering production costs, productivity gains can help Canadian firms to better compete with foreign firms, and thus regain some of the lost market share. The increased demand for Canadian forest products may, in turn, lead to a rise in the sector's employment. Needless to say, new markets represent an important opportunity of expansion for the Canadian forest products sector and should not be ignored. The strong demand for forest products in China, in particular, has taken front-stage in the past decade.

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[8] This section is largely based on the work of De Avillez (2014).

[9] The sector's competitiveness depends not only on productivity but also on other factors, such as exchange rates and the input costs (e.g. energy, materials and labour). Labour costs, in particular, represent a challenge to the Canadian forest products sector. High labour costs make it harder for the forest products sector in Canada to compete internationally with low-wage countries such as Russia, China, and Brazil. In fact, even when compared to other *developed* countries, Canada's labour costs are quite high. It is unlikely that labour costs in the Canadian forest products sector will experience a significant fall.

Clearly, the forest products sector has little control over the macroeconomic environment in which it is operating. Like many natural resources sectors, it is highly subject to the vicissitudes of the economic cycles and the conditions of the macro-economy. Nevertheless, this report will attempt to show that despite poor conditions in the first decade of the twenty-first century, the Ontario forest products sector was able to generate positive productivity growth, although its performance was far behind other provinces and the national average.

II. Ontario's Forest Products Sector in the Canadian Context

A. The Structure of Canada's Forest Products Sector

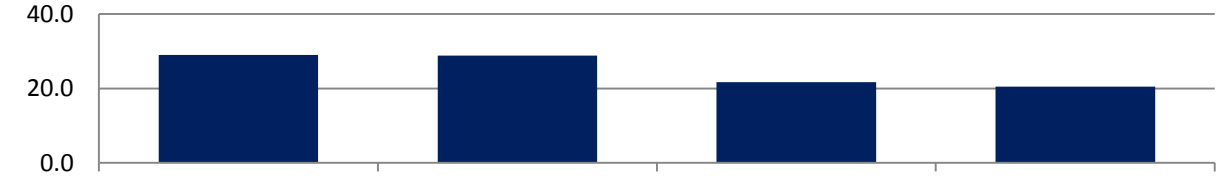
Northern Ontario contains the overwhelming majority of Ontario's commercially-productive forests. The north's boreal forest accounts for 76 per cent of forested land in the province. The region is home to 16 of the province's 33 pulp and paper mills and 22 of the province's 25 largest sawmills producing 80 per cent of the province's lumber. About one-third of communities in Northern Ontario are dependent on the forest products sector.

While the Ontario's forest products sector is not the largest among the Canadian provinces, it nevertheless provides an important source of employment and output for the province (Chart 2). In 2011, the most recent year for which nominal GDP data are available, the Ontario forest products sector produced $4.0 billion, representing 0.6 per cent of total economy nominal GDP in the province. Quebec and British Columbia were the only provinces to produce more: British Columbia's forest products sector produced $5.3 billion (or 2.7 per cent of total economy nominal GDP in the province), and the Quebec forest products sector produced $5.3 billion (or 1.6 per cent of total economy nominal GDP in the province).

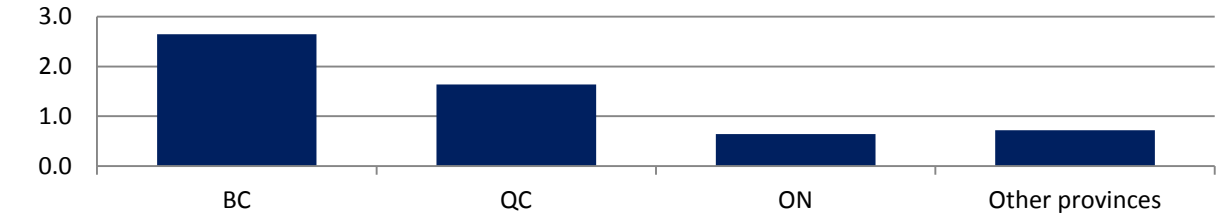
Chart 2: Nominal GDP in the Forest Products Sector, 2011

Panel A: Millions of Current Dollars

Panel B: Share of National Forest Products Sector, Per Cent



Panel C: Share of Provincial Economy, Per Cent



Source: CANSIM Table 379-0030

In 2011, Ontario accounted for a smaller share of the Canadian forest products sector than Quebec (21.7 per cent versus 28.8 per cent) and British Columbia (29.1 per cent). At the component level, Ontario represented a significantly smaller share than both Quebec and British Columbia with respect to forestry and logging and wood product manufacturing, but Ontario accounted for nearly as much of the paper manufacturing sector as the largest producer (Quebec). In particular, Ontario accounted for 32.1 per cent of total Canadian paper manufacturing nominal output in 2011, while Quebec accounted for 32.5 per cent and British Columbia accounted for only 18.9 per cent.

Of the three industry groups in the Ontario forest products sector, nominal GDP originated mainly in the paper manufacturing sector, which produced $2.6 billion in 2011 (Table 1). The wood product manufacturing sector contributed $1.0 billion in 2011, while forestry and logging contributed only $0.4 billion.

Table 1: Share of Nominal Output in Canada's Forest Products Sector, Per Cent, 2011

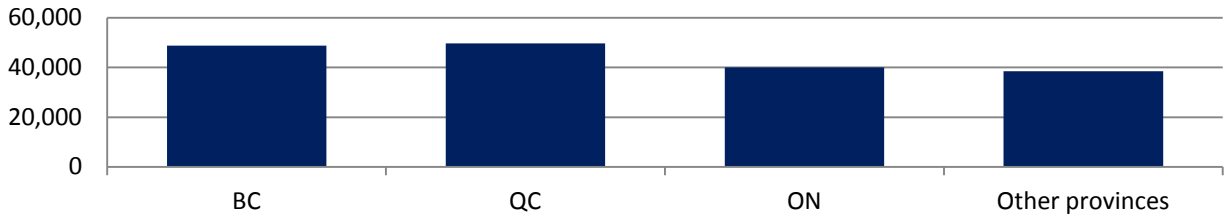
Province	Forest products sector	Forestry and logging	Wood product manufacturing	Paper manufacturing
ON	21.69	10.61	15.12	32.08
QC	28.81	23.04	27.47	32.53
BC	29.05	44.61	32.77	18.89
NFL	--	1.17	0.36	--
PEI	--	0.09	--	--
NS	--	2.15	1.61	--
NB	--	6.88	4.16	--
MB	1.30	0.68	1.95	1.05
SK	--	0.91	1.59	--
AB	--	9.48	14.87	--

Source: CSLS calculations based on Statistics Canada data.

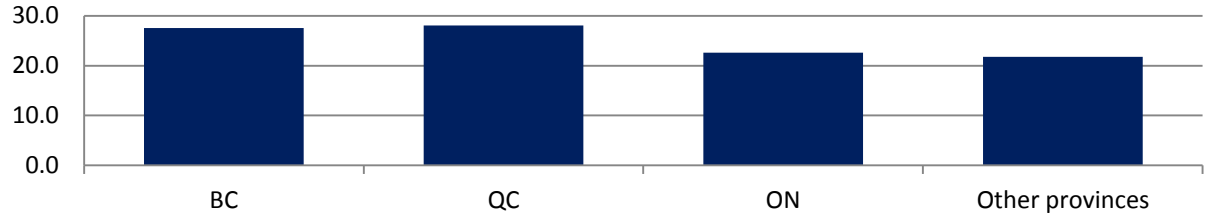
In terms of employment, similar patterns arise: Quebec and British Columbia have the largest provincial forest products sectors, followed by Ontario. These three provinces make up the majority of the job opportunities in the forest products sector in Canada, with the other ten provinces accounting for only 21.8 per cent (Chart 3). In terms of employment shares of each province's respective economy, British Columbia's forest products sector has the most economic importance, followed by Quebec and Ontario. Ontario's forest products sector's share of total economy employment is actually smaller than that exhibited by other Canadian provinces.

Chart 3: Employment, Forest Products Sector, Canada and Selected Canadian Provinces, 2011

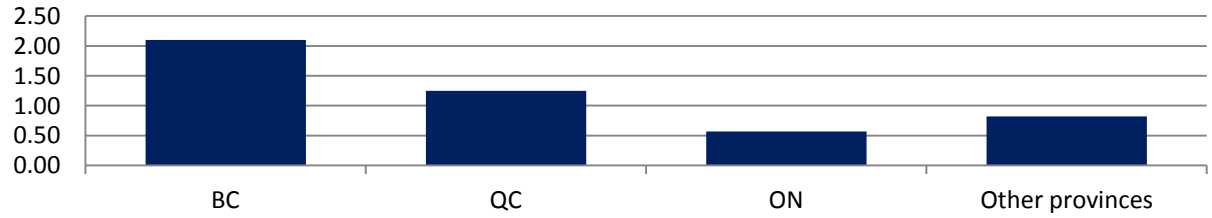
Panel A: Number of Jobs



Panel B: Share of National Forest Products Sector, Per Cent



Panel C: Share of the Provincial Economy, Per Cent



Source: CSLS calculations based on Statistics Canada data.

Essentially, these figures suggest that the forest products sector in Ontario is an important part of the Canadian forest products sector. As such, maintaining the health of the Ontario forest products sector through strong productivity growth is crucial to maintaining the health of the Canadian forest products sector as a whole.

B. The Productivity Performance of Ontario's Forest Products Sector in Comparison with Other Provinces: 2000-2013

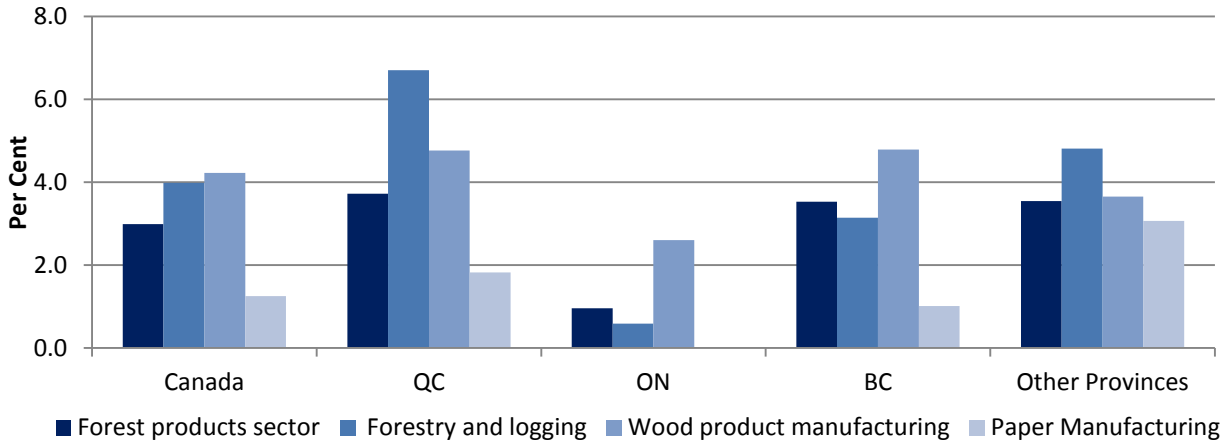
Between 2000 and 2013, Ontario's forest products sector was the weakest performer in terms of labour productivity growth among the provinces for which data are available (Chart 4). In particular, labour productivity in Ontario's forest products sector grew at an average annual rate of 1.0 per cent between 2000 and 2013, while labour productivity in Quebec and British Columbia's forest products sectors grew at average annual rates of 3.7 per cent and 3.5 per cent, respectively.[10] As a result, Ontario was well below the average annual growth rate of labour productivity in the Canadian forest products sector (3.0 per cent). However, Ontario's forest

[10] Quebec's productivity growth between 2000 and 2013 is analyzed in depth by the CSLS in Thomas (2015).

products sector outperformed the all-industry average in Canada (0.9 per cent) as well as the all-industry average in Ontario (0.6 per cent), suggesting that the sector performed adequately from an all-industry perspective.

When broken down by subsector, Ontario's forest products sector demonstrated weaker labour productivity performance than the Canadian average in all three industry groups throughout the 2000-2013 period (Chart 3). The magnitude of the difference in labour productivity growth between Canada and Ontario was the largest in forestry and logging (3.4 percentage points), while there were slightly less pronounced differences in wood product manufacturing and paper manufacturing (1.6 and 1.3 percentage points, respectively).

Chart 4: Labour Productivity, Forest Products Sector, Canada and Selected Provinces, Compound Average Annual Growth, Per Cent 2000-2013



Relative to the other provinces for which data are available, Ontario's labour productivity growth was the weakest in every subsector between 2000 and 2013. In absolute terms, Ontario's wood product manufacturing demonstrated reasonably strong labour productivity growth throughout the period (2.6 per cent per year), but was still far below the growth exhibited by Quebec (4.8 per cent per year) and British Columbia (4.8 per cent per year).

In sum, despite keeping pace with the all-industry average, labour productivity growth in Ontario's forest products sector was below that of the other major forest-products producing provinces for all three subsectors between 2000 and 2013.

C. The Performance of Ontario's Forest Products Sector in Comparison with Other Provinces: 2007-2013

This section focuses on the most recent period (2007-2013) to provide a more detailed analysis of the components of labour productivity growth, namely output growth and labour

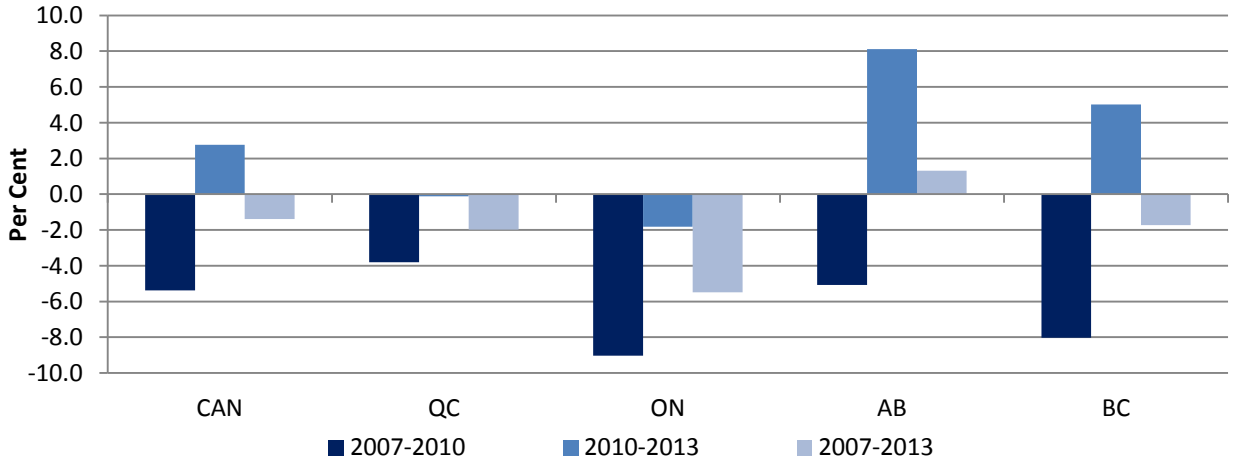
input growth. As this period is more closely associated with the current economic conditions than the longer period (2000-2013), the results provide more relevant information. The section starts with real gross domestic product (GDP), examining the entire 2007-2013 period as well as two sub-periods (2007-2010 and 2010-2013). Next, the section examines hours worked, before combining the results to analyze labour productivity.

i. Real GDP

Ontario had the worst output performance of the four major forest-products producing provinces in the 2007-2013 period, as well as in both the 2007-2010 and 2010-2013 sub-periods (Chart 5). Between 2007 and 2013, Ontario's compound average annual growth rate (-5.5 per cent) was 3.5 percentage points lower than that of Quebec (-2.0 per cent), 3.8 percentage points lower than that of British Columbia (-1.7 per cent), and 6.8 percentage points lower than that of Alberta (1.3 per cent). The negative growth rate experienced throughout this period largely reflects massive declines in real GDP between 2007 and 2010 (-9.0 per cent per year); however, real GDP also declined between 2010 and 2013 (-1.8 per cent per year), a recovery period for the Canadian forest products sector as a whole.

At the national level, real GDP in the forest products sector fell at an average annual rate of 5.4 per cent between 2007 and 2010, rebounding to a positive growth rate of 2.8 per cent per year between 2010 and 2013 due to large upswings in real GDP growth in Alberta and British Columbia. This pattern of much greater output growth in the second sub-period was observed in all of the provinces for which data are available; however, only Alberta and British Columbia experienced positive output growth after 2010. Both Ontario and Quebec continued to see declines in output in the forest products sector after 2010, although Ontario saw much larger falls than Quebec (-1.8 per cent per year versus -0.1 per cent per year).

Chart 5: Real GDP by Province, Forest Products Sector, Compound Average Annual Growth, Per Cent, 2007-2013



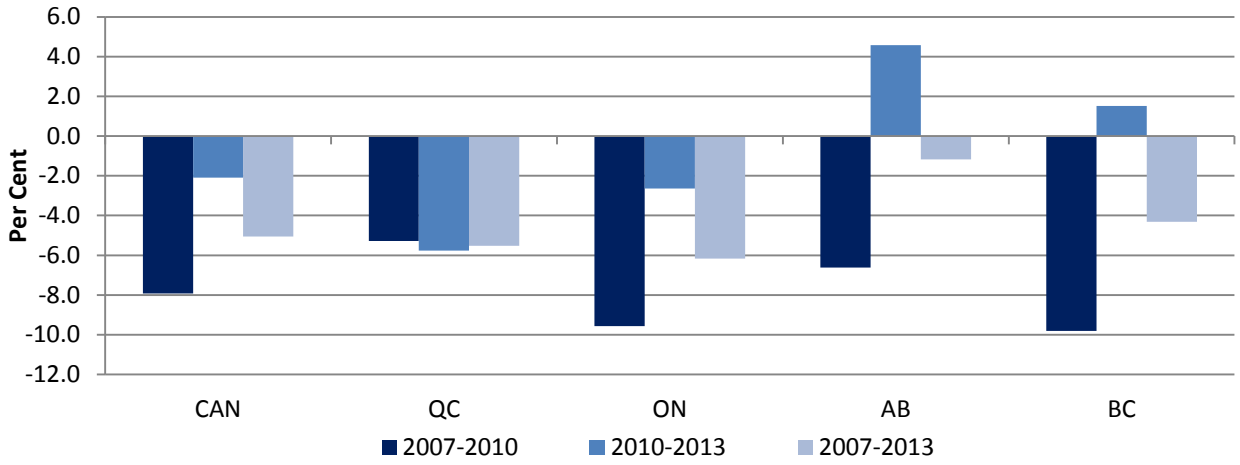
Source: CSLS calculations based on Statistics Canada data.

ii. Hours Worked[11]

In general, total hours worked, which is driven by employment, fell drastically in all of the provinces for which data are available in the 2007-2010 period because of the recession, while it fell much less dramatically in most provinces in the 2010-2013 period when output growth rebounded.[12]

Between 2007 and 2013, hours worked fell 6.2 per cent per year in Ontario, while they fell 4.3 per cent per year in British Columbia, 5.5 per cent per year in Quebec and 1.2 per cent per year in Alberta (Chart 6). In contrast to real GDP, Ontario was not the worst performer in terms of hours worked in both sub-periods. In particular, hours worked in Ontario fell 9.6 per cent per year in the first sub-period, slightly slower than in British Columbia, while they fell only 2.6 per cent per year in the latter sub-period, less quickly than in Quebec.

Chart 6: Hours Worked by Province, Forest Products Sector, Compound Average Annual Growth, Per Cent, 2007-2013



Source: CSLS calculations based on Statistics Canada data.

iii. Labour Productivity

The labour productivity performance of Ontario's forest products sector was dismal when compared to other major forest-products producing provinces and the Canadian average: Ontario experienced the lowest labour productivity growth in the 2007-2013 period and in both the 2007-2010 and 2010-2013 sub-periods. Labour productivity in the Ontario forest products sector grew 0.7 per cent per year between 2007 and 2013 (Chart 7), 3.0 percentage points behind Quebec (3.7

[11] Hours worked estimates are available from three difference sources: Survey of Employment, Payroll and Hours (SEPH), Labour Force Survey (LFS), and Canadian Productivity Accounts (CPA). This report uses the CPA estimates to calculate productivity. For a discussion of the differences between these three surveys and their implications for productivity estimates, see De Avillez (2014).

[12] It is interesting to note that hours worked in Quebec actually fell marginally faster in the second sub-period, which counters the trend observed in other provinces.

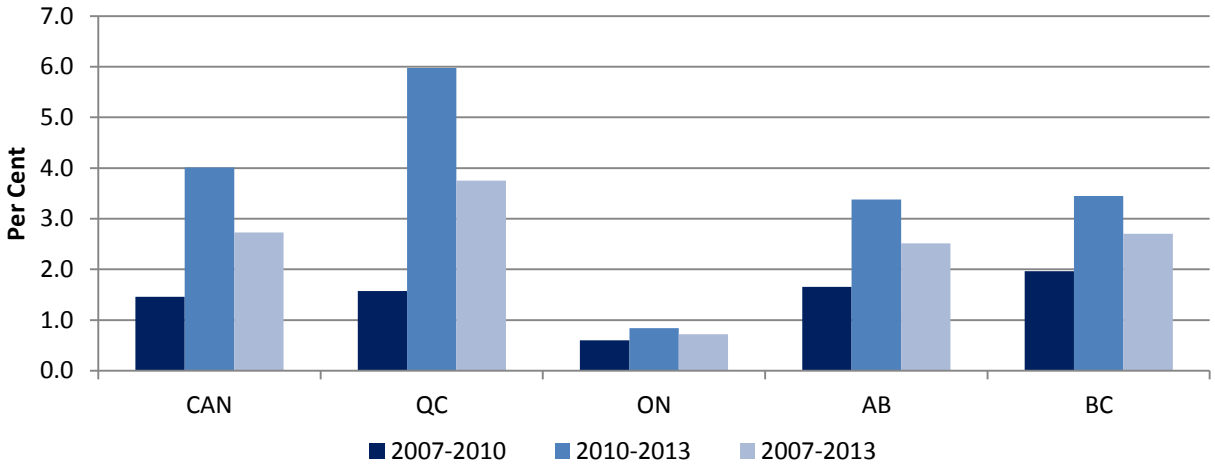
per cent per year), 2.0 percentage points below British Columbia (2.7 per cent per year), 1.8 percentage points behind Alberta (2.5 per cent per year), and 2.0 percentage points below the Canadian average (2.7 per cent per year). Nonetheless, when compared to the total economy in Ontario (0.5 per cent per year) and the total economy in Canada (0.9 per cent per year), the labour productivity performance of Ontario's forest products sector was at or only slightly below average between 2007 and 2013.

In absolute terms, Ontario's forest products sector performed slightly better in terms of labour productivity growth in 2010-2013 relative to 2007-2010, with growth of 0.6 per cent per year in 2007-2010 and 0.8 per cent per year in 2010-2013. Ontario's productivity performance was mildly less promising between 2007 and 2010 because of substantially larger declines in real GDP in 2007-2010 compared to 2010-2013. Nevertheless, the industry was able to undertake a much needed revamp and cut excess capacity: hours worked in the forest products sector in Ontario fell slightly faster than real GDP, generating positive labour productivity growth (0.6 per cent per year) between 2007 and 2010, slightly stronger than the labour productivity growth experienced by the total economy in Ontario in this period (0.5 per cent per year).

Compared to its counterparts in other provinces, the labour productivity performance of Ontario's forest products sector between 2007 and 2010 was excessively weak: every other province for which data are available relied on downsizing and layoffs to generate significant labour productivity growth during this period with hours worked falling much faster than output. In contrast, hours worked fell almost as fast as output in Ontario's forest products sector.

Between 2010 and 2013, British Columbia and Alberta were able to register positive output growth, suggesting that labour productivity growth in these two provinces was not wholly the result of hours worked falling faster than real GDP. (British Columbia actually saw hours worked increase by 1.5 per cent per year between 2010 and 2013.) Dissimilarly, both Ontario and Quebec experienced declines in real GDP between 2010 and 2013. However, despite experiencing a significantly larger decrease in real GDP than Quebec between 2000 and 2013, hours worked decreased much less in Ontario, suggesting that forest products firms in Ontario did less to improve productivity and competitiveness.

Chart 7: Labour Productivity by Province, Forest Products Sector, Compound Average Annual Growth, Per Cent, 2007-2013



Source: CSLS calculations based on Statistics Canada data.

The forest products sector in Ontario had a level of labour productivity of $46.75 per hour in 2011, much lower than in other Canadian provinces (Table 2). British Columbia registered the highest labour productivity levels in 2011 ($58.00 per hour), followed by other provinces ($49.01 per hour) and Quebec ($48.78 per hour). However, within these aggregate figures, there is an extreme amount of variation: the industry groups within each province demonstrate an enormous amount of variability.

At a more detailed level, in Ontario, paper manufacturing had labour productivity of $62.39 per hour in 2011, followed by forestry and logging ($39.87 per hour) and wood product manufacturing ($29.34 per hour). This ranking among the forestry products industry groups was consistent among the provinces and in Canada as a whole. Among the provinces, Ontario had the lowest labour productivity levels in wood product and paper manufacturing, while labour productivity in Ontario's forestry in logging industry was (slightly) higher than in its Quebec counterpart but still below the national average.

Table 2: Nominal Labour Productivity Levels, Forest Products Sector, Per Cent, 2011

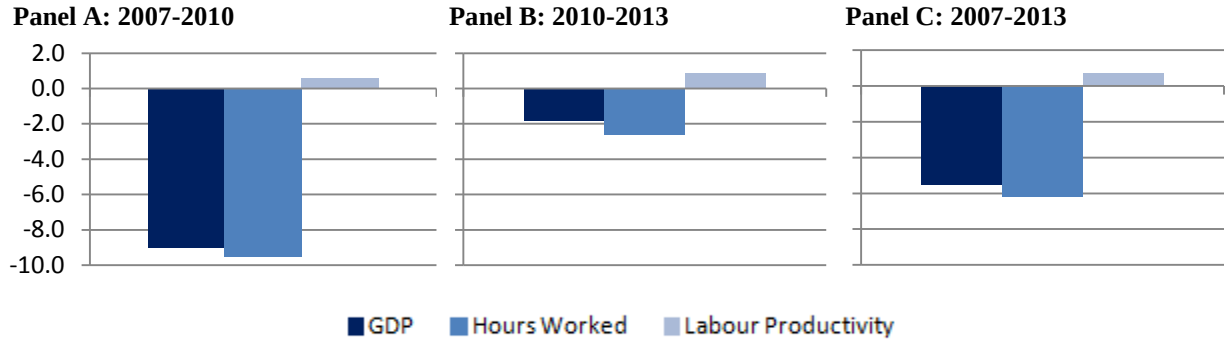
	Canada	Quebec	Ontario	British Columbia	Other Provinces
Absolute Level (Current Dollars)					
Forest products sector	50.69	48.78	46.75	58.00	49.01
Forestry and logging	48.99	38.54	39.87	61.21	48.45
Wood product manufacturing	38.48	36.74	29.34	46.89	38.68
Paper manufacturing	69.52	70.59	62.39	79.77	72.85
Relative Level (Canada=100)					
Forest products sector	100.0	96.2	92.2	114.4	96.7
Forestry and logging	100.0	78.7	81.4	124.9	98.9
Wood product manufacturing	100.0	95.5	76.2	121.9	100.5
Paper manufacturing	100.0	101.5	89.7	114.7	104.8

Source: CSLS calculations based on Statistics Canada data.

Clearly, the perfect storm that hit the sector has done substantial damage to all of the Canadian provinces, but the damage done to Ontario seems to be slightly more intense and sustained. The Ontario forest products sector has clearly attempted to overhaul production processes and reduce hours worked, as did all of the other provinces, but the confluence of those negative factors so deeply affected the forest products sector in Ontario that a recovery is yet to take hold. (Ontario was the only province in which real GDP growth in the forest products sector was not positive between 2010 and 2013.)

In sum, given the perfect storm that hit the industry in the first decade of the twenty-first century, the fact that Ontario's forest products sector experienced positive labour productivity growth is impressive. Nonetheless, the sector performed poorly compared to its counterparts in other provinces, and must improve its productivity performance to remain competitive domestically and internationally.

Chart 8: Growth in Output, Hours Worked, Labour Productivity, Ontario, Compound Annual Growth Rate, Per Cent, 2007-2013

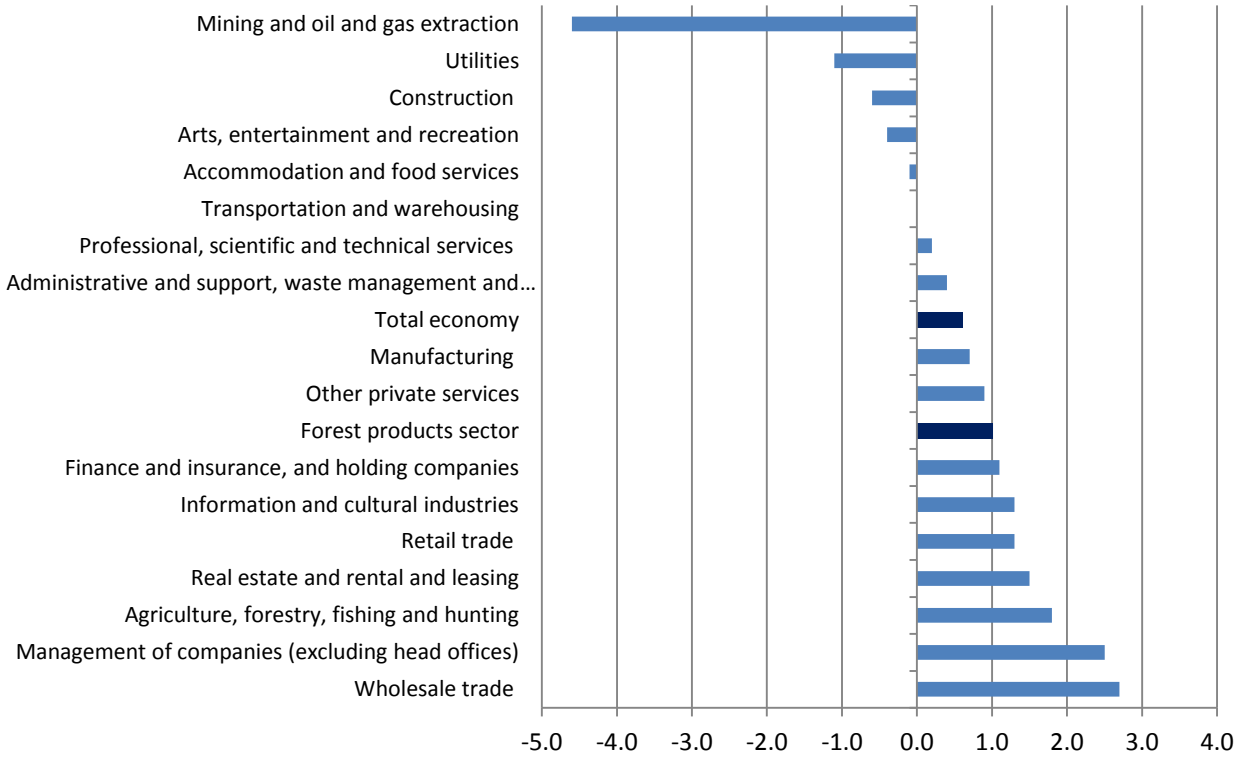


Source: CSLS calculations based on Statistics Canada data.

D. Labour Productivity Growth in Ontario's Forest Products Sector Compared to Two- and Three-digit NAICS Industries: 2000-2013

Between 2000 and 2013, the forest products sector had the eighth highest labour productivity growth among the eighteen two-digit NAICS industries in Ontario (Chart 9). It also outperformed the all-industry average. The forest products sector's labour productivity performance was above average relative to the other two-digit NAICS industries in both 2000-2007 and 2007-2013. Between 2000 and 2007, labour productivity growth was 1.2 per cent per year, while it was 0.7 per cent per year between 2007 and 2013 (Table 3). Between 2000 and 2007, the forest products sector was outperformed by seven two-digit NAICS industries. In contrast, between 2007 and 2013, the forest products sector was outperformed by only four two-digit NAICS industries. The forest products sector was clearly hit hard by the 2008-09 recession and the collapse of the U.S. housing market in 2006-2009, which is reflected in the weaker growth rate in this sub-period.

Chart 9: Labour Productivity Growth, Two-Digit NAICS Sectors, Compound Average Annual Growth, Per Cent, Ontario, 2000-2013



Source: CSLS calculations based on Statistics Canada data.

Table 3: Labour Productivity Growth, Two-Digit NAICS Sectors, Compound Average Annual Growth, Ontario, 2000-2013

	2000-2007	2007-2010	2010-2013	2007-2013	2000-2013
Total economy	0.8	0.5	0.5	0.5	0.6
Agriculture, forestry, fishing and hunting	0.7	5.7	0.3	3.0	1.8
Mining and oil and gas extraction	-7.0	-7.6	4.3	-1.8	-4.6
Utilities	4.2	-9.8	-4.2	-7.0	-1.1
Construction	0.4	-1.0	-2.5	-1.8	-0.6
Manufacturing	0.8	0.2	1.0	0.6	0.7
Wholesale trade	3.9	2.7	0.0	1.3	2.7
Retail trade	2.2	2.9	-2.4	0.2	1.3
Transportation and warehousing	0.3	-1.6	0.9	-0.4	0.0
Information and cultural industries	2.2	1.1	-0.8	0.1	1.3
Finance and insurance, and holding companies	2.6	-1.5	0.2	-0.6	1.1
Real estate and rental and leasing	-0.6	3.1	5.1	4.1	1.5
Professional, scientific and technical services	-0.1	0.0	1.2	0.6	0.2
Management of companies (excluding head offices)	4.4	3.2	-2.7	0.2	2.5
Administrative and support, waste management and remediation services	0.4	-1.0	1.7	0.3	0.4
Arts, entertainment and recreation	-0.5	0.9	-1.5	-0.3	-0.4
Accommodation and food services	-1.1	1.5	0.5	1.0	-0.1
Other private services	1.6	-0.4	0.7	0.1	0.9
Forest products sector	*1.2*	*0.6*	*0.8*	*0.7*	*1.0*

Source: CSLS calculations based on Statistics Canada data.

Between 2000 and 2013, the forest products sector experienced the largest decline in both real GDP (-3.8 per cent per year) and employment (-4.6 per cent per year) among all two-digit NAICS sectors (Table 4). The forest products sector in Ontario experienced declines in real GDP and employment that were almost double the declines seen in the manufacturing sector, the next worst performer. Despite experiencing such massive declines in both real GDP and employment, the increase in labour productivity in the forest products sector was surpassed the all-industry average in Ontario, as hours worked fell significantly more than real GDP.

Table 4: Real GDP, Employment and Labour Productivity, Two-Digit NAICS Sectors, Ontario, 2000-2013

Industry	Real GDP		Employment		Labour Productivity	
	2000-2013	2007-2013	2000-2013	2007-2013	2000-2013	2007-2013
	Compound Average Annual Growth, Per Cent					
All industries	1.5	0.9	1.3	0.8	0.6	0.5
Agriculture, forestry, fishing and hunting	1.1	2.1	-0.5	-0.6	1.8	3.0
Mining, quarrying, and oil and gas extraction	-0.8	1.4	3.6	2.5	-4.6	-1.8
Utilities	1.8	2.2	2.2	9.3	-1.1	-7.0
Construction	2.3	0.6	3.4	3.1	-0.6	-1.8
Manufacturing	-2.0	-2.8	-2.5	-3.2	0.7	0.6
Wholesale trade	2.8	1.4	0.4	0.0	2.7	1.3
Retail trade	2.7	1.3	1.8	1.6	1.3	0.2
Transportation and warehousing	1.4	0.9	1.9	1.9	0.0	-0.4
Information and cultural industries	2.8	1.4	2.1	2.0	1.3	0.1
Finance and insurance	2.5	1.3	1.6	1.9	1.1	-0.6
Real estate and rental and leasing	2.7	2.4	1.6	-1.3	1.5	4.1
Professional, scientific and technical services	1.8	1.2	2.0	0.9	0.2	0.6
Management of companies (excluding head offices)	3.4	0.9	1.2	0.7	2.5	0.2
Administrative and support, waste management and remediation services	2.2	-1.0	1.8	-0.7	0.4	0.3
Arts, entertainment and recreation	0.7	-0.8	2.0	0.8	-0.4	-0.3
Accommodation and food services	0.7	1.8	1.5	1.5	-0.1	1.0
Other services (except public administration)	1.8	0.4	1.2	0.3	0.9	0.1
Forest products sector	*-3.8*	*-5.5*	*-4.6*	*-6.0*	*1.0*	*0.7*

Source: CSLS calculations based on Statistics Canada data.

The forest products sector is composed of two industry groups that belong to the manufacturing sector. Hence, examining trends within the manufacturing sector can provide useful information concerning the relative behaviour of the forest products sector, as well as both paper manufacturing and wood product manufacturing. The immediate observation that stems from the output, employment and productivity growth in 2000-2013 and 2007-2013 is that the downturn in the manufacturing sector was due to downturns in the vast majority of the three-digit industries (Table 5).

Table 5: Real GDP, Employment and Labour Productivity, Three-Digit NAICS Codes, Ontario, 2000-2013

Industry	Output		Employment		Labour Productivity	
	2000-2013	2007-2013	2000-2013	2007-2013	2000-2013	2007-2013
	Compound Average Annual Growth, Per Cent					
Manufacturing	-2.0	-2.8	-2.5	-3.2	0.7	0.6
Food manufacturing	1.2	0.2	0.8	0.7	0.7	0.1
Beverage and tobacco product manufacturing	-4.4	-1.8	-0.6	3.9	-3.6	-5.4
Textile and textile product mills	-7.0	-6.9	-6.5	-6.3	-0.1	-1.6
Clothing and leather and allied product manufacturing	..	-6.8	-8.4	-10.0	..	2.3
Wood product manufacturing	-2.4	-5.7	-5.1	-7.2	2.6	1.2
Paper manufacturing	-4.0	-5.4	-3.9	-5.0	0.0	0.2
Printing and related support activities	-1.8	-3.8	-2.3	-3.6	0.8	-0.6
Petroleum and coal product manufacturing	-1.2	-1.1	0.9	4.7	-2.4	-5.5
Chemical manufacturing	-0.7	-1.3	-0.4	-2.5	0.0	1.5
Plastics and rubber products manufacturing	-1.5	-2.3	-3.1	-4.1	1.7	2.0
Non-metallic mineral product manufacturing	-0.3	-3.1	-0.5	-1.3	0.6	-0.9
Primary metal manufacturing	-1.7	-3.9	-4.1	-2.7	2.9	-0.2
Fabricated metal product manufacturing	-2.4	-3.2	-2.0	-3.5	-0.2	0.7
Machinery manufacturing	-2.9	-3.4	-2.7	-3.4	0.1	0.0
Computer and electronic product manufacturing	-5.5	-7.1	-4.3	-6.1	-0.9	-0.7
Electrical equipment, appliance and component manufacturing	-3.8	-0.7	-2.3	-1.2	-0.9	1.1
Transportation equipment manufacturing	-1.4	-2.5	-3.0	-3.9	1.7	1.4
Furniture and related product manufacturing	-4.7	-5.2	-3.8	-5.9	-0.5	0.9
Miscellaneous manufacturing	0.9	0.9	-1.1	-0.5	1.8	0.9
Forest products sector	*-3.8*	*-5.5*	*-4.6*	*-6.0*	*1.0*	*0.7*

Source: CSLS calculations based on Statistics Canada data.

Although the forest products sector performed worse than the manufacturing sector as a whole in terms of real GDP and employment growth in 2000-2013, it outperformed many three-digit NAICS manufacturing industries. With respect to real GDP growth, the forest products sector outperformed beverage and tobacco product manufacturing (-4.4 per cent per year), textile and textile product mills (-7.0 per cent per year), computer and electronic product manufacturing (-5.5 per cent per year), and furniture and related product manufacturing (-4.7 per cent per year). With respect to employment growth, the forest products sector outperformed textile and textile product mills (-6.5 per cent per year), and clothing and leather and allied product manufacturing (-8.4 per cent per year).

Similarly, although the forest products sector performed better than the manufacturing sector as a whole in terms of labour productivity growth between 2000 and 2013, it was outperformed by many three-digit NAICS manufacturing industries. In particular, the forest products sector was outperformed by plastics and rubber products manufacturing (1.7 per cent per year), primary metal manufacturing (2.9 per cent per year), transportation equipment manufacturing (1.7 per cent per year), and miscellaneous manufacturing (1.8 per cent per year).

E. Labour Productivity Levels in Ontario's Forest Products Sector Relative to Two-Digit NAICS Industries: 2000-2011

This subsection will compare productivity levels in Ontario's forest products sector to productivity levels in other two-digit NAICS industries in Ontario over the 2000-2011 period. Labour productivity levels are calculated using nominal output figures. Labour productivity level comparisons are usually done in nominal terms, directly capturing the value generated by one hour of work (or one worker), which fluctuates with the price of the goods and services the industry produces. The main limitation of real levels is that they are a function not only of real growth rates, but also of the nominal level in an arbitrary base or reference year. As a consequence, comparisons of real labour productivity levels across industries can lead to vastly different results depending on the state of relative prices in the chosen base or reference year. In order to avoid this problem, the report focuses on nominal labour productivity levels. It is important to keep in mind that changes in nominal productivity levels incorporate not only actual productivity growth, but also price changes (De Avillez, 2014).

Relative to other industries, labour productivity levels in the forest products sector were quite high in 2000, at $50.24 per hour worked (or 10.6 per cent above the all-industry average) (Table 6). Only eight of twenty-three industries had higher labour productivity levels. However, by 2011, the forest products sector saw its labour productivity levels fall to $46.75 per hour worked (or 4.3 per cent below the all-industry average), while most other industries saw their labour productivity levels increase; this pushed the forest products sector into tenth place.

The forest products sector saw its labour productivity level fall in absolute terms between 2000 and 2011 by $3.49 per hour worked. Out of twenty-three industries, only three saw larger declines in labour productivity levels: mining and oil and gas extraction (-$129.63 per hour worked), the energy sector (-$129.12 per hour worked), and utilities (-$60.71 per hour worked). However, given that real labour productivity grew consistently between 2000 and 2011 (0.5 per cent per year), the fall in labour productivity levels exhibited by the forest products sector was entirely attributable to falling prices. Implicit prices in the forest products sector declined by 1.4 per cent per year between 2000 and 2011, while they increased by 2.3 per cent per year in the total economy.

Table 6: Nominal Labour Productivity Levels, Two-Digit NAICS Sectors, Ontario, 2000-2011

	Level (Current Dollars)			Relative (Per Cent)		
	2000	**2005**	**2011**	**2000**	**2005**	**2011**
Total economy	45.40	47.23	48.80	100.00	100.00	100.00
Business sector industries	41.93	43.64	44.40	92.36	92.41	90.98
Business sector, goods	50.50	50.39	50.00	111.22	106.69	102.46
Agriculture, forestry, fishing and hunting [11]	20.18	21.62	23.60	44.44	45.78	48.36
Mining and oil and gas extraction [21]	266.03	207.86	136.40	585.92	440.11	279.51
Utilities [22]	193.81	164.30	133.10	426.86	347.88	272.75
Construction [23]	37.14	39.52	35.90	81.80	83.68	73.57
Manufacturing [31-33]	50.96	51.25	54.40	112.24	108.52	111.48
Business sector, services	37.55	40.47	42.30	82.70	85.68	86.68
Wholesale trade [41]	40.30	46.78	58.30	88.77	99.05	119.47
Retail trade [44-45]	21.20	23.93	26.90	46.70	50.67	55.12
Transportation and warehousing [48-49]	38.72	41.44	38.20	85.27	87.74	78.28
Information and cultural industries [51]	63.23	79.63	78.60	139.25	168.60	161.07
Finance and insurance, and holding companies	65.03	68.09	68.30	143.23	144.17	139.96
Professional, scientific and technical services [54]	39.65	41.81	41.60	87.32	88.52	85.25
Administrative and support, waste management and remediation services [56]	26.92	26.45	25.30	59.28	56.00	51.84
Arts, entertainment and recreation [71]	22.58	22.68	22.10	49.72	48.02	45.29
Accommodation and food services [72]	17.40	16.15	17.30	38.31	34.18	35.45
Other private services	30.72	31.86	29.90	67.66	67.46	61.27
Forest products sector	*50.24*	*50.15*	*46.75*	*110.64*	*106.17*	*95.79*

Source: CSLS calculations based on Statistics Canada data.

Note: Health care and social assistance and educational services have been dropped as these figures refer to hours worked in the business sector.

III. A Detailed Analysis of Ontario's Output, Employment and Labour Productivity Performance: 1997-2013

This section provides a detailed examination of the productivity performance of the Ontario forest products sector between 1997 and 2013. It is divided into four subsections. The first subsection will examine the forest products sector as a whole. The second, third and fourth subsections will examine forestry and logging, wood product manufacturing and paper manufacturing, respectively. Each subsection will examine real GDP, employment and hours worked, and labour productivity between 1997 and 2013.

A. Forest Products Sector

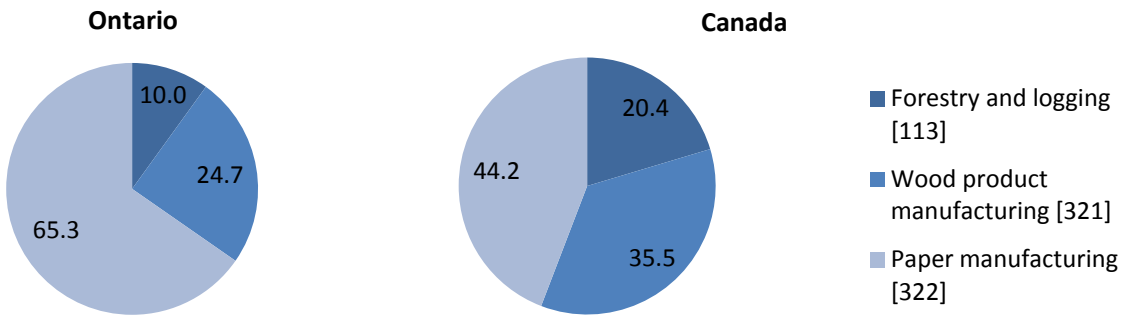
The forest products sector is composed of three three-digit North American Industry Classification System (NAICS) industries: forestry and logging (NAICS code 113), wood product manufacturing (NAICS code 321), and paper manufacturing (NAICS code 322). In 2010, the last year for which data are available, there were 3,775 forest products sector establishments in Ontario, of which there were 1,754 forestry and logging establishments, 1,608 wood product manufacturing establishments and 413 paper manufacturing establishments. In 2007, there were 4,115 forest products sector establishments.

i. Output

a. Nominal GDP

Paper manufacturing represented 65.3 per cent of the nominal GDP of Ontario's forest products sector in 2011, while wood product manufacturing accounted for 24.7 per cent and forestry and logging accounted for only 10.0 per cent (Chart 10). In comparison with Canada as a whole, Ontario relies much more heavily on paper manufacturing, and much less heavily on wood product manufacturing and forestry and logging.

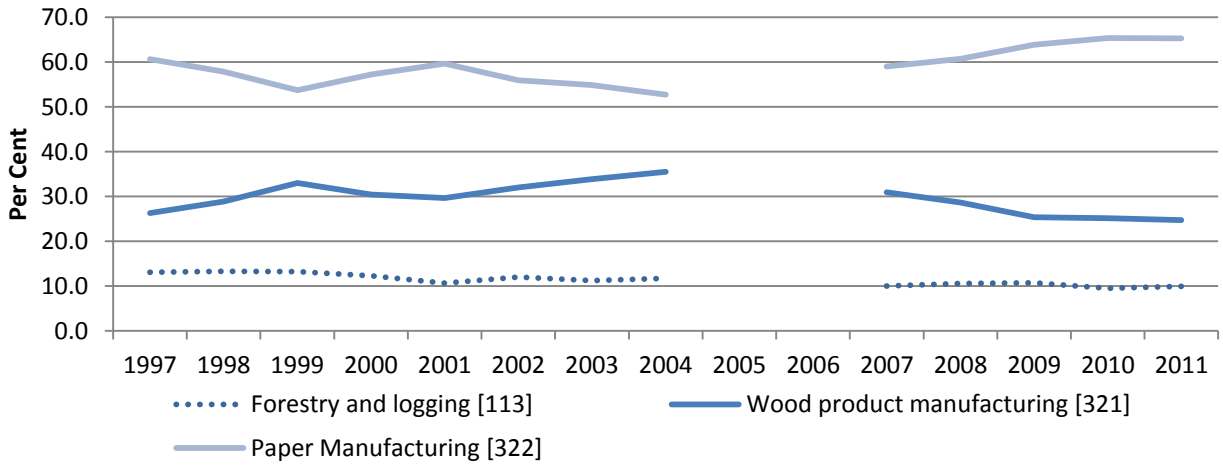
Chart 10: Breakdown of Nominal GDP in the Forest Products Sector, Ontario, 2011



Source: CSLS calculations based on Statistics Canada data.

Since 1997, within the forest products sector in Ontario, paper manufacturing has consistently represented the largest portion of nominal GDP, followed by wood product manufacturing and forestry and logging (Chart 11). Whether or not this pattern will continue to persist depends on a number of factors, including the types of product innovations undertaken by all three industry groups as well as the market and macroeconomic circumstances.

Chart 11: Breakdown of Nominal GDP in the Forest Products Sector by Subsector, Ontario, 1997-2011



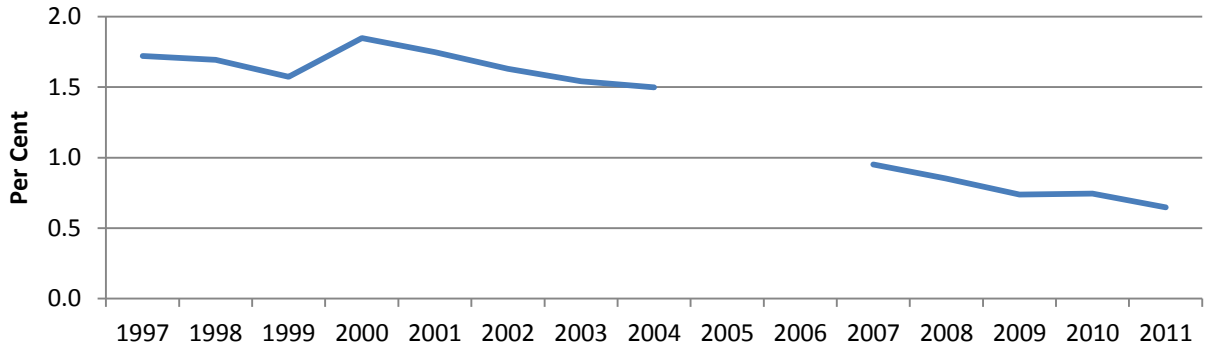
Note: Data were suppressed for 2005 and 2006.
Source: CSLS calculations based on Statistics Canada data.

Between 2000 and 2011, the share of the forest products sector in total economy nominal GDP in Ontario has fallen dramatically (Chart 12). In particular, the forest products sector fell from a high of 1.9 per cent of total economy nominal GDP in 2000 to a low of 0.7 per cent in 2011, a decline of 1.2 percentage points.[13] Since 2000, there has been a clear prominent long-run decline in the economic importance of the forest products sector in Ontario, a trend exhibited by every Canadian province and at the national level. The decline in the share of the forest products sector in total nominal GDP was due to much weaker nominal GDP growth in the forest products sector compared to the total economy (-5.6 versus 3.9 per cent per year) (Table 7).

Despite a declining economic importance provincially, the forest products sector will likely continue to be an important backbone for many rural communities in Ontario, providing high paying jobs. Moreover, since the forest products sector in Ontario has remained active and demonstrated comparable performance in terms of productivity relative to all industries, while facing a perfect storm that was not felt as intensely elsewhere in the economy, it is clear that the forest products sector will prove resilient and crucial to the Canadian economy, albeit at a much smaller size than in the previous century.

[13] Caution should be used when interpreting these numbers due to the potential incomparability of current Statistics Canada time series with terminated Statistics Canada time series.

Chart 12: Share of Forest Products Sector in Total Economy Nominal GDP, Ontario, Per Cent, 1997-2011



Source: CSLS calculations based on Statistics Canada data.

Table 7: Nominal GDP, Implicit Price Deflators and Real GDP, All Industries and Forest Products Sector, Compound Average Annual Growth, Ontario, 1997-2013

	Nominal GDP		Implicit Price Deflator		Real GDP	
	All Industries	Forest Products Sector	All Industries	Forest Products Sector	All Industries	Forest Products Sector
1997-2000	7.03	9.61	0.87	4.71	6.11	4.68
2000-2007	4.61	-4.87	2.46	-2.63	2.11	-2.30
2007-2013	--	--	--	--	0.87	-5.50
2007-2011	2.62	-6.82	2.01	0.88	0.60	-7.63
2000-2011	3.88	-5.58	2.29	-1.37	1.55	-4.28
2000-2013	--	--	--	--	1.53	-3.79

Source: CSLS calculations based on Statistics Canada data.

b. Prices

The GDP deflator, a measure of the aggregate price level, is calculated by dividing nominal GDP by real GDP. Between 1997 and 2011, prices decreased by approximately 0.1 per cent per year.[14] This was concentrated between the 2000 and 2011 period, when prices decreased by 1.4 per cent per year (Table 7). Between 2000 and 2007, prices fell by 2.6 per cent per year, while they rose 0.9 per cent per year between 2007 and 2011. The price declines between 2000 and 2007 explain why nominal GDP declined much more rapidly than real GDP (-4.9 per cent per year versus -2.3 per cent per year), unlike most other industries in which prices are rising and nominal GDP growth exceeded real output growth.

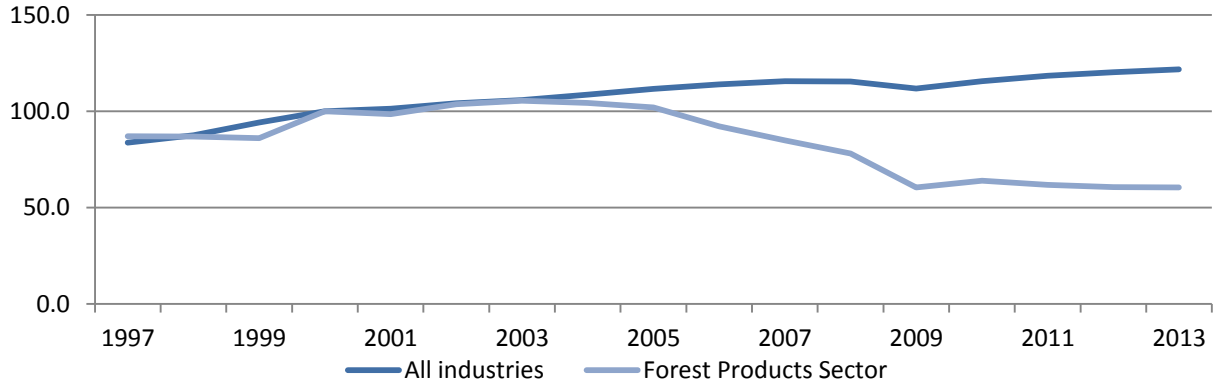
c. Real GDP

Between 1997 and 2013, real GDP in the Ontario forest products sector has grown more slowly than total economy real GDP (-2.3 per cent per year versus 2.4 per cent per year) (Table

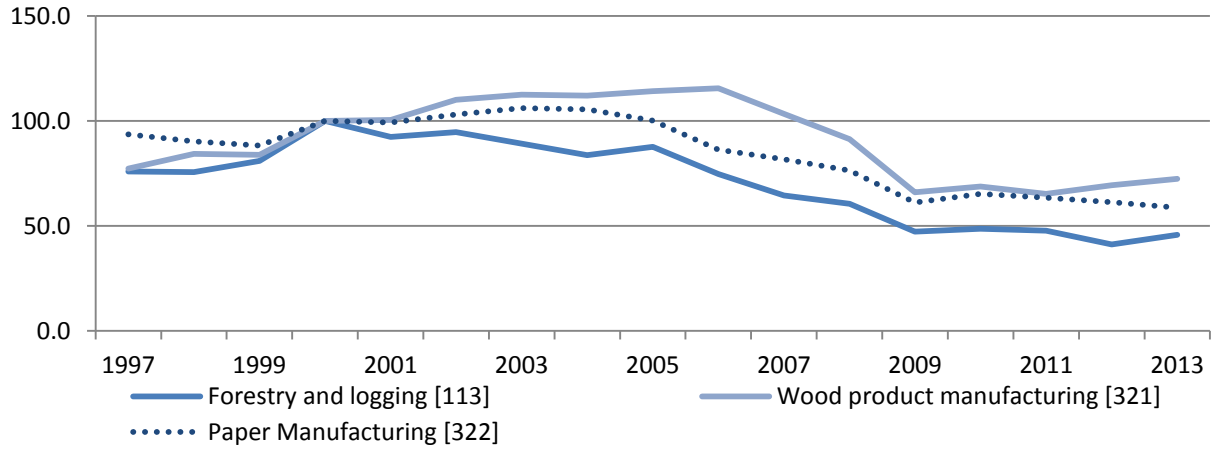
[14] This number should be interpreted with caution, as it reflects multiple different Statistics Canada time series, which may not be directly comparable.

7). In Ontario, trends in real GDP growth in the forest products sector were in line with trends in the total economy between 1997 and 2004. In contrast, the real GDP of Ontario's forest products sector trended rapidly downward from 2004 to 2009 before stabilizing from 2009 to 2013 (Chart 13). In 2013, real GDP in the forest products sector was 39.5 per cent below its level in 2000, while real GDP in the total economy was 21.9 per cent above its level in 2000. Real GDP in forestry and logging has been in decline since 2000, while paper and wood product manufacturing started to decline in 2004 and 2006, respectively. After experiencing large declines in the 2000s, real GDP in all three sub-sectors was stable between 2009 and 2013.

Chart 13: Real GDP in the Forest Products Sector, Ontario, 2000=100, Per Cent, 1997-2013
Panel A



Panel B



Source: CSLS calculations based on Statistics Canada data.

ii. Employment and Hours Worked

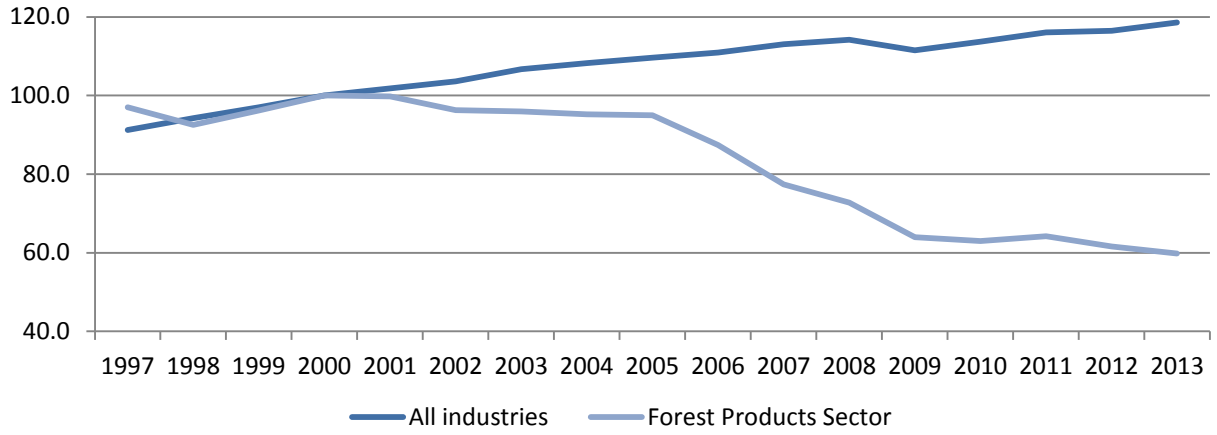
a. Employment

Employment in the forest products sector in Ontario has been declining since the beginning of the twenty-first century. Employment trends in the forest products sector were in line with trends in the total economy between 1997 and 2000 (Chart 14). From 2000 to 2005,

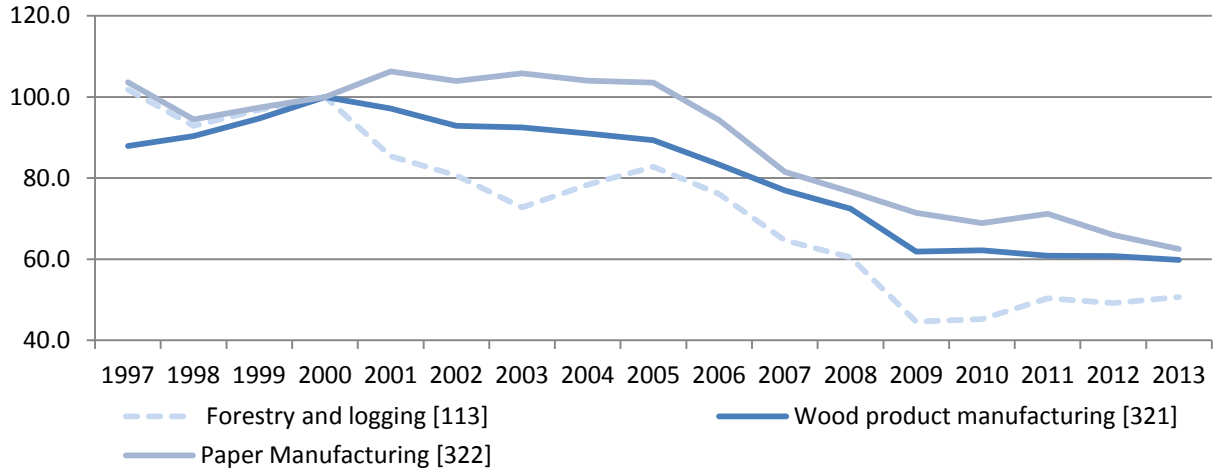
employment fell slightly in the Ontario forest products sector, while it continued to rise in the total economy. Employment in Ontario's forest products sector trended rapidly downward from 2005 to 2009 before stabilizing from 2009 to 2013. In 2013, employment in the forest products sector was 41.2 per cent below its level in 2000, while employment in the total economy was 18.6 per cent above its level in 2000. Employment in forestry and logging has been in decline since 1997, while paper and wood product manufacturing started in decline to the early 2000s. After experiencing large declines in the 2000s, employment in all three sub-sectors was stable between 2009 and 2013. In fact, employment rose slightly in forestry and logging in this period.

Chart 14: Employment in the Forest Products Sector, Ontario, 2000=100, Per Cent, 1997-2013

Panel A



Panel B

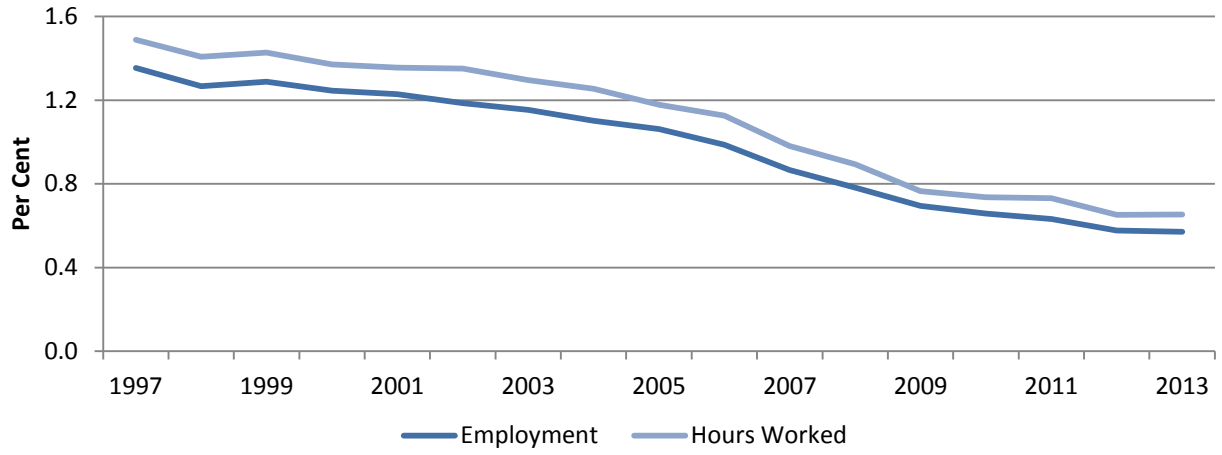


Source: CSLS calculations based on Statistics Canada data.

Similar to nominal GDP, employment shows that the economic importance of the forest products sector in Ontario is in decline. Since a peak of 1.4 per cent in 1997, the share of the forest products sector in total employment in Ontario has fallen to 0.6 per cent in 2013 (Chart 15). Clearly, the forest products sector in Ontario is in decline, but this is unsurprising, given the structural shift from pulp and paper products to electronic devices and electronic media and the trend of increasing low-cost international competition. Nevertheless, the forest products sector

remains an integral component of the economic fabric in Northern Ontario, providing high-paying employment in rural communities.

Chart 15: Share of the Forest Products Sector in Total Economy Employment and Hours Worked, Ontario, Per Cent, 1997-2013

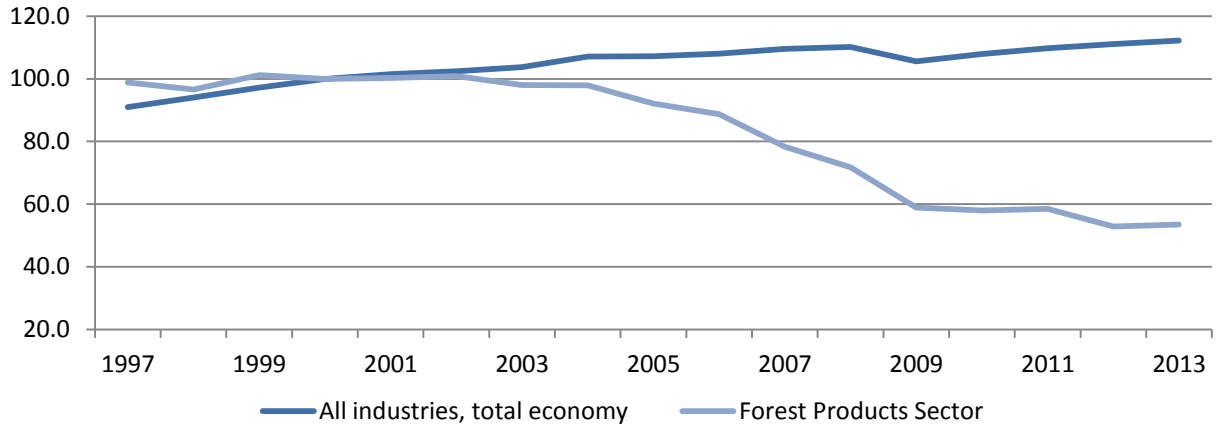


Source: CSLS calculations based on Statistics Canada data.

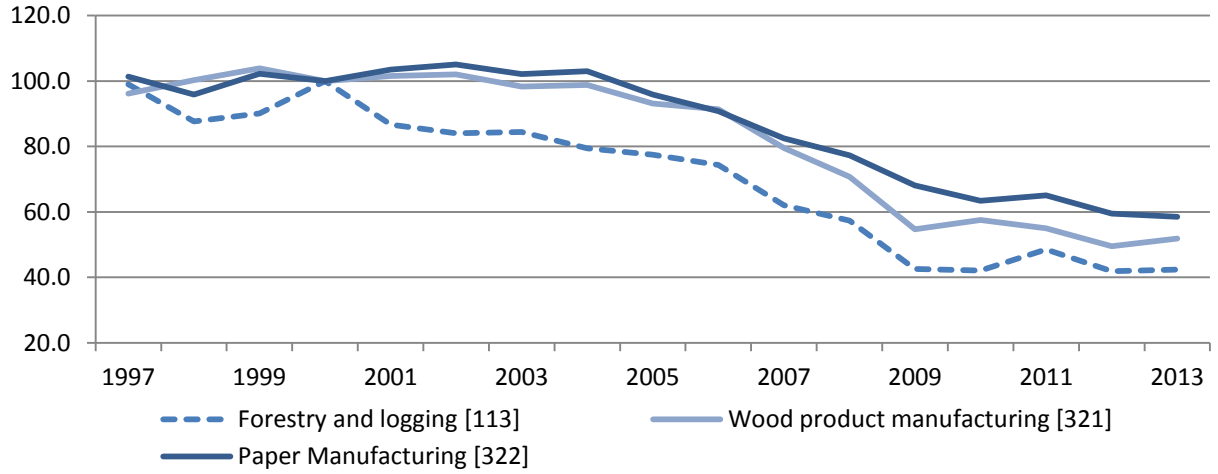
b. Hours Worked

In Ontario, hours worked in the forest products sector have declined since the turn of the century, with much stronger declines in the 2007-2013 period. In line with trends in real GDP, hours worked in Ontario's forest products sector declined from 2002 to 2009 before stabilizing from 2009 to 2013 (Chart 16). The downturn in hours worked in the 2000s was most certainly a result of the perfect storm that hit the sector. In contrast, hours worked in the total economy have been increasing fairly steadily since 2000, excluding a minor decline in 2009. In 2013, hours worked in the forest products sector were 46.5 per cent below their level in 2000, while hours worked in the total economy were 12.2 per cent above their level in 2000. Hours worked in forestry and logging have been in decline since 2000, while both paper and wood product manufacturing started to decline in 2004. After experiencing large declines in the 2000s, hours worked in all three sub-sectors were stable from 2009 to 2013.

Chart 16: Hours Worked in the Forest Products Sector, Ontario, 2000=100, Per Cent, 1997-2013
Panel A



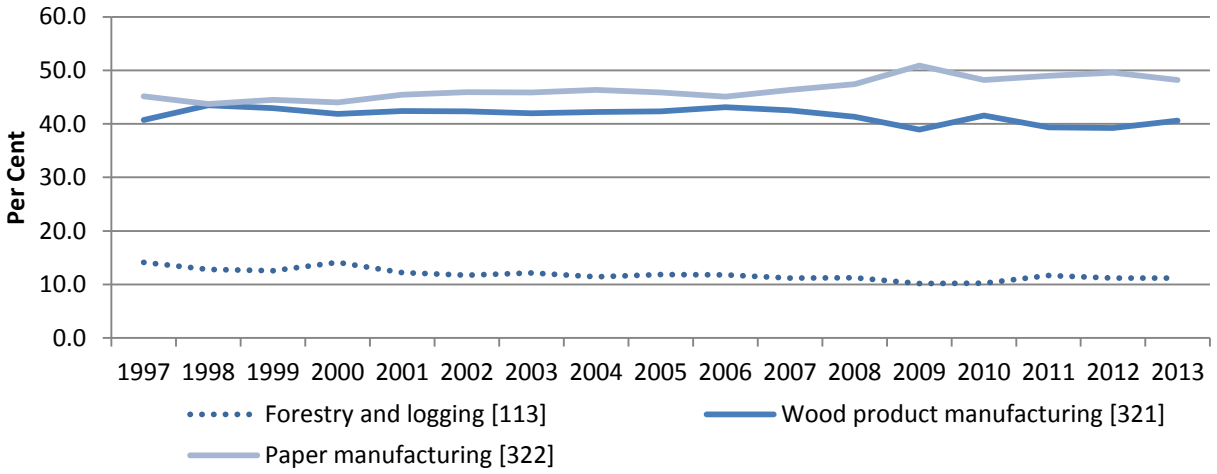
Panel B



Source: CSLS calculations based on Statistics Canada data.

In 2013, wood product manufacturing represented 40.6 per cent of hours worked in the forest products sector, while paper manufacturing represented 48.2 per cent (Chart 17). Paper manufacturing has always been the most important part of the Ontario forest products sector in terms of hours worked in Ontario, with wood product manufacturing coming in close behind. By definition, this has left forestry and logging with a consistent and comfortable 10-15 per cent of hours worked. These shares are unsurprising given that Ontario's forest products sector is more concentrated in paper manufacturing than the national average in terms of nominal GDP. However, the share of wood product manufacturing in total hours worked is significantly larger than its share in total nominal GDP, while the share of paper manufacturing in total hours worked is significantly smaller than its share in total nominal GDP; this indicates that labour productivity is higher in paper manufacturing than in wood product manufacturing.

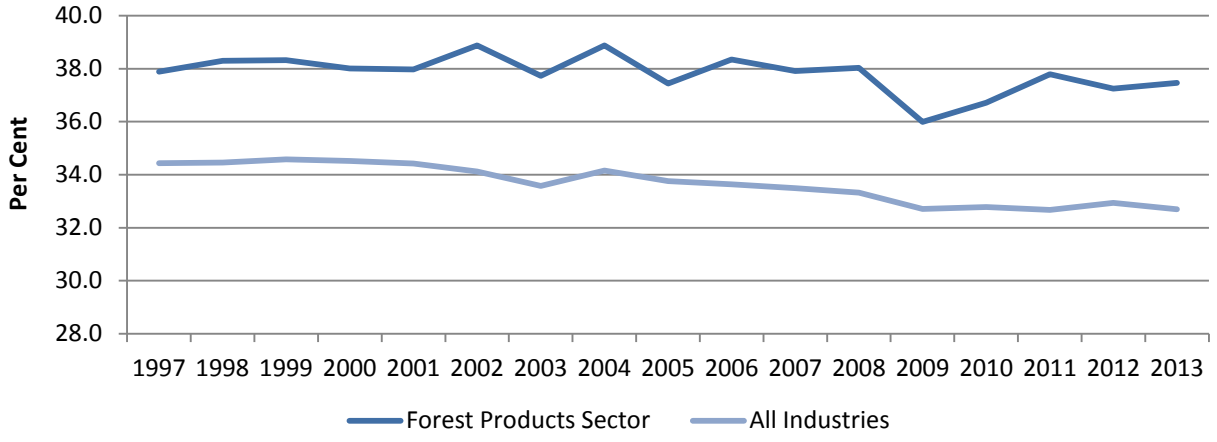
Chart 17: Breakdown of Hours Worked, Forest Products Sector by Subsector, Ontario, Per Cent, 1997-2013



Source: CSLS calculations based on Statistics Canada data.

Since aggregate forest products sector employment and hours worked have displayed relatively similar trends between 1997 and 2013, it comes as no surprise that the average weekly hours per job have been fairly constant. In particular, the average number of weekly hours per job in Ontario fell by only 0.4 hours per week from 1997 to 2013 (Chart 18). The total economy in Ontario has also seen a decline in the average number of weekly hours per job, but it was more pronounced at 1.7 hours per week.

Chart 18: Average Weekly Hours Per Job, Forest Products Sector, Ontario, Per Cent, 1997-2013



Source: CSLS calculations based on Statistics Canada data.

iii. Labour Productivity

Ontario's forest products sector has sustained positive labour productivity growth since 1997, with the strongest growth in 1997-2000 (4.3 per cent per year) (Table 8). Compared to the total economy, labour productivity growth in the forest products sector was impressive, growing slightly faster than the all-industry average in all of the periods (Chart 19).

Table 8: Real GDP, Hours Worked and Labour Productivity Growth Rates, Ontario, Per Cent, 1997-2013
Panel A

	Real GDP		Hours Worked		Labour Productivity	
	All industries	Forest products sector	All industries	Forest products sector	All industries	Forest products sector
1997-2000	6.11	4.68	3.18	0.39	2.83	4.28
2000-2007	2.11	-2.30	1.32	-3.43	0.78	1.16
2007-2010	-0.01	-9.03	-0.51	-9.57	0.51	0.60
2010-2013	1.76	-1.83	0.30	-0.62	0.45	0.84
2007-2013	0.87	-5.50	0.39	-6.17	0.48	0.72
2000-2013	1.53	-3.79	0.89	-4.70	0.64	0.96

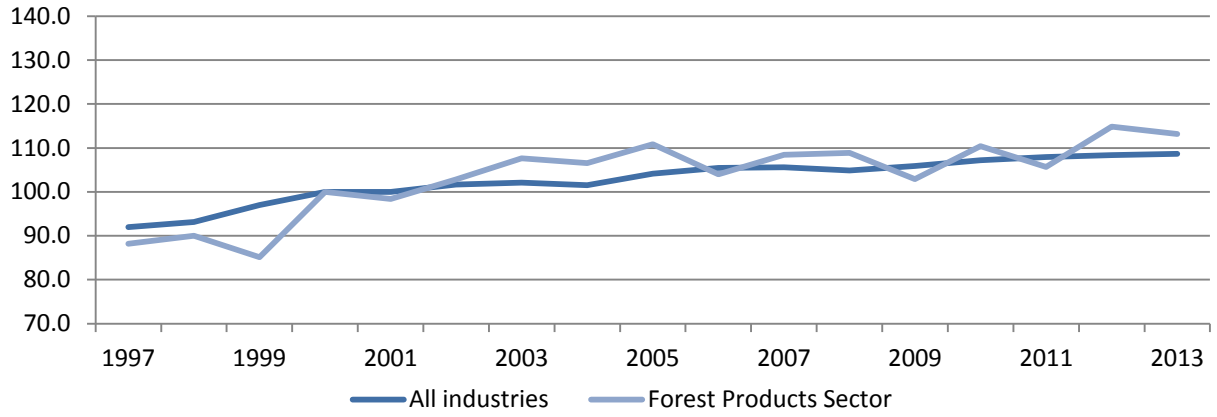
Panel B

	Real GDP			Hours Worked			Labour Productivity		
	Logging	Wood Product	Paper	Logging	Wood Product	Paper	Logging	Wood Product	Paper
1997-2000	9.62	8.95	2.20	0.32	1.33	-0.45	9.27	7.51	2.66
2000-2007	-6.07	0.47	-2.84	-6.59	-3.22	-2.72	0.55	3.81	-0.12
2007-2010	-8.95	-12.67	-7.24	-12.13	-10.26	-8.36	3.62	-2.69	1.23
2010-2013	-2.02	1.74	-3.44	0.06	-0.79	-0.62	-2.26	5.30	-0.81
2007-2013	-5.55	-5.74	-5.36	-6.15	-6.88	-5.55	0.64	1.22	0.20
2000-2013	-5.83	-2.45	-4.01	-6.38	-4.93	-4.04	0.59	2.61	0.03

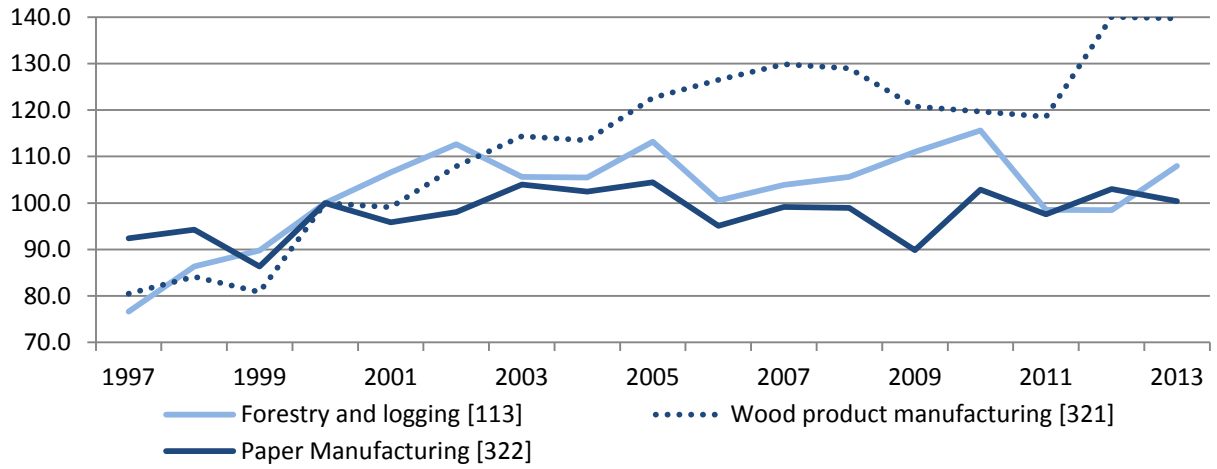
Source: CSLS calculations based on Statistics Canada data.

As a result of the aforementioned trends in real GDP and hours worked, labour productivity growth in Ontario's forest products sector was unstable, with labour productivity continually rising and falling between 1997 and 2013 (Chart 19). Despite this, labour productivity in the forest products sector increased 13.2 per cent between 2000 and 2013 due to hours worked falling more than real GDP. In contrast, the total economy only saw labour productivity increase by 8.7 per cent between 2000 and 2013. Despite poor output growth after 2004, the forest products sector maintained strong labour productivity growth by cutting hours worked. Labour productivity in wood product manufacturing has been on an upward trend since 2000, while labour productivity growth has been volatile in both paper manufacturing and forestry and logging since the early 2000s.

Chart 19: Labour Productivity in the Forest Products Sector, Ontario, 2000=100, Per Cent, 1997-2013
Panel A



Panel B



Source: CSLS calculations based on Statistics Canada data.

B. Forestry and Logging

Forestry and logging (NAICS code 113) is the three-digit NAICS subsector of the forest products sector that consists of establishments mainly concerned with growing and harvesting timber on a long production cycle (of ten years or more). Short production cycles are excluded because these require horticultural interventions before harvesting, which results in production processes than are more comparable to the production processes in the crop production subsector.[15] In 2010, there were 1,754 forestry and logging establishments in Ontario, down from 2,007 in 2007 and up from 1,352 in 2004.

Within the forestry and logging subsector, there are three four-digit NAICS industry groups, which each specialize in different stages of the production cycle: timber tract operations (NAICS code 1131), forestry nurseries and gathering of forest products (NAICS code 1132) and

[15] Christmas trees are an example of trees that are classified under the crop production subsector.

logging (NAICS code 1133). The timber tract operations industry group includes those establishments that are primarily engaged in the operation of timber tracts, for the purpose of selling standing timber. Forest nurseries and gathering of forest products includes those establishments engaged in growing trees for the purpose of reforestation and those engaged in gathering forest products, such as gums, barks, balsam, needles and Spanish moss. Logging includes those establishments primarily engaged in cutting timber, producing rough, round, hewn, or riven primary wood, and producing wood chips in the forest, as well as those industries engaged in cutting and transporting timber.

Unfortunately for Ontario and Canada, there is extremely limited data on forestry and logging at the four-digit NAICS level. Hence, the next subsections of this report will focus on the forestry and logging industry at the three-digit level.

i. Output

a. Nominal GDP

Between 1997 and 2000, forestry and logging performed exceptionally in terms of nominal GDP, increasing 7.5 per cent per year (Table 9). However, this growth was quickly reversed between 2000 and 2011, when nominal GDP decreased 7.4 per cent per year.[16]

Table 9: Nominal GDP, Implicit Prices and Real GDP, Forestry and Logging, Ontario, Compound Average Annual Growth, 1997-2013

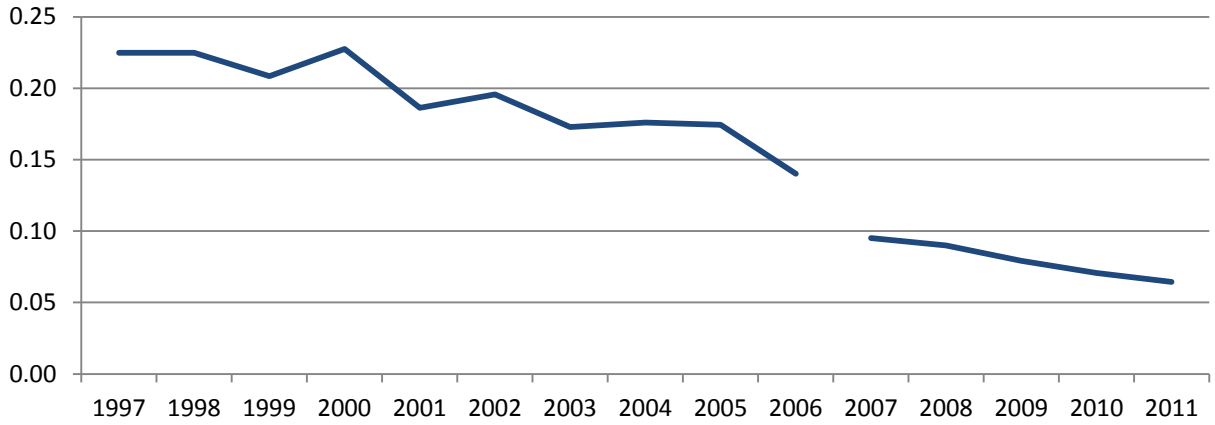
	Nominal GDP		Implicit Prices		Real GDP	
	All industries	Forestry and logging	All industries	Forestry and logging	All industries	Forestry and logging
1997-2000	7.03	7.46	0.87	-1.97	6.11	9.62
2000-2007	4.61	-7.62	2.46	-1.65	2.11	-6.07
2007-2013	--	--	--	--	0.87	-5.55
2007-2011	2.62	-6.95	2.01	0.30	0.60	-7.22
2000-2011	3.88	-7.38	2.29	-0.95	1.55	-6.49
2000-2013	--	--	--	--	1.53	-5.83

Source: CSLS calculations based on Statistics Canada data.

Forestry and logging has seen its share of nominal GDP decline dramatically. It fell from 0.22 per cent of total economy GDP in 1997 to 0.06 per cent in 2011 (Chart 20). This suggests that forestry and logging has lost most of its economic importance in the past three decades and that its direct contribution to Ontario's GDP is extremely small. This is not surprising, given the relatively small share of forestry and logging in the forest products sector and the relatively smaller share of the forest products sector in total economy nominal GDP.

[16] The 2000-2007 compound average annual growth is biased downwards due to a break in the Statistics Canada time series. Exercise caution.

Chart 20: Share of Total Economy Nominal GDP, Forestry and Logging, Ontario, 1997-2011



Source: CSLS calculations based on Statistics Canada data.

b. Prices

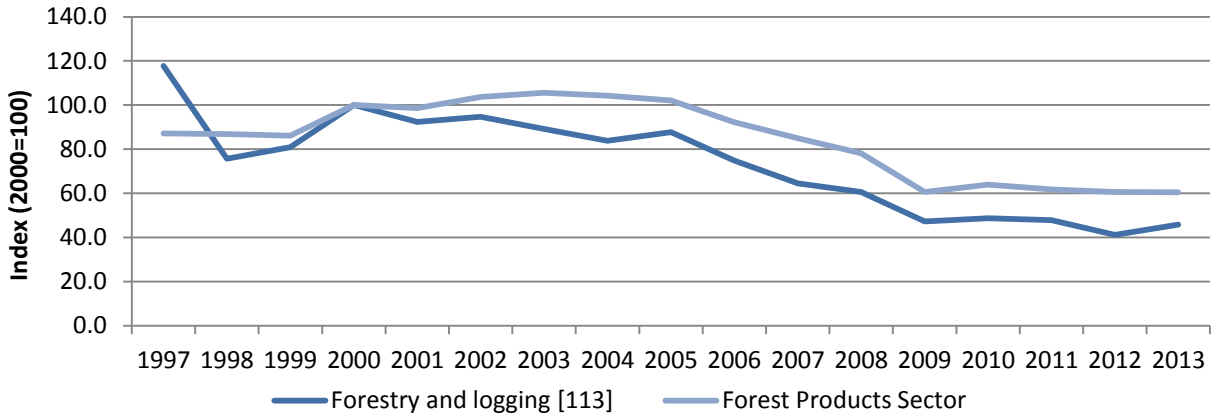
Prices in forestry and logging have been falling over the past sixteen years. Falling prices indicate that nominal GDP growth underestimates real output growth. Between 1997 and 2000, prices declined by almost 2.0 per cent per year, while they fell by 1.7 per cent per year between 2000 and 2007 (Table 9). Interestingly, they rose 0.3 per cent per year thereafter.

c. Real GDP

Real output growth in forestry and logging has been dismal in the twenty-first century (Chart 21). When broken down into two periods, forestry and logging in Ontario saw real GDP decrease 6.1 per cent per year between 2000 and 2007, while the decline was slightly less strong in the most recent years, falling 5.6 per cent per year between 2007 and 2013.

The decline in the 2007-2013 period coincided with the slump in the U.S. housing market and the 2008-09 recession, with declines in real GDP of 13.7 per cent in 2007, 6.1 per cent in 2008 and 22.0 per cent in 2009. As previously mentioned, given the concentration of poor performance around the 2005-2009 period, the downturn in the later period likely reflects the U.S. housing bust and the recession to a great extent, among other unfavorable factors like an elevated Canadian dollar.

Chart 21: Real GDP, Forestry and Logging, Ontario, 2000=100, Per Cent, 1997-2013



Source: CSLS calculations based on Statistics Canada data.

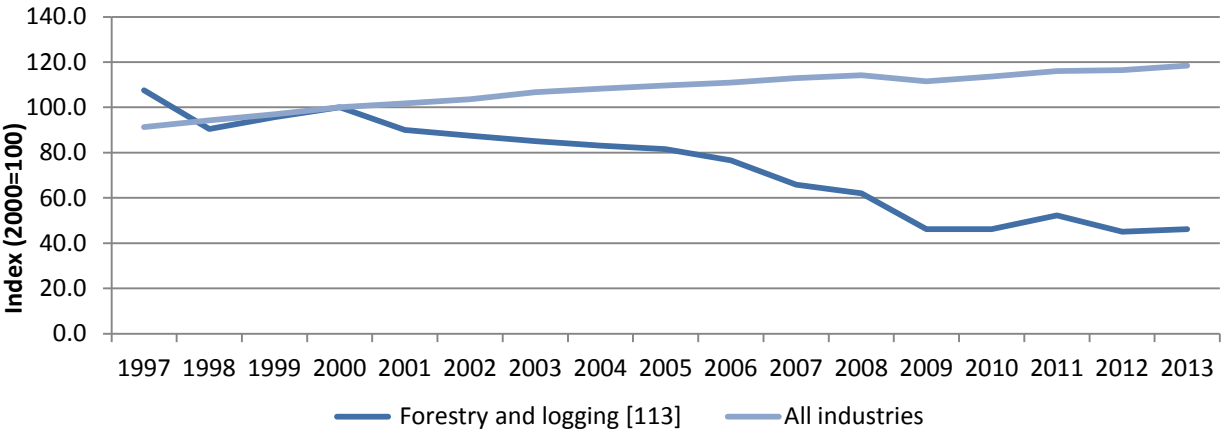
ii. Employment and Hours Worked

a. Employment

Employment in forestry and logging has seen similar declines. Between 1997 and 2013, employment decreased by 5.1 per cent per year. By sub-period, it fell by 5.8 per cent per year between 2000 and 2007 and 5.7 per cent per year between 2007 and 2013. Between 1997 and 2000, employment fell by only 2.4 per cent per year (Chart 22).

Employment share figures suggest that forestry and logging is less economically important than a little less than two decades ago. In particular, the share of forestry and logging employment in total economy employment has declined drastically, falling from 0.18 per cent in 1997 to 0.06 per cent in 2013.

Chart 22: Employment, Forestry and Logging, Ontario, 2000=100, Per Cent, 1997-2013

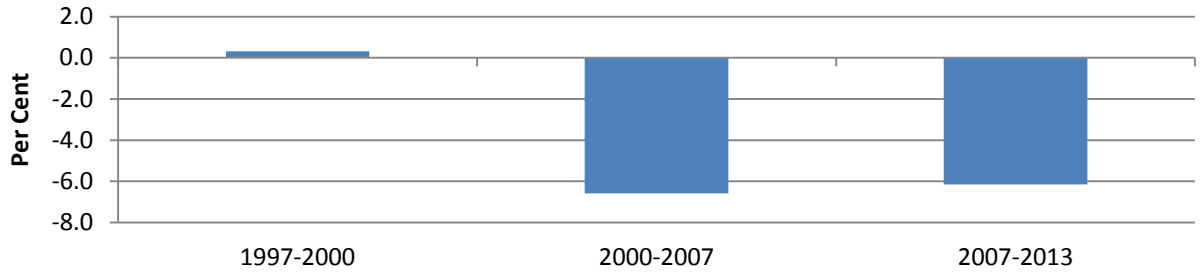


Source: CSLS calculations based on Statistics Canada data.

b. Hours Worked

Hours worked in the forestry and logging sector in Ontario suffered a very similar fate to the total forest products sector. Between 1997 and 2000, hours worked increased by 0.3 per cent per year, but since the turn of the century, hours worked have declined. In particular, hours worked fell 6.6 per cent per year between 2000 and 2007, and 6.2 per cent per year between 2007 and 2013. The steepest declines were seen between 2000 and 2007, likely reflecting the layoffs resulting from the perfect storm that ravaged the industry (Chart 23). The sector's response to this perfect storm through layoffs and mill closures was required for survival and puts Ontario's forest products sector in a better position to grow in the future.

Chart 23: Hours Worked, Forestry and Logging, Compound Average Annual Growth, Ontario, 1997-2013



Source: CSLS calculations based on Statistics Canada data.

The relative importance of forestry and logging as a source of employment has declined considerably since 1997. Between 1997 and 2013, forestry and logging's share of hours worked in the total economy fell from 0.21 per cent to 0.11 per cent.

iii. Labour Productivity

Labour productivity in forestry and logging has grown slower than the overall forest products sector since 1997. Most of the increase in labour productivity was concentrated between 1997 and 2000, when it grew 9.3 per cent per year. Labour productivity grew much more slowly between 2007 and 2013, at 0.64 per cent per year. Between 2000 and 2007, labour productivity growth was positive but even less promising than the mild growth between 2007 and 2013: 0.55 per cent per year (Table 10).

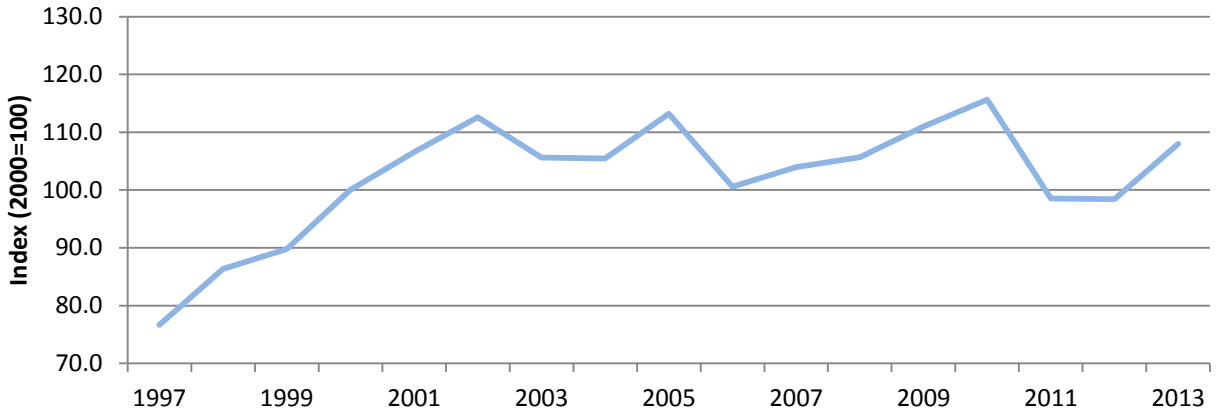
Table 10: Real GDP, Hours Worked and Labour Productivity, Forestry and Logging, Ontario, Compound Average Annual Growth, Per Cent, 1997-2013

	Real GDP		Hours Worked		Labour Productivity	
	Forest Products Sector	Forestry and Logging	Forest Products Sector	Forestry and Logging	Forest Products Sector	Forestry and Logging
1997-2000	4.68	9.62	0.39	0.32	4.28	9.27
2000-2007	-2.30	-6.07	-3.43	-6.59	1.16	0.55
2007-2010	-9.03	-8.95	-9.57	-12.13	0.60	3.62
2010-2013	-1.83	-2.02	-0.62	0.06	0.84	-2.26
2007-2013	-5.50	-5.55	-6.17	-6.15	0.72	0.64
2000-2013	-3.79	-5.83	-4.70	-6.38	0.96	0.59

Source: CSLS calculations based on Statistics Canada data.

Chart 24 illustrates trends in labour productivity growth in forestry and logging between 1997 and 2013. Labour productivity grew rapidly from 1997 to 2002, after which it was relatively volatile and displayed no clear trend.

Chart 24: Labour Productivity, Forestry and Logging, 2000=100, Per Cent, 1997-2013



Source: CSLS calculations based on Statistics Canada data.

These figures suggest that forestry and logging undertook a much needed restructuring and shed excess labour, responding in a competitive and practical fashion to the perfect storm in the 2000s. However, it clearly responded less quickly and less efficiently than wood product manufacturing, which experienced much stronger labour productivity growth in 2000-2013, as we shall see in the following sub-section.

C. Wood Product Manufacturing

Wood product manufacturing (NAICS code 321) is the three-digit NAICS subsector of the forest products sector that is mainly engaged in manufacturing products from wood. Within this subsector, there are three four-digit NAICS industry groups: sawmills and wood preservation

(NAICS code 3211), veneer, plywood and engineered wood product manufacturing (NAICS code 3212), and other wood product manufacturing (NAICS code 3219). Sawmills and wood preservation includes establishments engaged in sawing logs into lumber and similar products, or preserving these products. Veneer, plywood and engineered wood product manufacturing includes establishments that are engaged in making products that improve the natural characteristics of wood, by making veneers, plywood, reconstituted wood panel products or engineered wood assemblies. Other wood product manufacturing includes establishments engaged in manufacturing a diverse range of wood products, such as millwork.

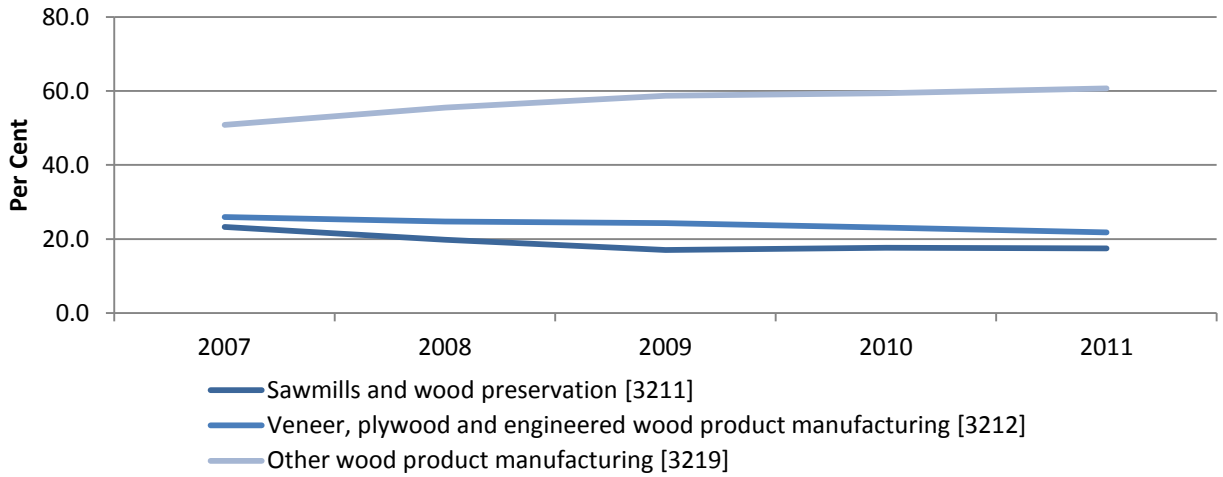
In 2010, there were 1,608 wood product manufacturing establishments in Ontario, of which there were 311 sawmills and wood preservation establishments, 129 veneer, plywood and engineered wood product manufacturing establishments and 1,168 other wood product manufacturing establishments. In 2007, there were 1,656 wood product manufacturing establishments, down from 1,713 in 2004.

i. Output

a. Nominal GDP

Nominal output data at the four-digit NAICS level are only available after 2006. However, the data that do exist suggest that other wood product manufacturing has been the largest source of nominal GDP in the wood product manufacturing industry group from 2007 to 2011 (Chart 25). Moreover, the share of other wood product manufacturing has increased, perhaps due to innovations and the introduction of new products into the other wood product manufacturing subsector, while the shares of the other two four-digit NAICS industries have been falling quickly.

Chart 25: Breakdown of Nominal GDP in Wood Product Manufacturing, Ontario, Per Cent, 2007-2011



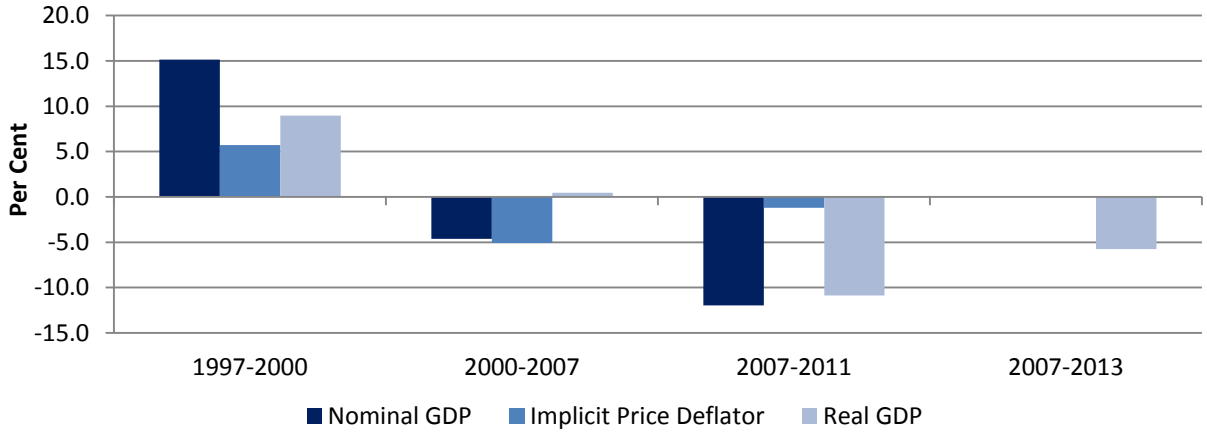
Source: CSLS calculations based on Statistics Canada data.

Wood product manufacturing saw nominal GDP grow very quickly between 1997 and 2000 at 15.2 per cent per year (Chart 26). However, between 2000 and 2007, this fell sharply to -4.6 per cent per year, and between 2007 and 2011, this fell even more to -12.0 per cent per year. This pattern of growth is identical to the pattern exhibited by the overall forest products sector between 1997 and 2011.

At the four-digit NAICS level, much of the falling nominal GDP between 2007 and 2011 came from sawmills and wood preservation, but a large portion also came from veneer, plywood and engineered wood product manufacturing, exhibiting declines of 18.0 per cent per year and 15.7 per cent per year, respectively. Other wood product manufacturing also saw negative growth, but it was substantially less pronounced than its peers at only 7.9 per cent per year.

Between 2007 and 2011, the share of wood product manufacturing in total economy nominal GDP in Ontario decreased from 0.29 per cent to 0.16 per cent. Hence, as a whole, wood product manufacturing in 2011 was far less economically important than it was in only 2007. The declining economic importance of wood product manufacturing is also reflected in the output shares of the three four-digit NAICS industries of which it is composed. In particular, between 2007 and 2011, all three industries saw their output shares decline by 0.4-0.5 percentage point. This dramatic reduction in only four years merits serious attention.

Chart 26: Nominal GDP, Implicit Prices and Real GDP, Ontario, Wood Product Manufacturing, 1997-2013



Source: CSLS calculations based on Statistics Canada data.

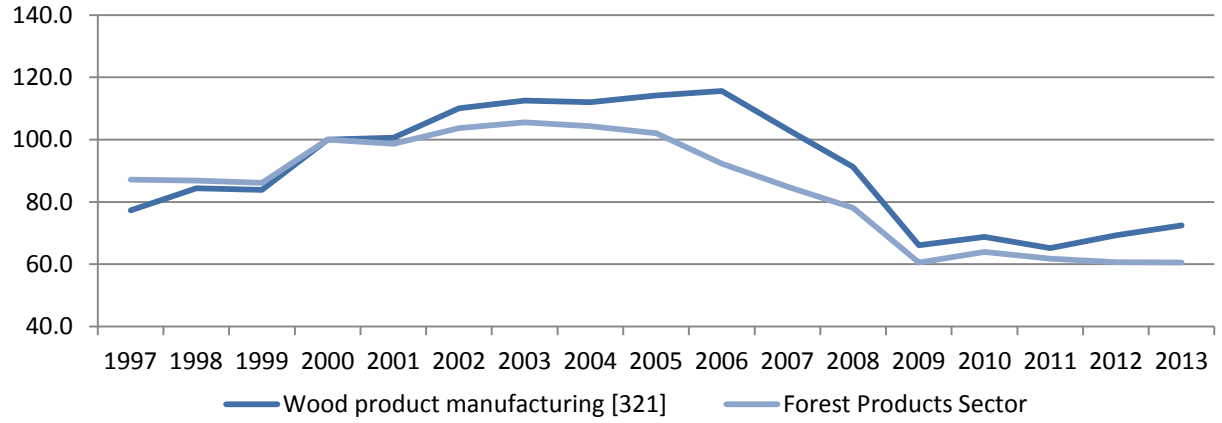
b. Prices

Prices in wood product manufacturing have been consistently declining since the turn of the century, falling by 5.1 per cent per year between 2000 and 2007, and 1.2 per cent per year between 2007 and 2011 (Chart 26). The decline in prices after 2000 indicate that nominal GDP growth has understated real GDP growth. In contrast, since prices rose between 1997 and 2000, nominal GDP growth overstated real GDP growth.

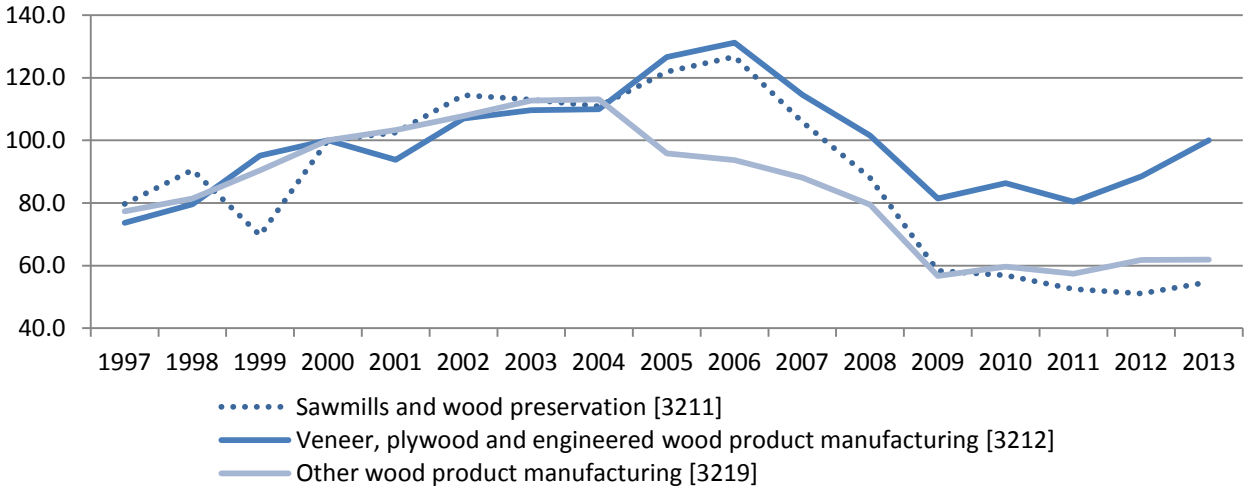
c. Real GDP

In wood product manufacturing, real output grew from 1997 to 2002, stagnated from 2002 to 2005, and then fell to a trough in 2009 (Chart 27). Since 2009, there has been a very weak rebound. The story was similar for all three industry groups within wood products manufacturing. Veneer, plywood and engineered wood product manufacturing and sawmills and wood preservation grew steadily until 2006, and declined dramatically from 2006 to 2009. In contrast, other wood product manufacturing started to decline in 2004. Both sawmills and wood preservation and other wood product manufacturing experienced stagnant growth since 2009, while veneer, plywood and engineered wood product manufacturing experienced a strong rebound, reaching its 2000 level in 2013.

Chart 27: Real GDP, Wood Product Manufacturing, Ontario, 2000=100, Per Cent, 1997-2013
Panel A



Panel B



Source: CSLS calculations based on Statistics Canada data.

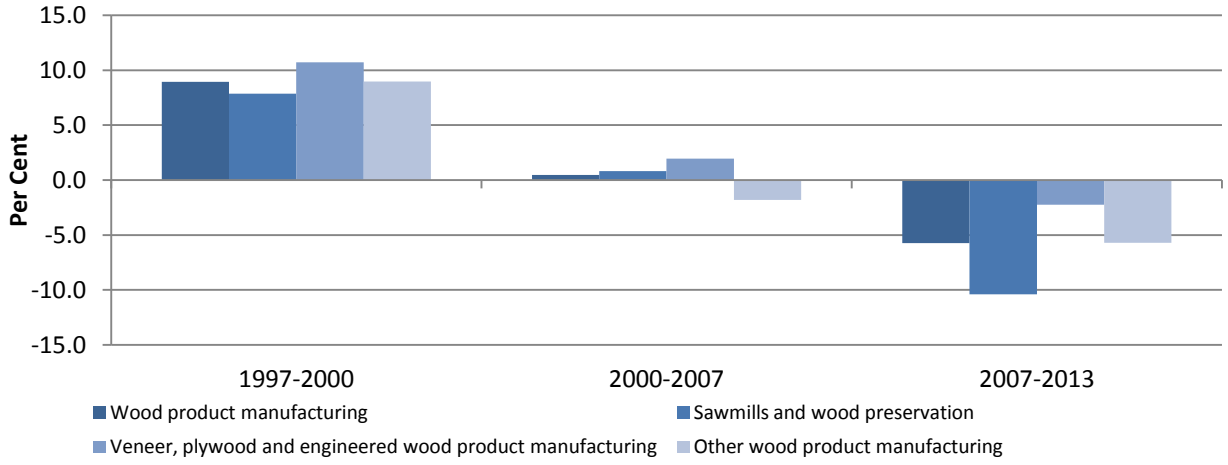
Between 1997 and 2000, real GDP in wood product manufacturing increased 9.0 per cent per year (Chart 28). This rate of growth fell in the next two periods, dropping to 0.5 per cent per

year between 2000 and 2007 and -5.7 per cent per year between 2007 and 2013.

The negative growth in the 2007-2013 period was concentrated in sawmills and wood preservation, which saw real GDP decrease by 10.4 per cent per year. Unpacking the economic incentives that drove these different responses throughout these different time periods deserves serious consideration, especially in the mid- to late-2000s, given that the perfect storm may have had slightly differing effects by industry group: an appreciating Canadian dollar, the U.S. housing bust and increasing international competition should have affected each industry within wood product manufacturing relatively similarly. Veneer, plywood and engineered wood product manufacturing and other wood product manufacturing also saw decreases during this period of 2.2 per cent per year and 5.7 per cent per year, respectively.

Growth during the 2000-2007 period was driven by the veneer, plywood and engineered wood product manufacturing industry, with growth of 2.0 per cent per year. In contrast, sawmills and wood preservation demonstrated growth of only 0.8 per cent per year while other wood product manufacturing experienced a decline of 1.8 per cent per year.

Chart 28: Real GDP, Wood Product Manufacturing, Ontario, Compound Average Annual Growth Rate, Per Cent, 1997-2013



Source: CSLS calculations based on Statistics Canada data.

ii. Employment and Hours Worked

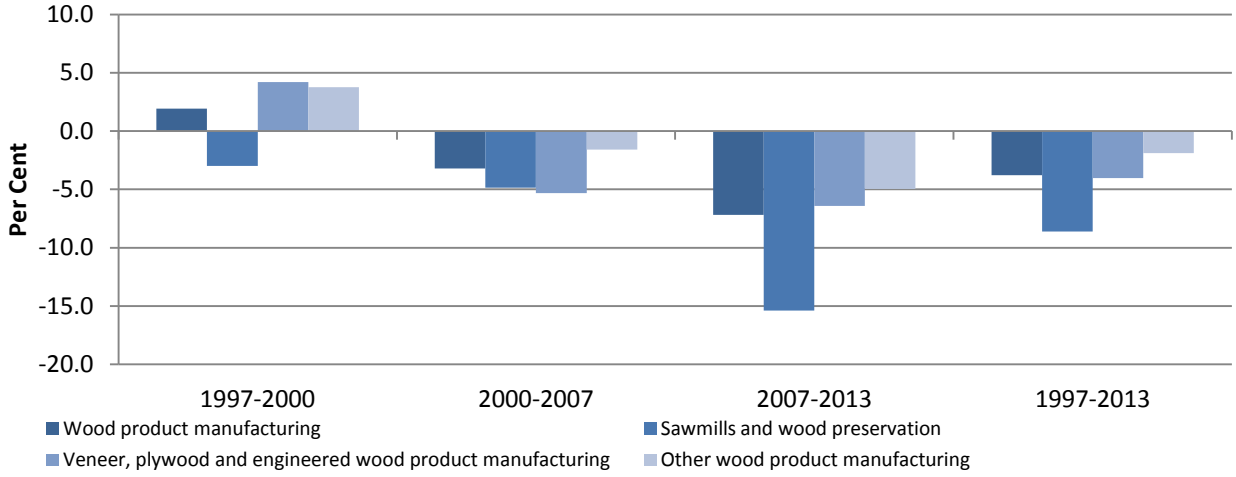
a. Employment

Between 1997 and 2013, employment in the wood product manufacturing industry declined by 3.8 per cent per year. This decline was entirely concentrated in the twenty-first century, since employment increased by 1.9 per cent per year between 1997 and 2000 (Chart 29). Between 2000 and 2007, employment in the wood product manufacturing industry fell by 3.2 per cent per year. Similarly, employment fell 7.2 per cent per year from 2007 to 2013.

At the four-digit NAICS level, sawmills and wood preservation was the weakest performer between 1997 and 2013, with a decline of 8.6 per cent per year. Other wood product manufacturing and veneer, plywood and engineered wood product manufacturing experienced declines in employment of 1.9 and 4.0 per cent per year, respectively. The decline in sawmills and wood preservation was driven by an employment decline of 15.4 per cent per year between 2007 and 2013. Other wood product manufacturing and veneer, plywood and engineered wood product manufacturing did not perform much better during this period, with declines of 5.0 and 6.4 per cent per year, respectively.

The employment patterns of the three industries that make up wood product manufacturing are complex. This suggests that economic incentives in this industry group were varied. Each industry was responding to the perfect storm in a unique way and may have been affected differently by different factors.

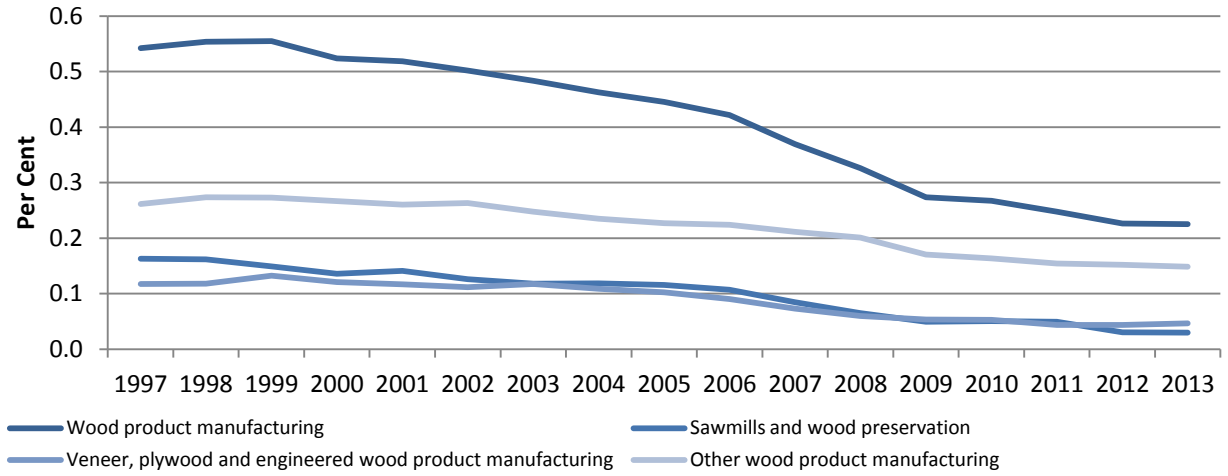
Chart 29: Employment, Wood Product Manufacturing, Ontario, Compound Average Annual Growth, Per Cent, 1997-2012



Source: CSLS calculations based on Statistics Canada data.

Similar to the forestry and logging industry, the wood product manufacturing industry has seen its share of total economy employment fall from 0.54 per cent in 1997 to 0.23 per cent in 2013, peaking to 0.55 per cent in 1999 (Chart 30). Sawmills and wood preservation saw its share of employment fall from 0.16 per cent to 0.03 per cent between 1997 and 2013. Veneer, plywood and engineered wood product manufacturing saw employment shares fall from 0.12 per cent to 0.05 per cent in the same period. Other wood product manufacturing suffered less than its peers, falling from 0.26 per cent to 0.15 per cent between 1997 and 2013.

Chart 30: Share of Wood Product Manufacturing Employment in Total Economy Employment, Ontario, Per Cent, 1997-2012



Source: CSLS calculations based on Statistics Canada data.

b. Hours Worked

Hours worked in the wood product manufacturing industry followed a very similar pattern to hours worked in the total forest products sector. Between 1997 and 2000, hours worked increased by 1.3 per cent per year (Table 11). In contrast, between 2000 and 2007 and between 2007 and 2013, hours worked declined (-3.2 and -6.9 per cent per year, respectively).

Table 11: Hours Worked, Wood Product Manufacturing, Compound Average Annual Growth, Per Cent, Ontario, 1997-2013

	Forest products sector	Wood product manufacturing	Sawmills and wood preservation	Veneer, plywood and engineered wood product manufacturing	Other wood product manufacturing
1997-2000	0.39	1.33	-5.06	3.93	3.71
2000-2007	-3.43	-3.22	-4.15	-6.37	-1.54
2007-2013	-6.17	-6.88	-15.14	-5.15	-5.00
2000-2013	-4.70	-4.93	-9.39	-5.81	-3.15

Source: CSLS calculations based on Statistics Canada data.

At the four-digit NAICS level, sawmills and wood preservation demonstrated negative growth in all three periods, while veneer, plywood and engineered wood product manufacturing and other wood product manufacturing demonstrated positive growth between 1997 and 2000 and negative growth in the 2000-2007 and 2007-2013 periods.

At the three-digit level, wood product manufacturing is mildly less important in terms of its share of all hours worked in the forest products sector, dropping marginally from 40.7 per cent of all hours worked in the forest products sector in 1997 to 40.6 per cent in 2013. Sawmills

and wood preservation and veneer, plywood and engineered wood product manufacturing saw their share of total hours worked in the forest products sector fall from 12.0 per cent to 5.2 per cent and 9.1 per cent to 8.6 per cent, respectively. Other wood product manufacturing, on the other hand, actually saw its share increase from 19.6 per cent in 1997 to 26.7 per cent in 2013.

At the four-digit NAICS industry level, sawmills and wood preservation (29.5 per cent) and other wood product manufacturing (48.1 per cent) represented the largest shares of the total number of hours worked in the wood product manufacturing industry in 1997, while veneer, plywood and engineered wood product manufacturing represented the smallest portion. In 2013, other wood product manufacturing saw its share increase at the expense of veneer, plywood and other engineered wood product manufacturing and sawmills and wood preservation. Sawmills and wood preservation represented 13.0 per cent of all hours worked in wood product manufacturing, while other wood product manufacturing saw its share increase to 65.7 per cent.

iii. Labour Productivity

Labour productivity in the wood product manufacturing industry displayed similar trends to the total forest products sector: the strongest growth was seen between 1997 and 2000, the second strongest growth was seen between 2000 and 2007, and the weakest growth was seen between 2007 and 2013 (Table 12). Hours worked declined between 2000 and 2007 and between 2007 and 2013, while real GDP increased between 2000 and 2007 and decreased by less than hours worked between 2007 and 2013. As a result, labour productivity increased in both periods.

At the four-digit NAICS industry level, labour productivity exhibited increases in two of the three industries between 2000 and 2013: sawmills and wood preservation saw an increase of 5.4 per cent per year and veneer, plywood and engineered wood product manufacturing saw an increase of 6.2 per cent per year, while other wood product manufacturing saw a decrease of 0.5 per cent per year.

Table 12: Real GDP, Hours Worked and Labour Productivity Growth Rates, Ontario, Per Cent, 1997-2012
Panel A

	Real GDP		Hours Worked		Labour Productivity	
	Forest products sector	Wood product manufacturing	Forest products sector	Wood product manufacturing	Forest products sector	Wood product manufacturing
1997-2000	4.68	8.95	0.39	1.33	4.28	7.51
2000-2007	-2.30	0.47	-3.43	-3.22	1.16	3.81
2007-2010	-9.03	-12.67	-9.57	-10.26	0.60	-2.69
2010-2013	-1.83	1.74	-0.62	-0.79	0.84	5.30
2007-2013	-5.50	-5.74	-6.17	-6.88	0.72	1.22
2000-2013	-3.79	-2.45	-4.70	-4.93	0.96	2.61

Panel B

	Real GDP			Hours Worked			Labour Productivity		
	SWP	VPEWP	OWP	SWP	VPEWP	OWP	SWP	VPEWP	OWP
1997-2000	7.85	10.73	8.96	-5.06	3.93	3.71	13.59	6.55	5.07
2000-2007	0.81	1.96	-1.80	-4.15	-6.37	-1.54	5.18	8.90	-0.26
2007-2010	-18.63	-8.99	-12.16	-15.48	-9.60	-8.59	-3.72	0.67	-3.91
2010-2013	-1.32	5.08	1.23	-3.63	-0.11	-0.29	15.83	5.58	2.52
2007-2013	-10.39	-2.21	-5.70	-15.14	-5.15	-5.00	5.58	3.07	-0.75
2000-2013	-4.53	0.01	-3.62	-9.39	-5.81	-3.15	5.36	6.17	-0.49

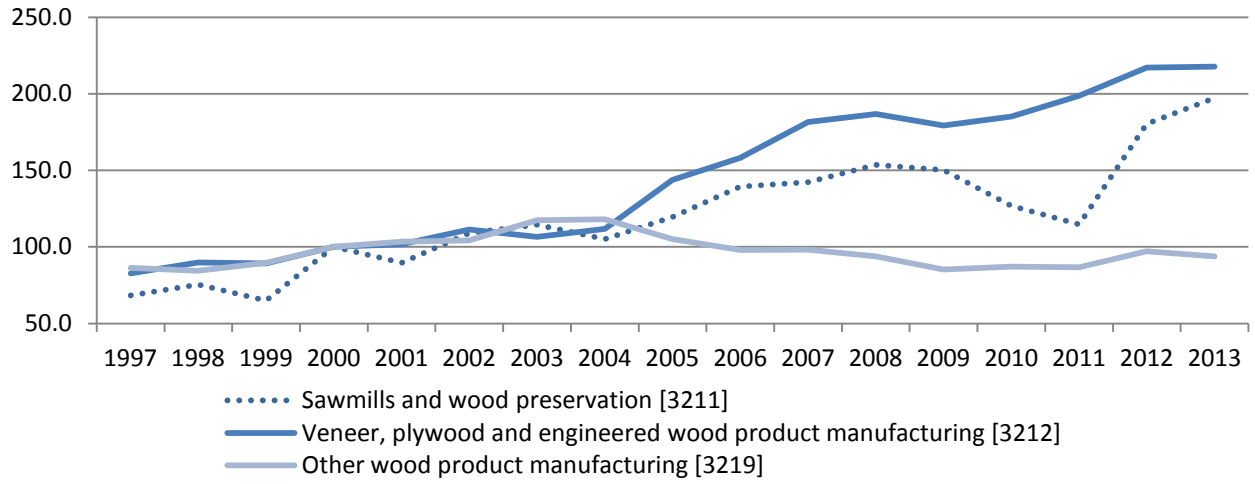
Note: "SWP" stands for sawmills and wood preservation. "VPEWPM" stands for veneer, plywood and engineered wood product manufacturing. "OWPM" stands for other wood product manufacturing.
Source: CSLS calculations based on Statistics Canada data.

Chart 31 illustrates trends in labour productivity growth in wood product manufacturing between 1997 and 2013. Labour productivity grew rapidly and consistently from 1997 to 2007, before weakening from 2008 to 2011. In 2012, labour productivity continued its upward trend before weakening slightly in 2013. In 2013, labour productivity was 39.7 per cent above its level in 2000, compared to 8.6 per cent in the total economy.

The story was similar for veneer, plywood and engineered wood product manufacturing and sawmills and wood preservation: labour productivity grew steadily until 2008, weakened for the next two to three years, and continued to rise thereafter. However, sawmills and wood preservation experienced a much larger decline after 2008 than veneer, plywood and engineered wood product manufacturing. In 2013, labour productivity was 117.7 per cent above its level in 2000 in veneer, plywood and engineered wood product manufacturing, compared to 97.2 per cent in sawmills and wood preservation. In contrast, labour productivity in other wood product manufacturing started to decline in 2004, and was slightly below its 2000 level in 2013.

Chart 31: Labour Productivity, Wood Product Manufacturing, 2000=100, Per Cent, 1997-2013
Panel A

Panel B



Source: CSLS calculations based on Statistics Canada data.

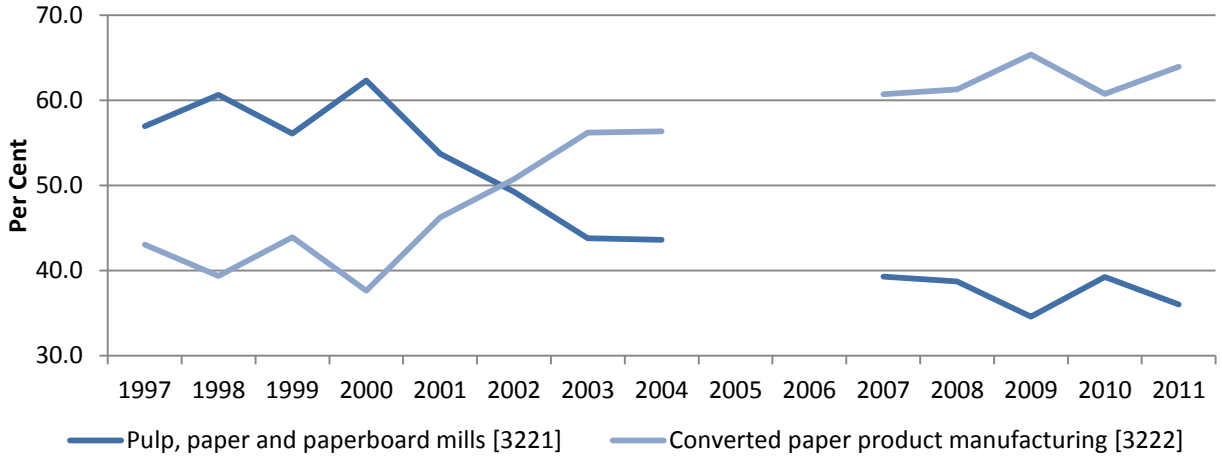
D. Paper Manufacturing

Paper manufacturing (NAICS code 322) is the three-digit NAICS subsector of the forest products sector mainly engaged in manufacturing pulp, paper or paperboard. Paper manufacturing is composed of two four-digit NAICS industry groups: pulp, paper and paperboard mills (NAICS code 3221) and converted paper product manufacturing (NAICS code 3222). The pulp, paper and paperboard mills industry group includes establishments engaged in manufacturing pulp, paper or paperboard. Manufacturing pulp involves the separation of the cellulose fibres from the other impurities found in wood, used paper or other fibre sources, while manufacturing paper involves matting these fibres into a sheet. The converted paper product manufacturing industry group comprises establishments mainly concerned with manufacturing paper products from purchased paper and paperboard. Converted paper products are produced from paper and other materials by various cutting and shaping techniques.

In 2010, there were 413 paper manufacturing establishments in Ontario, of which there were 66 pulp, paper and paperboard mills and 347 converted paper product manufacturing establishments. In 2007, there were 452 paper manufacturing establishments, while in 2004, there were 533.

Since 1984, pulp, paper and paperboard mills have virtually switched roles. In 1984, pulp, paper and paperboard mills represented 57.0 per cent of total nominal GDP produced by the paper manufacturing sector, while converted paper product manufacturing represented only 43.0 per cent. In 2011, converted paper product manufacturing represented 64.0 per cent of total nominal GDP produced by the sector, while pulp, paper and paperboard mills represented only 36.0 per cent (Chart 32).

Chart 32: Breakdown of Nominal GDP in the Paper Manufacturing Sector, Ontario, 1997-2011

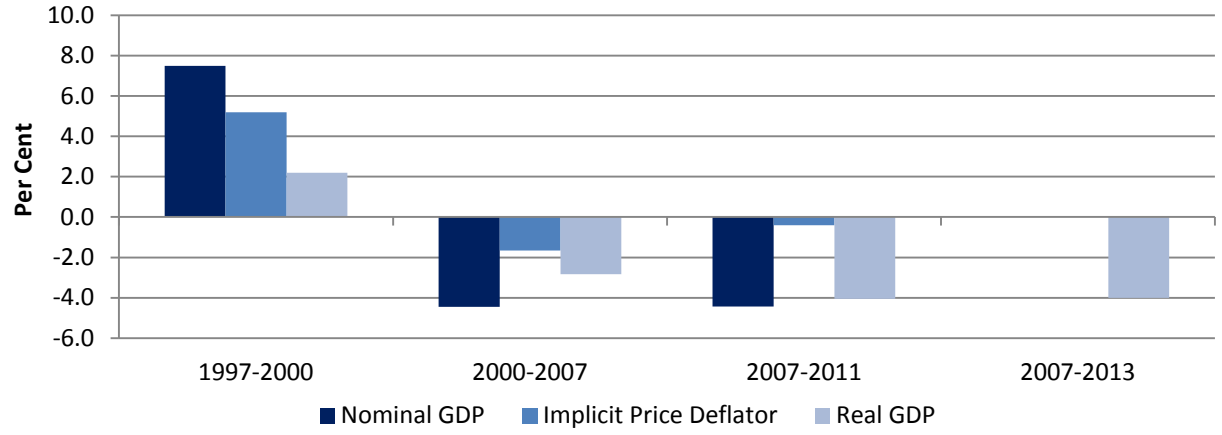


i. Output

a. Nominal GDP

Nominal GDP in the paper manufacturing subsector showed similar trends to the forest products sector as a whole: strong positive growth between 1997 and 2000 (7.6 per cent per year), and negative growth between 2000 and 2007 (-4.5 per cent per year) and between 2007 and 2011 (-4.4 per cent per year) (Chart 33).

Chart 33: Nominal GDP, Implicit Prices and Real GDP, Paper Manufacturing, Compound Average Annual Growth, Ontario, Per Cent, 1997-2013



Source: CSLS calculations based on Statistics Canada data.

At the four-digit NAICS level, converted paper product manufacturing performed much less strongly than pulp, paper and paperboard mills. Between 1997 and 2000, the nominal GDP growth experienced by converted paper product manufacturing was almost four times less than that of pulp, paper and paperboard mills (2.8 per cent versus 10.8 per cent). Between 2000 and 2007, growth in pulp, paper and paperboard mills was negative (-10.6 per cent per year), while

growth in converted paper product manufacturing was positive (2.3 per cent per year). Between 2007 and 2011, both subsectors experienced low nominal GDP growth rates, but pulp, paper and paperboard mills was twice as worse as converted paper product manufacturing, registering 6.5 per cent per year versus 3.2 per cent per year.

Similar to the forest products sector as a whole, the economic importance of paper manufacturing in Ontario is in decline. Between 1984 and 2004, paper manufacturing saw its share of total economy nominal GDP fall from 1.3 per cent to 0.8 per cent. Between 2007 and 2011, the share of paper manufacturing in nominal total economy GDP fell from 0.6 per cent to 0.4 per cent.

At the four-digit NAICS level, both industries displayed similar trends to paper manufacturing. Between 1997 and 2006, converted paper product manufacturing actually saw its share of total economy nominal GDP fall from 0.45 per cent to 0.40 per cent. Hence, nearly the entire fall in the share of paper manufacturing between 1997 and 2006 was driven by the falling economic importance of pulp, paper and paperboard mills, which saw its share of total economy nominal GDP fall from 0.83 per cent to 0.26 per cent between 1984 and 2006 and from 0.22 per cent to 0.15 per cent between 2007 and 2011. This declining share of pulp, paper and paperboard mills reflects the structural shift in the economy from pulp and paper products to electronic devices and electronic media.

b. Prices

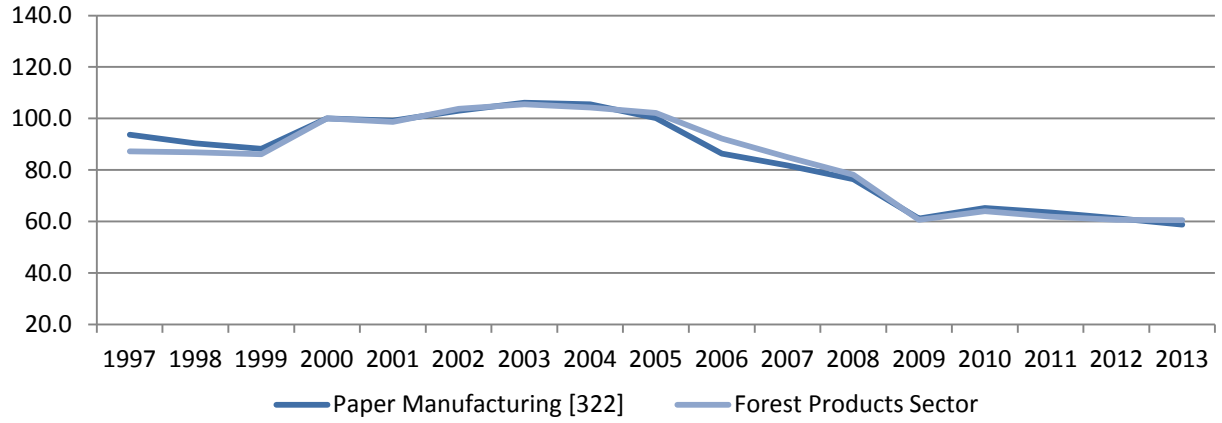
Implicit prices in paper manufacturing showed similar trends to the forest products sector as a whole (Chart 33). Between 1997 and 2000, prices rose by 5.2 per cent per year, before falling 1.7 per cent per year between 2000 and 2007. Intriguingly, prices rose by 1.8 per cent per year between 2007 and 2013. On net, this resulted in an overall decrease in prices between 1997 and 2013, but the price decline was much less rapid than in other Canadian provinces (0.4 per cent per year).

c. Real GDP

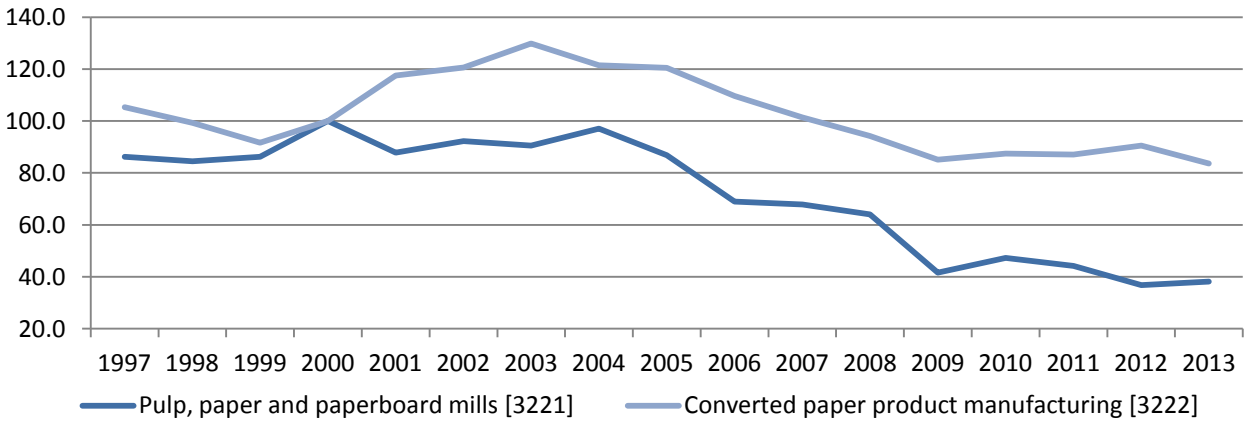
Real GDP in the paper manufacturing sector behaved similarly to the forest products sector as a whole, with positive growth between 1997 and 2000 and negative growth between 2000 and 2013 (Chart 34). In particular, real GDP grew at 2.2 per cent per year between 1997 and 2000, while it fell by 2.8 per cent per year between 2000 and 2007 and by 5.4 per cent per year between 2007 and 2013 (Chart 33).

Chart 34: Real GDP, Paper Manufacturing, Ontario, 2000=100, Per Cent, 1997-2013

Panel A



Panel B

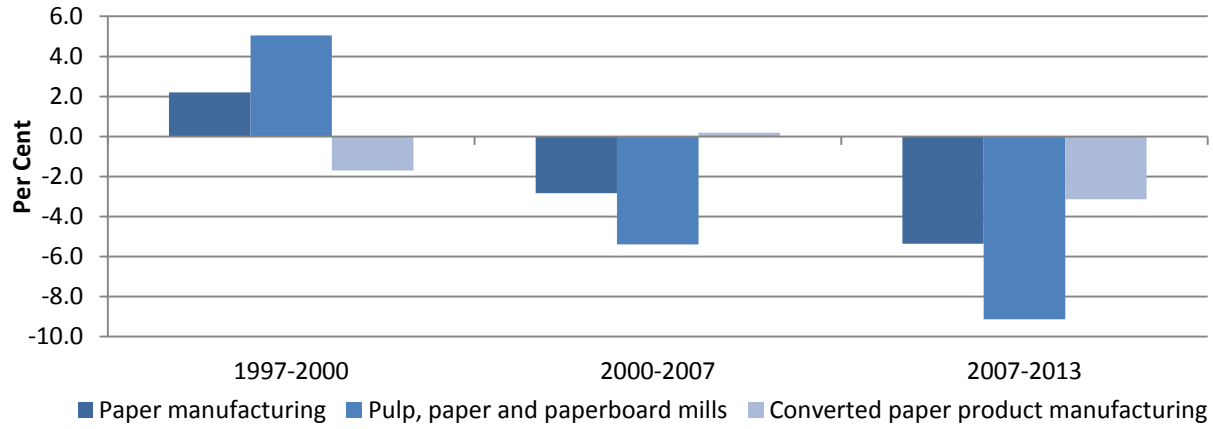


Source: CSLS calculations based on Statistics Canada data.

Similar to many other sectors, the negative growth rate exhibited between 2007 and 2013 was largely due to the 2008-09 recession. Real GDP fell substantially in this year (-20.0 per cent), but poor performance is not limited to this economic crisis, since paper manufacturing exhibited negative growth in each year between 2003 and 2009.

At the four-digit NAICS level, pulp, paper and paperboard mills behaved similarly to paper manufacturing between 1997 and 2013, while converted paper product manufacturing exhibited different trends (Chart 34 and Chart 35). In particular, pulp, paper and paperboard mills saw real GDP fall between 2000 and 2013, while it increased between 1997 and 2000, as did real GDP in the industry group as a whole. In contrast, real GDP in converted paper product manufacturing increased slightly between 2000 and 2007, while the paper manufacturing real GDP experienced declines.

Chart 35: Real GDP, Paper Manufacturing Sector and Subsectors, Ontario, Compound Average Annual Growth, 1997-2013



Source: CSLS calculations based on Statistics Canada data.

ii. Employment and Hours Worked

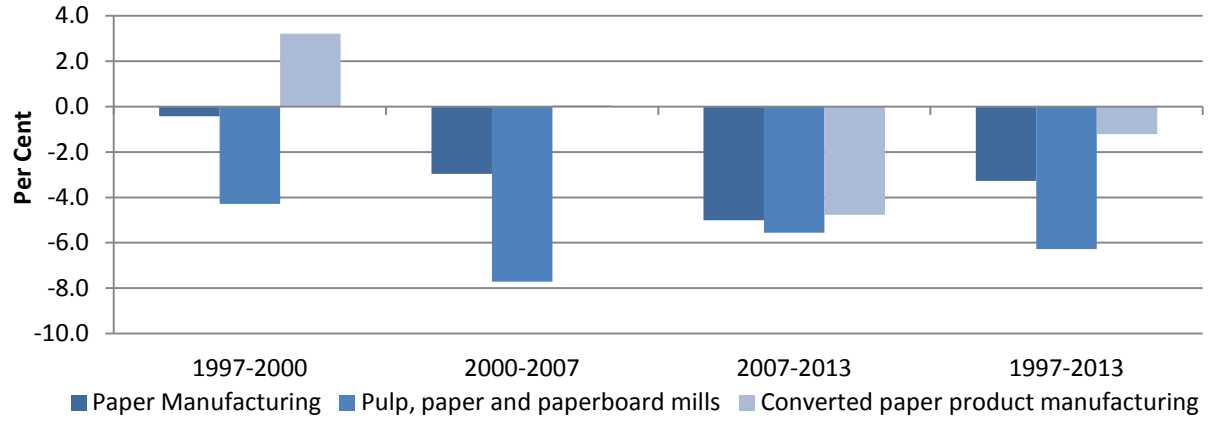
a. Employment

Employment in the paper manufacturing sector behaved similarly to employment in the forest products sector as a whole, showing little change in employment between 1997 and 2000 (-0.4 per cent per year), with strong negative growth of 3.0 and 5.0 per cent per year in the two following periods (2000-2007 and 2007-2013) (Chart 36). At the subsectoral level, pulp, paper and paperboard mills saw employment decline in all three periods, while converted paper product manufacturing saw employment increase exceptionally quickly between 1997 and 2000, only to decline between 2007 and 2013.

The economic importance of paper manufacturing for Ontario in terms of employment has declined (Chart 37). In 1997, paper manufacturing represented 0.6 per cent of total economy employment, while it accounted for only 0.3 per cent in 2013. This decline was seen relatively consistently throughout the entire period between 1997 and 2013.

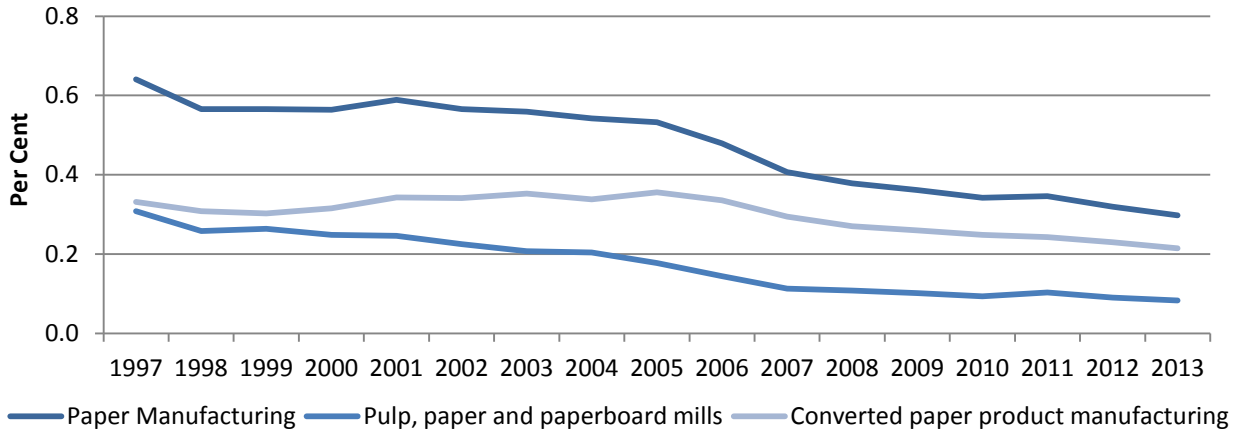
At the four-digit industry level, this trend is mimicked by pulp, paper and paperboard mills quite closely. In particular, between 1997 and 2013, pulp, paper and paperboard mills went from 0.3 per cent to 0.1 per cent of total economy employment, while converted paper product manufacturing saw its share decrease from 0.3 per cent to 0.2 per cent.

Chart 36: Employment, Paper Manufacturing, Compound Average Annual Growth, Ontario, 1997-2013



Source: CSLS calculations based on Statistics Canada data.

Chart 37: Share of Employment, Paper Manufacturing, Ontario, Per Cent, 1997-2013



Source: CSLS calculations based on Statistics Canada data.

b. Hours Worked

Hours worked in paper manufacturing were consistently declining throughout all three periods between 1997 and 2013 (Table 13). In particular, between 1997 and 2000, hours worked declined by 0.5 per cent per year, while they declined by 2.7 per cent per year between 2000 and 2007 and by 5.6 per cent year between 2007 and 2013.

Table 13: Hours Worked, Ontario, Paper Manufacturing, Compound Average Annual Growth, 1997-2013

	Paper manufacturing	Pulp, paper and paperboard mills	Converted paper product manufacturing
1997-2000	-0.45	-4.48	3.24
2000-2007	-2.72	-7.00	-0.02
2007-2013	-5.55	-6.20	-5.25
2000-2013	-4.04	-6.63	-2.47

Source: CSLS calculations based on Statistics Canada data.

At the four-digit NAICS industry level, hours worked in pulp, paper and paperboard mills demonstrated similar patterns to the paper manufacturing sector as a whole in all three periods. Converted paper products manufacturing performed similar to the total forest products sector in two of the three periods, demonstrating positive growth in hours worked between 1997 and 2000.

The economic importance of paper manufacturing in Ontario in terms of hours worked displays similar patterns to the economic importance of paper manufacturing in Ontario in terms of nominal GDP. Paper manufacturing as a whole saw its share of total economy hours worked fall from 0.7 per cent in 1997 to 0.3 per cent in 2013. The falling economic importance of paper manufacturing in Ontario in terms of hours worked was due to both of its subsectors: pulp, paper and paperboard mills saw its share fall from 0.3 per cent in 1997 to 0.1 per cent in 2013, and converted paper product manufacturing saw its share fall from 0.3 per cent to 0.2 per cent.

These significant declines in hours worked as a share of total economy hours worked reflect the responses of the paper manufacturing firms to the perfect storm that hit the industry in the mid- to late-1990s. All three industry groups that make up the forest products sector responded similarly by cutting hours worked to survive. In this sense, paper manufacturing is not distinct from wood product manufacturing and forestry and logging. However, paper manufacturing has had to weather an entirely different, much longer-term, storm due to the structural shift from pulp and paper products to electronic devices and electronic media.

iii. Labour Productivity

Labour productivity growth in paper manufacturing was much less promising than in either forestry and logging or wood product manufacturing. Despite strong positive growth between 1997 and 2000 (2.7 per cent per year), labour productivity growth was below average or negative between 2000 and 2007 (-0.1 per cent per year) and between 2007 and 2013 (0.2 per cent per year) (Table 14).

Table 14: Real GDP, Hours Worked and Labour Productivity Growth Rates, Ontario, 1997-2013

	Real GDP			Hours Worked			Labour Productivity		
	PM	PPPM	CPPM	PM	PPPM	CPPM	PM	PPPM	CPPM
1997-2000	2.20	5.05	-1.70	-0.45	-4.48	3.24	2.66	9.98	-4.79
2000-2007	-2.84	-5.40	0.19	-2.72	-7.00	-0.02	-0.12	1.71	0.20
2007-2010	-7.24	-11.33	-4.79	-8.36	-11.92	-6.77	1.23	0.67	2.12
2010-2013	-3.44	-6.88	-1.47	-0.62	-0.03	-0.87	-0.81	-6.78	2.32
2007-2013	-5.36	-9.13	-3.14	-5.55	-6.20	-5.25	0.20	-3.13	2.22
2000-2013	-4.01	-7.14	-1.36	-4.04	-6.63	-2.47	0.03	-0.55	1.13

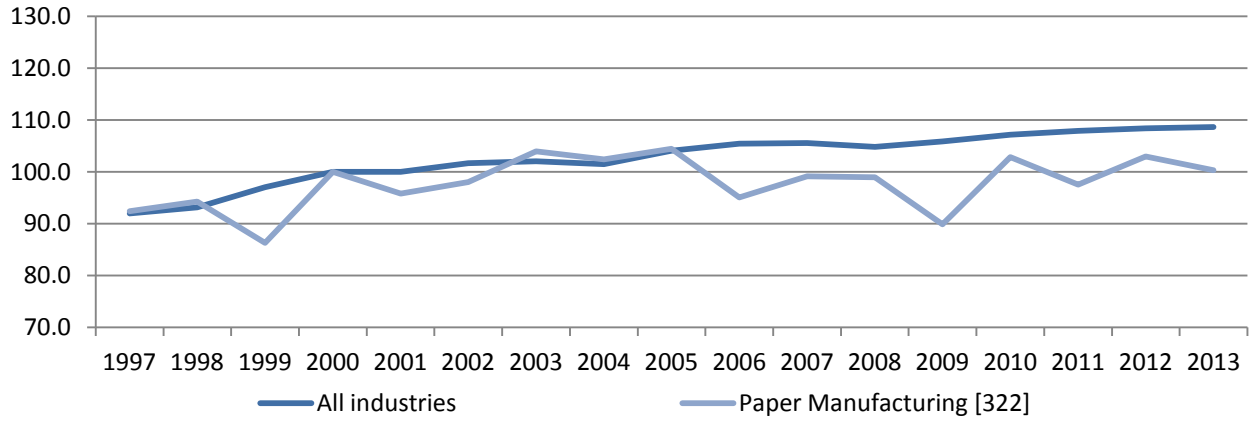
Note: "PM" stands for paper manufacturing. "PPPM" stands for pulp, paper and paperboard mills. "CPPM" stands for converted paper product manufacturing.
Source: CSLS calculations based on Statistics Canada data.

Chart 38 illustrates trends in labour productivity growth in paper manufacturing between 1997 and 2013. Labour productivity grew slowly from 2000 to 2005, after which it fell slightly and was only marginally above its 2000 level in 2013. In particular, labour productivity was only 0.3 per cent above its 2000 level in 2013.

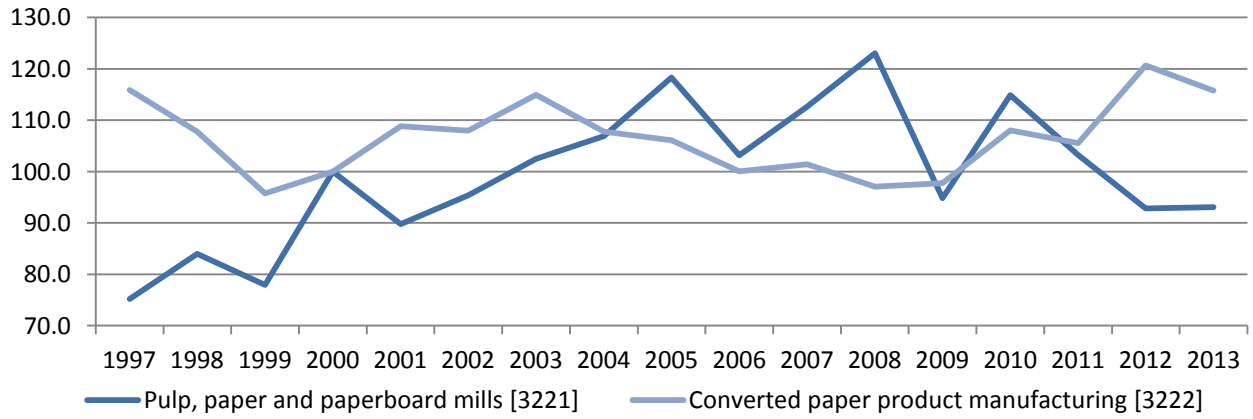
The two industry groups in paper manufacturing exhibited extremely divergent labour productivity growth trends between 1997 and 2013 (Chart 38). Pulp, paper and paperboard mills experienced negative labour productivity growth between 2007 and 2013 and positive labour productivity growth in the other two periods. On net, this resulted in negative labour productivity growth between 2000 and 2013. The positive labour productivity growth between 2000 and 2007 was not sufficient to offset the negative labour productivity growth between 2007 and 2013.

Converted paper product manufacturing, in contrast, had extremely strong negative labour productivity growth between 1997 and 2000, while it was able to register positive labour productivity growth in the other periods. On net, this resulted in labour productivity growth of 1.1 per cent per year between 2000 and 2013.

Chart 38: Labour Productivity, Paper Manufacturing, 2000=100, Per Cent, 1997-2013
Panel A



Panel B



Source: CSLS calculations based on Statistics Canada data.

In sum, the paper manufacturing industry group was not able to display strong labour productivity gains when faced with low or declining output growth and declining labour input, although it did generate mild labour productivity growth and strong labour productivity growth in a few instances. This suggests that the ability of Ontario's paper manufacturing firms (and firms in the entire forest products sector) to respond quickly and effectively to a poor macroeconomic environment was limited; however, further investigation is needed to determine why the response was so limited, especially in comparison to other Canadian provinces like Quebec and British Columbia.

IV. Factors and Drivers Influencing Productivity in the Forest Products Sector

This section of the report offers potential explanations for the productivity trends of Ontario's forest products sector that were described in the previous section. In particular, this section aims to explain the mild labour productivity growth in Ontario's forest products sector after 2000, despite the dramatic fall in output, which is often associated with negative labour productivity growth. This section contains two subsections. The first subsection will discuss the sources of labour productivity growth using growth accounting techniques. The second section will discuss the drivers of labour productivity growth in the forest products sector, including: 1) human capital; 2) innovation; 3) the macroeconomic environment; 4) the microeconomic environment; and 5) public policy.

A. Sources of Labour Productivity Growth

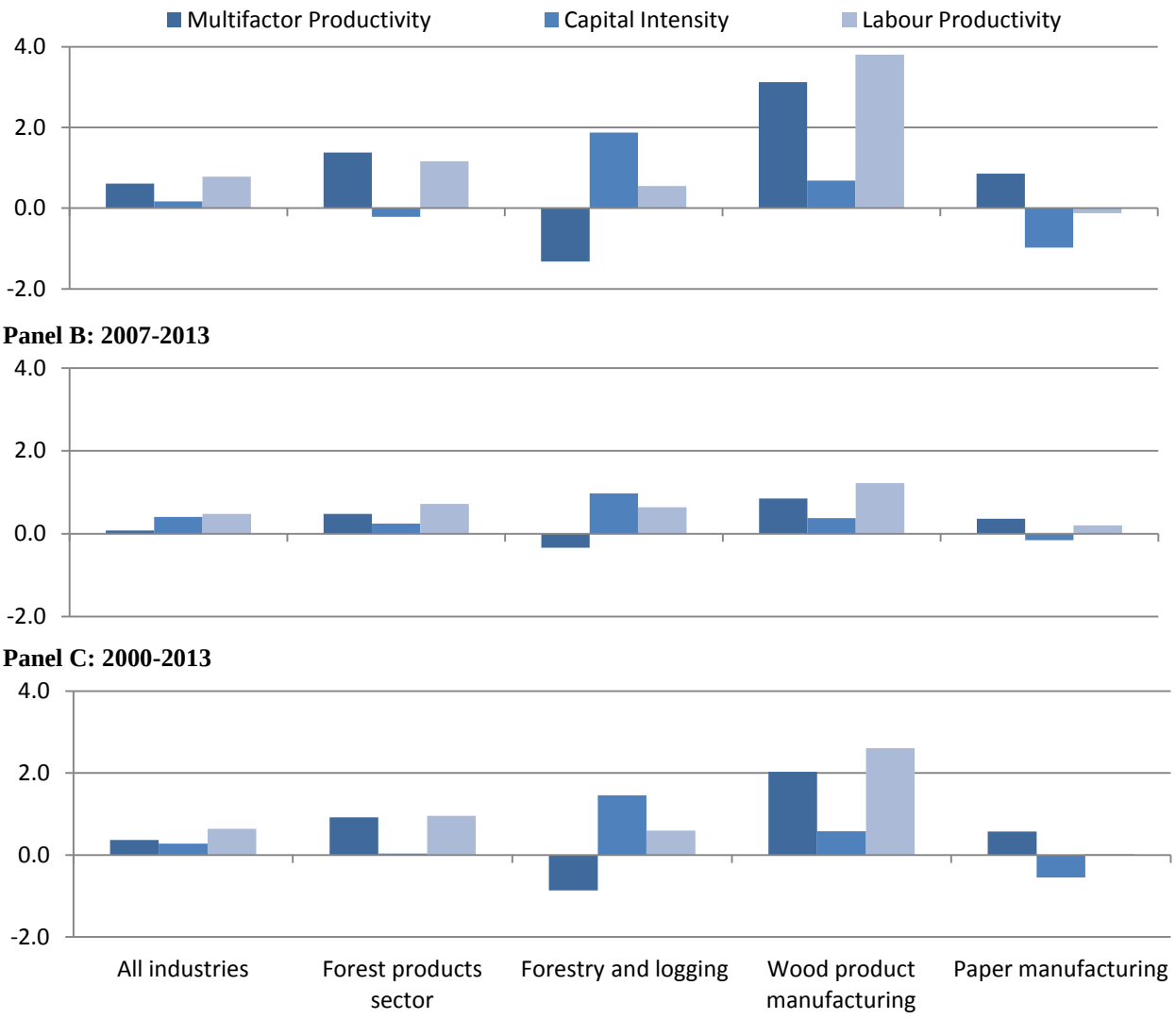
Using a growth accounting framework, labour productivity growth can be decomposed into changes in capital intensity, labour composition, and multifactor productivity. However, in this report, we decompose labour productivity growth into only changes in capital intensity and multifactor productivity due to a lack of data on labour composition.[17] By decomposing labour productivity growth, analyses of the drivers of productivity growth can be simplified. However, because of the links between many of the productivity growth drivers, in practice it is often difficult to disentangle drivers of capital intensity from drivers of multifactor productivity. This report does not attempt to undertake this task. However, the results in the next subsection on drivers should largely fit with the basic facts presented in this subsection.

Between 2000 and 2013, labour productivity in the forest products sector grew at a rate of 0.96 per cent per year, slightly higher than the all-industry average in the Ontario economy (0.64 per cent per year) (Chart 39). When looking at the sources of productivity growth, the stronger growth in the forest products sector was driven almost entirely by multifactor productivity, which contributed 0.92 percentage point in the forest products sector, while it only contributed 0.37 percentage point to labour productivity growth in the total economy. Capital intensity, on the other hand, contributed more to productivity growth in the total economy than it did in the forest products sector between 2000 and 2013 (0.27 percentage point versus 0.04 percentage point). When broken down by period, the trends are similar in 2000-2007 and 2007-2013, with multifactor productivity contributing the most to labour productivity growth in the forest products sector, while capital intensity had little effect.

[17] Capital intensity measures the amount of capital that each worker has at his or her disposal. In this report, capital intensity is measured as real capital stock (constant 2007 dollars) per hour worked. Multifactor productivity is the ratio between output and combined labour and capital inputs.

The strong contribution of multifactor productivity is also obtained in paper manufacturing and wood product manufacturing, while capital intensity contributed enormously to labour productivity growth in forestry and logging.

Chart 39: Sources of Labour Productivity Growth, Ontario, Per Cent, 2000-2013[18]



Source: CSLS calculations based on Statistics Canada data.

In previous studies (De Avillez, 2014), the contribution of labour composition was also studied at the level of the Canadian forest products sector as a whole. Unfortunately, due to data restrictions, the contribution of labour composition to labour productivity growth could not be studied at the provincial level. Nevertheless, De Avillez (2014) indicated that the contribution of labour composition to labour productivity growth is exceptionally small in most cases (0.2

[18] The estimates of multifactor productivity growth obtained in this paper are inconsistent with Statistics Canada estimates because capital services are not accounted for in the CSLS estimates.

percentage point in the forest products sector as a whole, and 0.0-0.1 percentage point in wood product manufacturing and forestry and logging). The only exception was paper manufacturing, which saw slightly larger contributions from labour composition (0.5-0.6 percentage point). These figures are suggestive for Ontario, as it is unlikely that there is a large distinction between provinces in the educational attainment of forest products sector workers. It is worth noting, however, that since Ontario has a higher proportion of paper manufacturing, the contribution of labour composition to labour productivity growth in the forest products sector might be slightly higher than in Canada as a whole.

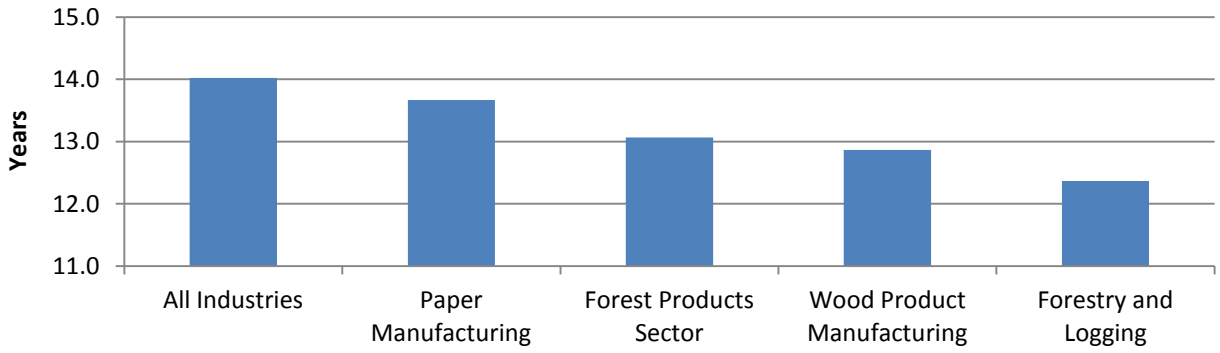
In sum, it is clear that multifactor productivity growth was the main source of labour productivity growth in the forest products sector. This is not surprising, given the weakness of investment growth and therefore capital intensity growth in the forest products sector. Unfortunately, given that multifactor productivity growth is affected by many factors, this finding alone provides little insight into the drivers of the labour productivity experienced by the sector after 2000. For example, labour composition was likely responsible for a small portion of the overall contribution of multifactor productivity, but without data it is impossible to determine how much of multifactor productivity's contribution is coming from labour composition.

B. Drivers of Labour Productivity Growth

i. Human Capital

Human capital is often thought to be an important contributor to labour productivity growth. Unfortunately, there is a lack of data on educational attainment at the three-digit NAICS level for the provinces in Canada. However, De Avillez (2014) studied the average years of schooling, the breakdown of the workforce of the forest products sector by educational attainment level and the risks of labour shortages in the sector at the national level.

Chart 40: Average Years of Schooling for Workers in the Forest Products Sector, 2012



Source: CSLS calculations based on Statistics Canada data.

The results presented in De Avillez (2014) for educational attainment and average years of schooling are likely true for the provinces; it is difficult to imagine substantial differences between the educational attainments of the workforce at the provincial level in any given sector. Workers in the Canadian forest products sector had almost one full year of education less than the average Canadian worker in the total economy. De Avillez (2014) notes that this difference is mainly due to forestry and logging and wood product manufacturing, as paper manufacturing had almost the same level of education as the average Canadian worker.

Similar to other industries and the total economy, the average level of schooling in the forest products sector has been on the rise over the past few decades. However, the overall education gap between forest products sector workers in Canada and the total economy has remained relatively stable.

When the workforce is broken down by educational attainment, the forest products sector had a higher proportion of workers with less than high school diploma and only a high school diploma than the total economy in 2012, while it had a lower proportion of workers with some post-secondary, a post-secondary diploma, or a university degree. This was true also true in 1990 and 2000. In 2012, however, the forest products sector had a higher proportion of workers with a post-secondary diploma than the total economy. The only sector within the forest products sector to demonstrate a different pattern than the forest products sector as a whole was paper manufacturing, which consistently had a higher proportion of workers with a post-secondary diploma than the total economy. This result is not surprising given that the average years of schooling in this sector were much higher than in the other two subsectors.

Clearly, human capital is an important source of productivity growth for any industry. In the forest products sector, there is evidence that the workforce is becoming increasingly educated over time, which may contribute to strong labour productivity growth in the future. Nevertheless, it is important to recall that labour composition contributed little to labour productivity growth at the national level. Therefore, it is unlikely that human capital has been a major contributor to labour productivity growth in Ontario's forest products sector.[19]

ii. Innovation

De Avillez (2014) outlines the approach we take in the report for understanding and analyzing innovation in the forest products sector at the national level. This section will study some of these innovation indicators at the provincial level.

[19] Labour shortages can affect productivity when workers in the sector have to be hired that have a lower educational attainment than would be optimal. In contrast to educational attainment, labour shortages tend be extremely different across the provinces. De Avillez (2014) suggests that the forest products sector is indeed facing skills shortages, especially in the paper manufacturing sector. However, it is difficult to believe that an industry that has had such a poor employment record in recent years could be facing a skills shortage.

a. Technological Prowess and Academic Research

The State of Science and Technology in Canada, a large scale survey conducted in 2012 by the Council of Canadian Academies concerning the overall direction of science and technology in a number of different areas, can be used to understand the state of innovation in the forest products sector. The assessment notes that there has been a decline in the output and impact of Canadian forestry research between the 1999-2004 and 2005-2010 periods when compared to the rest of the world. However, it also notes that "Canada's forestry research was ranked second in the world by top-cited researchers and that Canada accounts for over ten per cent of the world's papers in this subfield" (Council of Canadian Academies, 2012: 164).

The survey does not provide provincial level assessments, but the national picture can certainly provide an indication of the state of science and technology at the provincial level. As such, it can be expected that research in forestry in Ontario has been declining in recent years relative to the rest of the world, but that the research being undertaken still comprises a large portion of the papers published in the subfield (assuming a uniform distribution of publications at the provincial level in Canada). Furthermore, the location where research is being undertaken is not especially important, as published research is accessible across the world via the Internet.

b. Business Enterprise Research and Development (R&D) Expenditures

Another important indicator is business enterprise research and development (R&D) expenditures, since R&D is the main driver of technological progress which, in turn, is the principal driver of productivity growth in the long-run. As such, this section will examine business enterprise R&D (BERD) expenditures in the forest products sector and its subsectors throughout the 2000-2012 period. Unfortunately, due to data restrictions at the provincial level (mainly in forestry and logging) there is little insight to be gleaned at the aggregate level of the forest products sector.

In 2011, firms in the forest products sector in Ontario spent $48 million on R&D (Table 15). Paper manufacturing accounted for 64.6 per cent of total BERD expenditures in the forest products sector, with wood product manufacturing responsible for 33.3 per cent. Forestry and logging represented only 2.1 per cent of total forest products sector BERD expenditures. Since forestry and logging has tended to represent such a small proportion of BERD spending in the forest products sector, it is likely that total BERD spending in the forest products sector was sitting around $41 million in 2012.

Table 15: Business Enterprise Expenditures in R&D in the Forest Products Sector, Ontario, 2000-2012
Panel A: Millions of Current Dollars

	All industries	Forest products sector	Forestry and logging	Wood product manufacturing	Paper manufacturing
2000	6,857	..	x	x	x
2001	7,899	..	x	x	98
2002	7,063	..	x	x	82
2003	7,447	..	0	x	119
2004	7,833	140	0	14	126
2005	8,204	..	x	10	80
2006	8,153	182	1	10	171
2007	8,065	..	x	11	54
2008	7,883	..	4	x	50
2009	7,384	42	1	17	24
2010	7,193	68	1	18	49
2011	7,569	48	1	16	31
2012	7,268	..	x	14	26
2000-2006 (Average)	7,637	161	0	11	113
2006-2012 (Average)	7,645	85	2	14	58

Panel B: Compound Average Annual Growth

	All industries	Forest products sector	Forestry and logging	Wood product manufacturing	Paper manufacturing
2000-2007	5.25	..	..	..	..
2007-2012	-2.06	..	..	4.94	-13.60
2000-2012	2.76	..	..	..	..

Source: CSLS calculations based on Statistics Canada data.

Forestry and logging in Ontario has consistently represented the smallest proportion of BERD spending in the forest products sector, while paper manufacturing has represented the largest portion. Interestingly, with paper manufacturing in decline (-13.6 per cent per year between 2007 and 2012) and wood product manufacturing on the rise (4.9 per cent per year), paper manufacturing may soon lose its position. On net, since paper manufacturing accounts for such a large share of the forest products sector in Ontario, the declining performance of paper manufacturing has meant that BERD spending in the forest products sector has been declining. The difference in the average amount of BERD spending between 2000-2006 and 2006-2012 was shocking, falling by almost one half. The forest products sector, however, was hit extremely hard by the 2008-09 recession, since BERD spending declined by over half in both forestry and logging and in paper manufacturing between 2008 and 2009.

The recovery from the financial crisis has been virtually non-existent in forestry and logging, with BERD expenditures only $1 million higher in 2011 than in 2009. In wood product manufacturing, the recovery has been dismal, since expenditures declined from $17 million in 2009 to $14 million in 2012. However, BERD spending between 2006 and 2012 was on average higher than BERD spending between 2000 and 2006. Paper manufacturing, on the other hand,

has presented an entirely different story: expenditure levels rose back up to near 2008 levels by 2010, but they immediately fell back to crisis levels by 2012.

This data suggests that multifactor productivity growth should be stronger in wood product manufacturing in recent years, while it should be weaker in both paper manufacturing and forestry and logging. This is not reflected in the data. However, it is important to mention that there is no direct link between multifactor productivity growth and BERD expenditures. Indeed, it is possible that the strong multifactor productivity growth in recent years was not driven by rapid technological change coming from R&D. However, if there is a link between multifactor productivity growth and R&D, there tends to be a long lag. As such, it is possible that the high levels of investment in paper manufacturing in the early 2000s were driving productivity growth in the late 2000s. If this is the case, then the lower rates of BERD spending in the late 2000s do not bode well for productivity growth in next decade in paper manufacturing and forestry and logging, while the higher rates of BERD spending in wood product manufacturing in the late 2000s are more promising.

c. R&D Intensity

R&D intensity is defined as the share of BERD expenditures in nominal GDP. This is an important indicator of innovation performance. Once again, due to limited data at the provincial level concerning BERD, it is difficult to determine the trend of R&D intensity over time at the aggregate level. In 2011, BERD expenditures were 1.20 per cent of nominal output in the forest products sector, down from 1.96 per cent in 2004 (Table 16).

At the level of the industry groups, the declining share of BERD expenditures is seen only in paper manufacturing. Wood product manufacturing has seen a large rise in BERD intensity from 0.55 per cent in 2004 to 1.62 per cent in 2011. Forestry and logging has also seen its share of BERD expenditures rise: 0.00 per cent in 2003 to 0.25 per cent in 2011, with a peak of 0.78 per cent in 2008. Compared to all industries, BERD spending as a share of nominal output was higher in wood product manufacturing, while it was slightly lower in paper manufacturing and far lower in forestry and logging.

The lower share of BERD spending in nominal GDP compared to the mid-2000s suggests that recent improvement in multifactor productivity growth in forestry and logging is unrelated to BERD spending and BERD intensity. Changes in BERD spending and BERD intensity are also unable to explain the stronger multifactor productivity growth in wood product manufacturing, especially given that multifactor productivity growth decreased from 2000-2007 to 2007-2013 while BERD spending and BERD intensity increased. However, the slowdown in multifactor productivity growth in paper manufacturing from 2000-2007 to 2007-2013 may be related to the decrease in BERD spending and BERD intensity between these two periods.

Table 16: R&D Intensity in the Forest Products Sector, Ontario, 2000-2011

	All industries	Forest products sector	Forestry and logging	Wood product manufacturing	Paper manufacturing
2000	1.69	--	--	--	--
2001	1.89	--	--	--	2.25
2002	1.60	--	--	--	2.04
2003	1.63	--	0.00	--	3.07
2004	1.64	1.96	0.00	0.55	3.34
2005	1.65	--	--	0.42	--
2006	1.57	--	0.14	0.50	--
2007	1.45	--	--	0.67	1.73
2008	1.39	--	0.78	--	1.71
2009	1.33	1.02	0.23	1.63	0.91
2010	1.22	1.55	0.24	1.63	1.71
2011	1.23	1.20	0.25	1.62	1.19

Source: CSLS calculations based on Statistics Canada data.

d. R&D Personnel Intensity

R&D personnel intensity is defined here as the number of R&D personnel per one thousand workers. It is an important indicator of an industry's ability to innovate.[20]

In 2011, there were 10.6 R&D personnel per one thousand workers in the forest products sector in Ontario, down from a high of 14.3 in 2008 (Table 17). The level in 2011 was the lowest level seen since 2005. The forest products sector in Ontario has often had higher R&D personnel intensity than the total economy. The only year for which this is not true was 2005. Unfortunately, R&D personnel intensity in the forest products sector has been trending downwards in Ontario. This fall derives from the fact that the number of R&D personnel is falling faster than the number of employees. In fact, between 2006, the peak year for R&D personnel numbers, and 2011, R&D personnel fell from 950 to 529.

At the subsectoral level, the number of R&D personnel has actually increased in wood product manufacturing from 2001 to 2012 by 3.6 R&D personnel per one thousand workers. Both forestry and logging and paper manufacturing have also exhibited increases in R&D personnel intensity. Paper manufacturing increased from 7.7 R&D personnel per one thousand workers in 2001 to 12.2 R&D personnel in 2012. However, it is important to note that paper manufacturing has seen a fall since the recession. In 2006, there were 21.2 R&D personnel per one thousand workers in paper manufacturing, while there were 17.4 R&D personnel per one thousand workers in 2007. Since employment fell quite sharply, this suggests that the absolute level of R&D personnel fell even faster (Table 18). In particular, R&D personnel fell 67.4 per

[20] For information on the absolute number of research and development personnel, see Appendix Table 9A and 9B in the database available at www.csls.ca/res_reports.asp.

cent in forestry and logging from 2008 to 2012, while it fell 50.0 per cent in wood product manufacturing and 46.8 per cent in paper manufacturing. The period between 2007 and 2012 was the period that saw the largest declines, as there were actually gains in all three industries between 2000 and 2007.

At the subsectoral level, all three industries have displayed similar trends, reaching peaks in the mid-2000s and declining since then in both absolute terms and in terms of personnel intensity. This suggests that R&D personnel intensity was a potential contributor to multifactor productivity growth in the early- to mid-2000s. However, it was unlikely that it contributed much to labour productivity growth in the late 2000s or early 2010s.

Table 17: R&D Personnel Intensity, Forest Products Sector, 2000-2012

	All industries	Forest products sector	Forestry and logging	Wood product manufacturing	Paper manufacturing
2000	8.9	--	--	--	--
2001	9.7	--	--	2.4	7.7
2002	9.6	--	--	--	10.0
2003	10.0	--	2.0	--	10.9
2004	10.5	--	--	2.4	14.4
2005	10.8	8.2	0.7	3.9	15.0
2006	11.5	12.4	1.9	7.4	21.2
2007	12.3	--	--	7.3	17.4
2008	12.0	14.3	10.0	12.3	16.6
2009	11.0	13.2	4.2	11.3	16.9
2010	10.3	12.5	4.4	11.8	14.7
2011	9.9	10.6	3.8	9.3	12.9
2012	9.0	--	--	6.0	12.2

Source: CSLS calculations based on Statistics Canada data.

Table 18: R&D Personnel, Forest Products Sector, Ontario, 2000-2012

	Forest products sector	Forestry and logging	Wood product manufacturing	Paper manufacturing
2000	--	--	--	--
2001	--	--	77	304
2002	--	--	--	390
2003	--	11	--	455
2004	--	--	106	556
2005	677	6	152	519
2006	950	12	294	644
2007	--	--	228	482
2008	856	46	306	504
2009	718	18	290	410
2010	671	24	260	387
2011	529	15	208	306
2012	--	--	153	268

Source: CSLS calculations based on Statistics Canada data.

e. Machinery and Equipment (M&E) Investment Levels and Intensity

Innovation does not rely solely on R&D; it also relies on the adoption of state-of-the-art capital goods that improve the efficiency of the production process. De Avillez (2014) notes that this is particularly true for the forest products sector, where innovation tends to be embodied in physical capital. Unfortunately, data on investment in machinery and equipment (M&E) in forestry and logging has been suppressed for Ontario, while data has been suppressed for wood product manufacturing after 2009. Hence, this section will only be able to analyze M&E investment in wood product manufacturing before 2010 and in paper manufacturing.

Wood product manufacturing has shown dismal performance in terms of investment in M&E between 2000 and 2009, falling from a high of $119 million (chained 2007 dollars) in 2000 to a low of $21 million in 2009. The decline was mainly the result of the 2008-09 recession, when investment fell 71.3 per cent. Paper manufacturing investment in M&E in Ontario was equally disappointing, falling 4.8 per cent per year between 2000 and 2013. In stark contrast, between 2000 and 2013, M&E investment in the total economy increased 2.2 per cent per year. This suggests that the total economy is performing more strongly than the forest products sector in terms of updating capital assets.

These low investment figures suggest that firms in the wood product manufacturing industry group in Ontario are using outdated capital assets that do not embody the latest technological innovations. The results at the provincial level in Ontario do not differ from the results obtained by De Avillez (2014) for the Canadian forest products sector as a whole.

It is also important to look at M&E investment intensity, defined as real investment in

M&E per hour worked; it is an important indicator of embodied technological change, keeping track of the effort made by firms in a given industry to use up-to-date equipment.

Between 2000 and 2013, M&E investment intensity fell from $1.9 million to $0.6 million (Table 19). The majority of this decline was seen in 2007-2013, when machinery and investment intensity declined from $1.7 million in 2008 to $0.6 million in 2009. The total economy, in contrast, showed positive growth throughout the entire period (1.3 per cent per year).

Table 19: M&E Investment Intensity in the Forest Products Sector, Ontario, 2000-2013

	All industries	Forest products sector	Forestry and logging	Wood product manufacturing	Paper manufacturing
2000-2007	2.47	..	..	0.25	-6.03
2007-2013	-0.17	..	..	..	5.70
2000-2013	1.25	..	..	..	-0.79

Source: CSLS calculations based on Statistics Canada data.

The database constructed by the CSLS also provides current, constant and chained dollar figures for investment, depreciation and real net investment for engineering construction, building construction and intellectual property products, as well as for the aggregate, for wood product manufacturing in Ontario.[21]

In paper manufacturing, the investment figures for engineering construction and building construction are not much more promising than those for M&E, as they both exhibited negative growth rates between 2000 and 2013. Similar to M&E, the majority of the decline in investment in paper manufacturing was seen in the period between 2007 and 2013. Building construction saw a minor recovery in the mid-2000s, but that recovery was completely reversed in 2013. In contrast to M&E, building construction and engineering construction, intellectual property products investment was positive throughout the entire period, with growth of 0.4 per cent per year between 2000 and 2013.

Investment in engineering construction in paper manufacturing was actually sufficient to offset depreciation, leading to positive real net investment in many years between 2000 and 2013. However, real net investment exhibited negative growth on average between 2000 and 2013, which suggests that if trends continue, real net investment will be negative in the future, as it is for all of the other components. However, similar to M&E, real net investment was negative for building construction and intellectual property products in much of the period after 2000.

It is unlikely that engineering construction and building construction have contributed to multifactor productivity growth in paper manufacturing. However, since intellectual property products investment in paper manufacturing was positive and quite strong, it is possible that

[21] These are found in the Appendix Tables 7A-7AF available at www.csls.ca/res_reports.asp.

labour productivity growth was driven partially by multifactor productivity growth resulting from intellectual property products investment. It is worth noting that multifactor productivity growth in paper manufacturing was quite weak, so there is not much to explain in this subsector anyway. Furthermore, it is difficult to make statements for wood product manufacturing, forestry and logging and the forest products sector as a whole due to limited data.

f. Foreign Direct Investment

De Avillez (2014) notes that foreign direct investment (FDI) in the domestic economy and investment of Canadian firms abroad can foster technological diffusion, with firms creating new production processes or adapting established production processes to new realities. In addition to generating positive technological externalities, FDI can increase product market competition. Unfortunately, data is not available at the provincial level concerning FDI. Nevertheless, national level statistics can provide a small window into potential FDI investment trends at the provincial level, although it is important to keep in mind that the rate of investment likely varies quite starkly by province.

As such, looking at the national level, De Avillez (2014) found that between 2000 and 2012, inward FDI declined 48 per cent in the wood product manufacturing subsector and 23 per cent in the paper manufacturing subsector. Furthermore, between 2000 and 2012, outward FDI fell 56 per cent in wood product manufacturing and 52 per cent in paper manufacturing. Although it was well below the levels seen in the early 2000s, paper manufacturing FDI started to pick up pace again in the late 2000s.

These figures suggest that FDI investment in Ontario's forest products sector probably fell, which implies that technological diffusion deriving from FDI was probably minimal between 2000 and 2012. Hence, it is unlikely that FDI was contributing much to labour productivity growth through multifactor productivity.

g. Incidence of Innovation[22]

De Avillez (2014) studies in great detail three surveys of innovation at the firm and plant level. These surveys are arguably important indicators of innovative activity at a much more granular level than has been studied in the previous sections of this report. The three studies he considers are the *Survey of Innovation*, the *Survey of Advanced Technologies* and the *Survey of Innovation and Business Strategy*. The national level data is suggestive of provincial level innovation, but caution should be used when applying the results to provincial level assessments.

Quite briefly, these three surveys all provide a variety of different results concerning

[22] As there is no consistent time series, it is unclear how useful these surveys are as indicators of innovation.

innovative activities. The *Survey of Innovation* suggests that the forest products sector was performing quite poorly between 2002 and 2004. The *Survey of Innovation and Business Strategies* indicates that the forest products sector was performing above the total economy in terms of product and process innovation, but that it was on-par or below the manufacturing sector performance between 2007 and 2009. Finally, the *Survey of Advanced Technologies* suggests that wood product manufacturing had a higher incidence of adopting at least one advanced technology than the entire manufacturing sector, while paper manufacturing had a lower incidence of adopting just one advanced technology. When looking at results of the incidence of adoption of at least five advanced technologies, paper manufacturing outperformed the manufacturing sector as a whole, while wood product manufacturing was trailing behind.

Whether these results are indicative of innovative activities in Ontario is questionable, but they are certainly worth discussing, especially since Ontario has a high proportion of Canadian wood product and paper manufacturing plants. However, given the variability of the results of these three surveys, it is difficult to determine whether firms in the forest products sector in Ontario were innovative or not.

iii. Profits

There are three main paths through which profits can influence productivity:

- **Composition effect:** Low or negative profit levels can force low-productivity establishments out of business, raising the average productivity of the sector.

- **Survival effect:** Falling profits may serve as an incentive for firms to innovate, as they look for ways to cut costs and improve the overall efficiency of their production processes.

- **Investment effect:** Falling profits can also make it harder for firms to invest in R&D, or new capital, slowing down productivity growth.

In any sector or industry, it is difficult to determine the total effect of profits on productivity, since these three channels push productivity in different directions. De Avillez (2014) obtained data for profit levels in the Canadian forest products sector. Unfortunately, this data is not available at the provincial level. However, as with previous variables only available at the national level, inferences can be made concerning provincial level results by looking at the national picture. In this case, profits in the forest products sector in Canada have fallen considerably in all three subsectors since 2000.

Chart 41: Operating Profits in the Forest Products Sector, Canada, 2000-2011

Source: De Avillez (2014)

Since profits have been falling for such an extended period of time, it is likely that the positive contributions to productivity from the composition effect and the survival effect have waned, while the negative investment effect is starting to take precedence. The data on the number of establishments in the forest products sector only corroborates this suggestion, since the number of establishments has been falling quite steadily in all three industry groups since the mid-2000s. (There was a slight upward tick in the mid-2000s, which fits nicely with the observation that profits temporarily increased in the mid-2000s).

Estimated operating surpluses, a measure of profitability, in Ontario's paper and wood products manufacturing sectors declined from 2004 to 2008. The wood products manufacturing sector remained relatively stable from 1999 to 2003 but substantial declines occurred from 2004 to 2008. In 2004, the estimated operating surplus in the wood products manufacturing sector was $1.9 billion. By 2008, the estimated operating surplus in the wood products manufacturing sector dropped by 57 per cent to $0.8 billion (Ontario Ministry of Natural Resources, 2012). Operating surpluses in the paper manufacturing sector have steadily declined since 2000. In 2004, the estimated operating surplus in the paper manufacturing sector was $2.8 billion. By 2008, it had dropped 29 per cent to $2.0 billion (Ontario Ministry of Natural Resources, 2012).

Despite the overall drop in the total value of the operating surplus, the operating surplus margins (a measure of the rate of return) did not decline as significantly. The wood product sector's operating surplus margin declined slightly from 2004 to 2007 before increasing in 2008. The paper manufacturing sector's operating surplus margin increased slightly from 2004 to 2008. When considered together, the operating surplus margin in the forest sector was more or less unchanged. This suggests that when faced with poor market conditions, many high cost mills closed, leaving only the lower cost mills with higher surplus margins (Ontario Ministry of Natural Resources, 2012).

iv. Industrial and Intersectoral Shifts

De Avillez (2014) notes that productivity growth in the forest products sector is a combination of productivity growth in forestry and logging, wood product manufacturing, and paper manufacturing. For each subsector, in turn, productivity growth is the aggregation of productivity growth in more specific activities. Aggregate productivity growth depends not only on how much productivity growth is experienced by each subsector (**within sector effect**) but also on how important each activity is relative to the total; shifts toward higher-productivity activities can cause the overall productivity in that sector to increase (**reallocation effect**).

At the national level, De Avillez (2014) found that the reallocation effect in the Canadian forest products sector had very little impact during the 2000-2012 period. In particular, the reallocation effect explained only 4.6 per cent of annual labour productivity growth during the period, while the within sector effect accounted for the remaining 95.4 per cent.

If the lack of a reallocation effect is also the case at the provincial level, almost all of the labour productivity growth in Ontario was coming from wood product manufacturing between 2000 and 2013, since both paper manufacturing and forestry and logging had weak labour productivity growth.[23]

It is also important to note, however, that Ontario's forest products sector relies extremely heavily on paper manufacturing compared to other provinces within Canada. Since paper manufacturing had such poor growth across Canada, it is not surprising that productivity growth in Ontario was so much worse than other Canadian provinces. Hence, the compositional effect in Ontario may be operating to the detriment of figures of overall productivity in the forest products sector. If Ontario began to rely less heavily on paper manufacturing and more on wood product manufacturing, labour productivity growth figures may trend upwards.

v. Quality and Size of Canada's Natural Resources Base

The overall quality of the natural resources base can have important effects on productivity; all else constant, easily accessible and high-quality natural resources will lead to lower costs and higher productivity than hard-to-reach and low-quality natural resources. As Harrison and Sharpe (2009:52) state:

> "The reliance on less accessible timber stocks…can raise the cost in terms of labour and capital of producing a given quantity of logs, decreasing productivity. This tendency toward depletion and diminishing returns can be, and often is, offset by technological

[23] Chart 17 suggests that the share of each industry group in the total hours worked in the forest products sector was essentially unchanged between 2000 and 2013. Since hours worked shares are used to calculate labour productivity contributions, this only corroborates the assumptions that the reallocation effect is small at the provincial level.

> advances […] It is possible that Canada's relatively slow-growing forests, which result in long-distance hauling of logs […] makes super mills less viable than in other countries where wood fibre grows more quickly (Rheaume and Roberts, 2007:21). This situation could have a significant impact on productivity in the paper manufacturing subsector."

According to the *State of the Forests Annual Report 2013*, the rate of deforestation has declined in the last two decades in Canada; furthermore, this trend of declining deforestation is expected to continue throughout the next four decades. The only sector that is currently experiencing increasing deforestation rates is the oil and gas sector, although the recent crash in crude oil prices is likely to reverse this trend, especially if crude oil prices remain low. In the forestry sector, deforestation resulting from the creation of permanent forest access has been relatively stable (between 3,600 and 3,800 hectares per year since 2000). With deforestation rates declining, it is likely that productivity has been impacted much less in recent years by inaccessible forests than it was in the past.

In addition to deforestation from economic activity, forests can be reduced due to fires and insects. For example, Ontario had an above-average fire season in 2012, which included fires near Timmins and Kirkland Lake that caused evacuations and property damage. Deforestation from fires may have lowered productivity rates in recent years, as firms in the forest products sector were also forced to evacuate. Insects can also impact the ability for the forestry sector to harvest wood for forest products. In Ontario, alien species, like the emerald ash borer, have continued to spread into new areas. The increasing coverage of these alien species does have the potential to impact productivity in the forest products sector in the future, but the extent to which it has in the past is unclear. Diseases that afflict Ontario's forests have also increased in prominence in recent years due to milder and more humid springs, which favour the development and spread of foliar diseases. Diseases could also affect productivity levels in the forest products sector in Ontario. However, similar to the impact of insects, the extent to which diseases played a role in past productivity performance is unclear.

Harrison and Sharpe (2009) suggest that "in the long-run, the effect of [environmental changes from insects, diseases and fires, etc.] on productivity is not clear, but in the short- and medium-run, the cost of adjusting can hurt productivity". Hence, the quality and size of the natural resource base in Ontario is clearly important for productivity, but it is unclear how deeply fires, diseases and insects have impacted productivity levels and productivity growth in the past two decades. It has been suggested (De Avillez, 2014a) that there is no evidence that the quality and the size of the natural resource base in Canada has played a role, either positively or negatively, in terms of productivity growth.

In short, we found no evidence that increased productivity in Ontario was a supply-side phenomenon: it was not driven by more favourable natural resources development. However, it

is interesting to note that it is quite possible that growth in the forest products sector has been hindered in recent years (or may be hindered in the future) due to the crisis in the forestry sector. In particular, crises in the forestry sector can have negative impacts on investment in forest management, which can worsen timber supply problems in the longer term (Canadian Council of Forest Ministers, 2008). If forest management suffered during the crisis, then costs would have increased for firms in the forest products sector, which would have affected both output and thereby labour productivity. Whether or not forest management practices were affected by the crisis is not investigated in this report, but it is an issue worth considering. However, it seems that there are not obvious supply-side problems for fibre.

vi. Macroeconomic Environment

This section examines the impact of weak demand conditions on labour productivity growth in the forest products sector in Ontario. Prolonged periods of weak demand can have significantly negative impacts on labour productivity growth. Slowdowns in demand are typically associated with slower labour productivity growth and vice versa, as suggested by Verdoorn's law.[24]

Weak demand can stem from weak foreign demand, weak domestic demand, or both. In general, demand, whether domestic or foreign, is driven by exchange rates, unit labour costs, income and structural shifts (e.g. changing consumption patterns). In this section, foreign demand will be examined in detail through export demand. Exchange rates, unit labour costs and the incomes of importing countries will be examined with respect to how they impact exports. This section will also analyze the effect of structural changes on demand. Second, this section will examine how prices can impact labour productivity growth in the long run.

a. Exports

In the forest products sector in Ontario, 35.8 per cent of gross output is exported. The remainder is used for domestic consumption or as intermediate inputs in domestic production. From 2000 to 2013, Ontario's exports in the forest products sector declined by almost two-thirds (Table 20). Most of this decline came from declining European Union exports (-77.4 per cent) and United States exports (-63.9 per cent).

[24] Sharp decreases in demand can still be associated with positive labour productivity growth if firms respond to changing demand by lowering hours worked faster than demand is falling. This is especially likely to occur if firms face dramatic price or demand "shocks", which force firms to reduce inefficiencies in order to survive.

Table 20: International Exports by Destination, Millions of Dollars, 2000 and 2013

	Millions of Dollars		Share		Change
	2000	2013	2000	2013	2000-2013
United States	9,422	3,406	97.0	94.5	-63.9
European Union	132	30	1.4	0.8	-77.4
South and Central America	63	56	0.6	1.6	-11.1
Other	99	112	1.0	3.1	12.8
Total	9,736	3,604	100.0	100.0	-63.0

Source: Canadian Forest Service

The composition of exports in Ontario has also changed quite significantly between 2000 and 2013. Wood-fabricated materials and newsprint saw their share of total forest products exports fall by 5.6 and 6.0 percentage points between 2000 and 2013, respectively. In contrast, pulp and paper products saw its share of total forest products exports increase 5.9 percentage points between 2000 and 2013 (Table 21). Interestingly, the decline in international exports in Ontario was distributed quite equally across all categories between 2000 and 2013.

Table 21: International Exports by Product Type, Millions of Dollars, Ontario, 2000 and 2013

	Millions of Dollars		Share		Change
	2000	2013	2000	2013	2000-2013
Primary wood products	120	33	1.2	1.0	-72.6
Pulp and paper products	6,756	2,607	69.4	75.3	-61.4
Newsprint	1,704	398	17.5	11.5	-76.7
Wood pulp	1,341	524	13.8	15.1	-61.0
Wood-fabricated products	2,860	823	29.4	23.8	-71.2
Softwood lumber	847	224	8.7	6.5	-73.6
Total	9,763	3,463	100.0	100.0	-64.4

Source: Canadian Forest Service

Some major developments are behind this dramatic change in exports: a steady decline in consumption of newsprint in North America, and a sharp drop in residential construction in the United States prior to the 2007-08 financial crisis, and the global recession following the 2007-08 financial crisis. Newsprint consumption in North America has been declining since the turn of the century. In the United States, daily newspaper circulation is down from 55.8 million newspapers in 2000 to 44.4 million newspapers in 2011, as younger readers increasingly use electronic media and electronic devices instead of pulp and paper products.

Table 22: Exports, Volume and Price of Selected Products, 2000-2013

	Millions of Dollars		Change
	2000	2013	2000-2013
Volume (thousands of tonnes)			
Newsprint	1,991	570	-71.4
Other paper and paperboard	1,896	613	-67.7
Wood pulp	1,534	696	-54.6
Softwood lumber (thousands of m^3)	4,252	1,863	-56.2
Revenue per volume unit			
Newsprint	856	661	-22.7
Other paper and paperboard	922	978	6.0
Wood pulp	874	638	-27.1
Softwood lumber (thousands of m^3)	199	167	-16.1

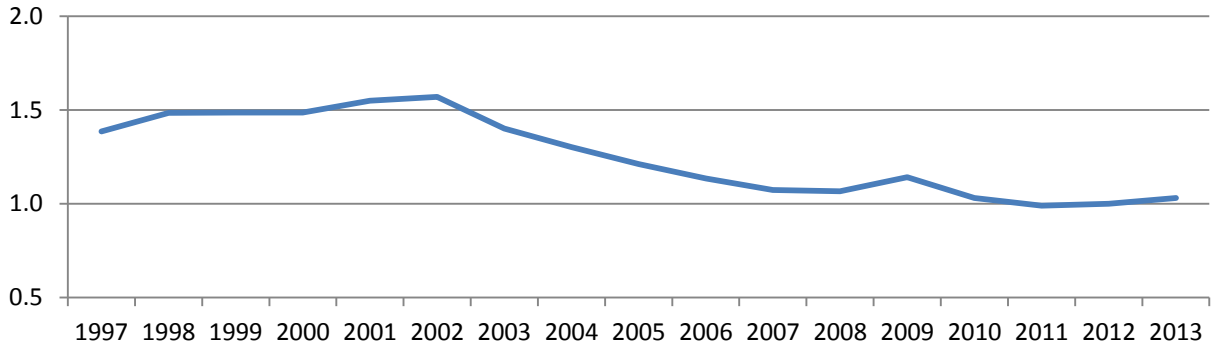
Source: Canadian Forest Service

Below, exchange rates will be examined, as they are important factors in explaining exports. Exports are also impacted by the economic environment in the country to which exports are destined, especially by income growth. In addition, exports are affected by relative cost competitiveness, which can be illustrated using unit labour costs. These three factors, as well as structural changes, will be discussed below.

b. Exchange Rates

Harrison and Sharpe (2009:55) state that exchange rates can also exert a short-run influence on productivity through their effect on output demand. If the Canadian dollar is depreciating relative to the U.S. dollar, then U.S. customers will find that Canadian products are becoming cheaper relative to other products, leading to an increase in export demand. When the Canadian dollar is appreciating relative to the U.S. dollar, then U.S. customers will find that Canadian products are becoming more expensive relative to other products, leading to a decrease in export demand. If firms respond to declining export demand by reducing hours worked faster than output is falling, productivity will increase, and vice versa.

Chart 42: Canada-US Exchange Rate, 1997-2013



Source: CSLS calculations based on Statistics Canada data.

Export (foreign) demand may offer a potential explanation for trends in productivity in the Ontario forest products sector. In particular, the Canadian dollar appreciated between 2000 and 2007; this appreciation reversed in 2008 and 2009, but resumed between 2010 and 2012 (Chart 43). Fortunately for the forest products sector, the Canadian dollar has begun to depreciate again in 2014 and 2015 with falling crude oil prices.

The appreciation of the dollar in the early- and mid-2000s would have reduced demand in the United States for Canadian forest products. Since approximately 95 per cent of Ontario's forest product exports go to the United States, demand for these products declined. Nonetheless, labour productivity increased in Ontario's forest products sector during this period, as firms were able to reduce labour input in an effort to cut costs and maintain their cost competitiveness.

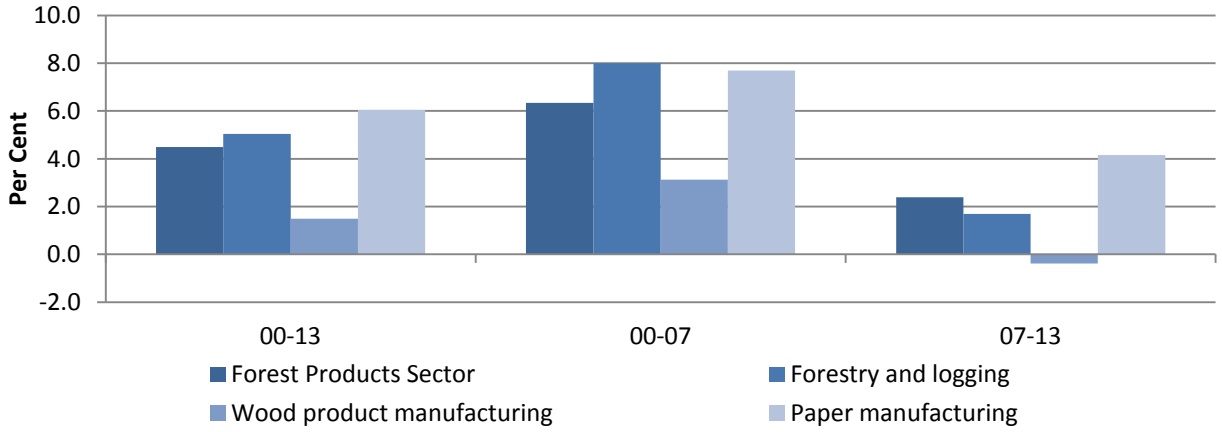
Harrison and Sharpe (2009:55) note that a trade-driven productivity growth cannot be sustained indefinitely because demand conditions are not a long-run driver of productivity in the same sense as technological progress, capital intensification, and skills development. While keeping this in mind, it is worth noting that the effect of exchange rate changes on export demand is likely to have contributed to some of the productivity trends in the forest products sector. Fortunately, the Canadian dollar is depreciating relative to the U.S. dollar, and as such, an increase in export demand can be expected in the coming years.

c. Unit Labour Costs and Energy Prices

A useful indicator of a sector's cost competitiveness is unit labour costs, defined here as the ratio between real GDP and nominal labour compensation. The change in unit labour costs (in U.S. dollars) can be decomposed into three components: 1) changes in the exchange rate, where an appreciation of the Canadian dollar leads to an increase in labour costs; 2) changes in hourly labour compensation (in national currency), where an increase in hourly labour compensation leads to an increase in unit labour costs; and 3) changes in labour productivity (in national currency), where an increase in labour productivity leads to a fall in unit labour costs.

Unit labour costs in the forest products sector in Canada increased between 2000 and 2013 at 4.5 per cent per year. The largest contributor to this increase was paper manufacturing, which saw unit labour costs increase 6.1 per cent per year between 2000 and 2013, followed by forestry and logging, which saw unit labour costs increase 5.0 per cent per year. In contrast, wood product manufacturing saw a relatively tame increase in unit labour costs between 2000 and 2013 (1.5 per cent per year). Since forest products are sold internationally, the most useful information is obtained by examining how Ontario's unit labour costs perform relative to international competitors. Unfortunately, this comparison will not be undertaken in this report. However, unit labour costs comparisons will be made with the Canadian and U.S. manufacturing sectors, as these data are readily available from The Conference Board.

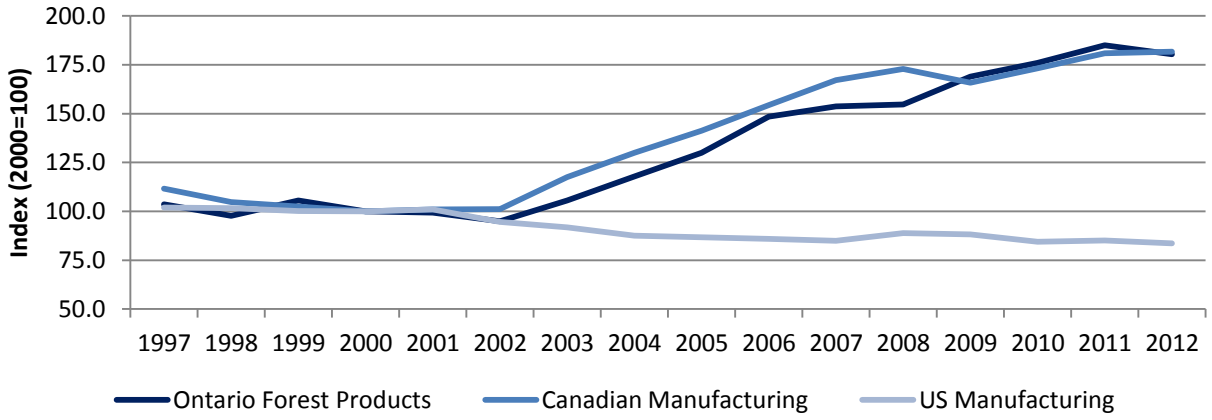
Chart 43: Unit Labour Costs, Forest Products Sector, Ontario, Compound Annual Growth Rates, Per Cent, 2000-2013



Source: CSLS calculations based on Statistics Canada data.

Unit labour costs (in U.S. dollars) in Ontario's forest products sector experienced trends similar to Canada's manufacturing sector between 1997 and 2012 (Chart 45). In particular, unit labour costs in both sectors were stable from 1997 to 2001, after which they began to rise. The bulk of the increase took place from 2002 to 2007, when the Canadian dollar experienced a great appreciation. By 2012, unit labour costs in both sectors reached about 180 per cent of their levels in 2001. In contrast, unit labour costs in the U.S. manufacturing sector were stable from 1997 to 2001, after which they began to fall steadily to 16.4 per cent below their 2001 level in 2012.

Chart 44: Unit Labour Costs in U.S. Dollars, 2000=100, 1997-2012

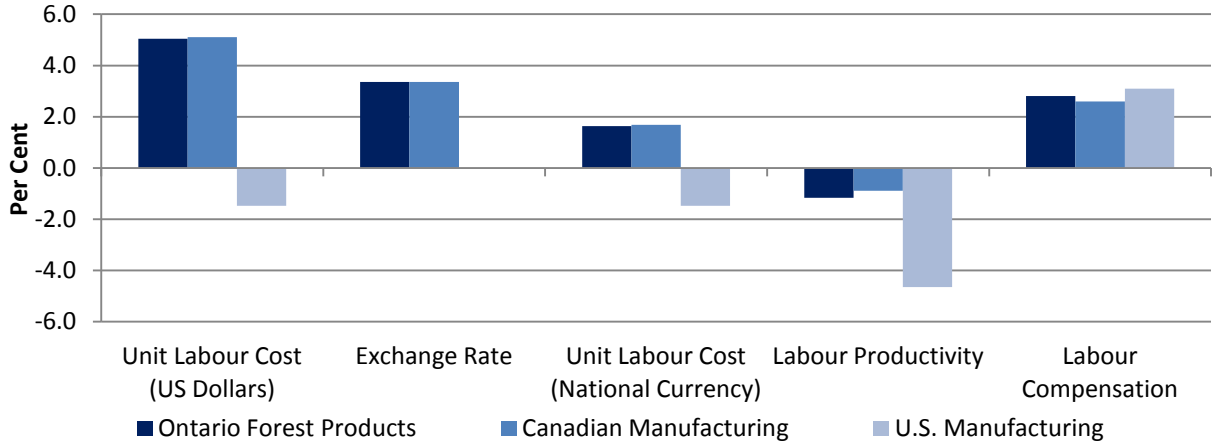


Source: CSLS calculations based on Statistics Canada and The Conference Board data.

The massive increase in unit labour costs in Ontario's forest products sector between 2000 and 2012 (5.0 per cent per year) was primarily driven by an appreciation of the Canadian dollar (which contributed 3.4 per cent per year to the increase in unit labour costs) and low productivity growth (which offset the increase in unit labour costs by only 1.2 per cent per year) (Chart 46). In contrast, the United States experienced much stronger labour productivity growth

from 2000 to 2012 (4.7 per cent per year), which drove the decrease in unit labour costs (-1.5 per cent per year). Surprisingly, the U.S. manufacturing sector and Ontario's forest products sector displayed comparable increases in hourly labour compensation between 2000 and 2012; this is unexpected considering the large drop in employment seen in the Ontario forest products sector.

Chart 45: Decomposition of Unit Labour Costs, Compound Average Annual Growth Rates, 2000-2012

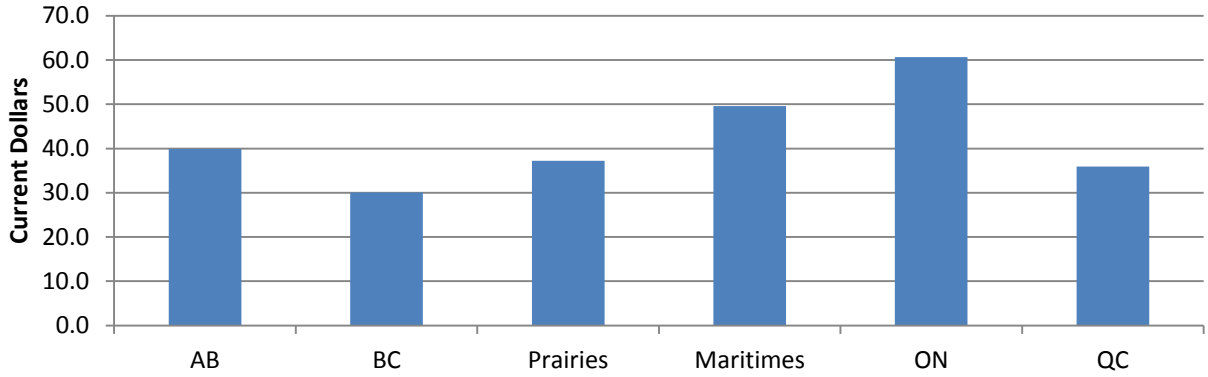


Source: CSLS calculations based on Statistics Canada and The Conference Board data.

Out of the three provinces for which data are available – Ontario, Quebec and British Columbia –, Ontario's unit labour costs increased exceptionally quickly. This suggests that compared to both British Columbia and Quebec, Ontario's forest products sector was much less competitive on the international market. This may explain why exports dropped sharply in Ontario compared to Quebec.

Another potential explanation for a declining competitiveness and thereby declining exports is increased energy costs. The pulp and paper industry is extremely energy intensive, and as such, high energy costs can deeply dampen competitiveness by increasing overall operating costs. Energy prices in Ontario are extremely high in comparison to other Canadian provinces and likely extremely high in comparison to other international operations (Chart 47). Hence, high energy costs may explain the recent decline in competitiveness and therefore exports in the pulp and paper industry in Ontario. Since pulp and paper is an extremely important part of the forest products sector in Ontario, the high energy costs in Ontario may potentially explain some of the results at the aggregate level.

Chart 46: Energy Costs, Pulp and Paper Mills, Selected Canadian Provinces, Average Cost per Tonne



Source: FisherSolve

d. Other Factors (Income and Structural Changes)

Domestic demand and foreign demand are both deeply affected by income and structural shifts in preferences. When income in the importing country falls, demand will also fall. When foreign demand falls, real output will respond in the exporting country. In order for the firms in the exporting country to survive in the long run, employment must decrease. If employment falls faster than real output falls, labour productivity will grow.

The 2008-09 recession severely reduced disposable income in the domestic economy in Canada, as well as in importing countries. Hence, it is no surprise that real output fell in the forest products sector in response. As mentioned earlier in the report, firms cut employment in order to survive, which led to positive labour productivity growth.

Another important driver of demand is a structural change in preferences. In the forest products sector, paper manufacturing is undergoing a structural change: consumers are moving away from pulp and paper products toward electronic media and electronic devices. This structural shift is putting downward pressure on the demand for forest products, resulting in decreases in real output in the forest products sector which in turn led to falls in employment.

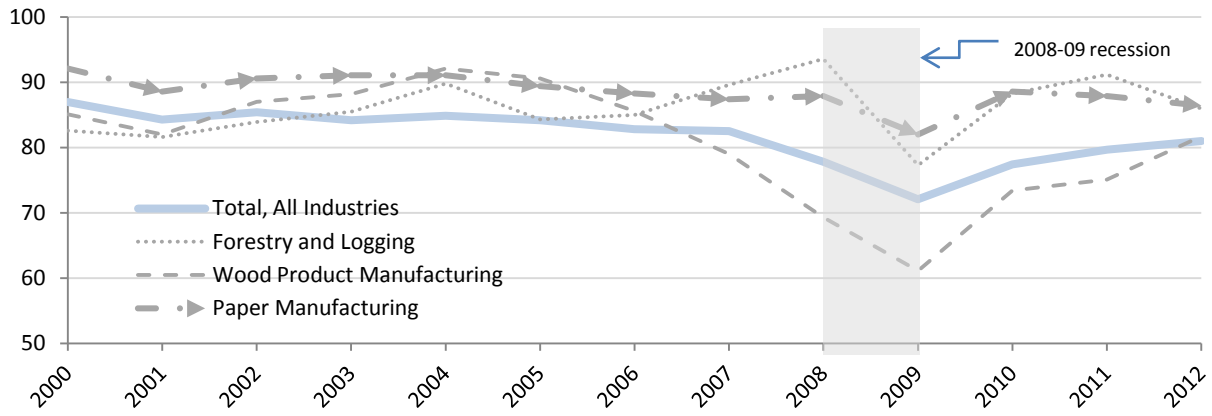
In short, as De Avillez (2014) notes, labour productivity exhibits procyclical behaviour, following closely trends in the macroeconomic environment: it increases during economic booms and decreases during recessions, following changes in both domestic and foreign demand. Given the factors discussed above, exchange rates, unit labour costs, income and structural changes, there are a variety of reasons why this correlation may appear. In particular, there are two explanations worth mentioning: capacity utilization and labour hoarding.

Capacity utilization can affect productivity results because during a recession, a significant part of the firms' capital stock is idle, which causes capital productivity to fall. In

contrast, during an economic boom, capital can be over-utilized, causing productivity to rise. Capacity utilization is estimated by Statistics Canada for a variety of industrial activities. Unfortunately, the data is only available at the national level. However, like many of the other variables discussed in this report, national level data can provide insight into likely developments at the provincial level.

In general, De Avillez (2014) concludes that capacity utilization has had very small effects over cyclically neutral periods, but that these effects are quite large in shorter time frames, especially around the 2008-09 recession. As such, when looking at the two subperiods (2000-2007 and 2007-2013), it is likely that capacity utilization is affecting labour productivity growth. However, when looking at the overall period (2000-2013), it is unlikely that capacity utilization has a large and significant effect on the productivity estimates.

Chart 47: Capacity Utilization in Forest Products Subsectors, 2000-2012



Source: De Avillez (2014)

Labour hoarding can affect productivity results because during recessions, firms have a tendency to keep more workers than would be optimal for a given level of production, which drives down productivity. Similar to capacity utilization, labour hoarding impacts short-term productivity growth, but it has very little impact on medium- and long-term productivity growth, since firms can fully adjust their labour input in the long run. Nevertheless, in the short-term, De Avillez (2014) found that labour hoarding significantly reduced labour productivity estimates in the forest products sector during the 2008-09 recession at the national level. As such, it is likely that labour productivity growth figures in the forest products sector in Ontario were slightly biased downwards in the period between 2007 and 2013, although labour productivity growth was still positive for all three subsectors even without accounting for labour hoarding.

As suggested by Verdoorn's law, there was a positive relationship between output growth and labour productivity growth in the Ontario forest products sector between 1997 and 2013. In particular, both labour productivity growth and output growth were strong (4.7 and 4.3 per cent

per year, respectively) from 1997 to 2000, while both labour productivity growth and output growth were weak (-3.8 and 1.0 per cent per year, respectively) from 2000 to 2013. However, it is important to note that labour productivity growth still grew by 1.0 per cent per year in 2000-2013 despite large declines in real output.

As previously discussed, the positive labour productivity growth after 2000 despite sharp declines in real GDP reflected the slack in the system and the response it generated in terms of hours worked and employment. According to MacLeod (2014), the slack in the forest products sector was so bad that "despite its size and large portfolio of mills, it set a world standard for neglect of its [mills; pulp and paper executives] in Canada failed to demonstrate real competency in leadership, imagination and investment. Meanwhile, many new facilities were built in South America and Southeast Asia, which today lead the world." The forest products sector in Ontario took the opportunity to shape up during the perfect storm and it may be set to better compete on the world market.

e. Prices

Productivity can also be affected by prices. In particular, Harrison and Sharpe (2009:53) note that output prices influence productivity by changing the average quality of the firms in the sector and of the resources used. Price increases bring into production establishments or productive resources that are of relatively low productivity and would not have been profitable at lower prices. In contrast, falling prices force marginal establishments to close, leaving only higher productivity establishments operating, which tends to raise the average level of productivity of a subsector.

Table 23: Implicit Prices, Forest Products Sector, Ontario, Compound Annual Growth, Per Cent, 2000-2011

	All industries	Forest products sector	Forestry and logging	Wood product manufacturing	Paper manufacturing
1997-2000	1.99	4.71	-1.97	5.70	5.19
2000-2007	2.46	-2.63	-1.65	-5.09	-1.66
2007-2011	2.01	0.88	0.30	-1.22	1.83
2000-2011	2.29	-1.37	-0.95	-3.70	-0.40

Source: CSLS calculations based on Statistics Canada data.

Since implicit prices in the forest products sector have been declining in wood product manufacturing, while they increased in forestry and logging and paper manufacturing, this theory offers an explanation for productivity trends in the forest products sector. It also offers a potential explanation at the level of the forest products sector as a whole.

vii. Microeconomic Environment

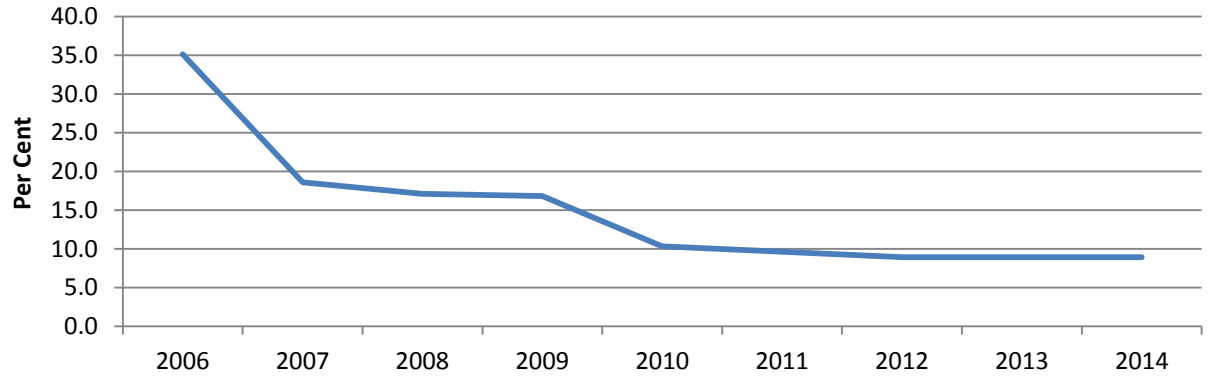
This subsection will examine how the microeconomic environment can influence behaviour at the firm level and subsequently affect productivity growth in the forest products sector as a whole. This section is divided into four parts, which discuss taxes, regulation, economies of scale, and returns to scale, respectively.

a. Taxation

Harrison and Sharpe (2009:57) observe that taxation can influence productivity through investment decisions, which in turn affect capital intensity. Firms make investments to maximize profits by investing until the return from the last dollar invested equals the cost. Taxes on firms' profits reduce the return on investment, while tax allowances, like the allowance for capital consumption, have the opposite effect.

The marginal effective tax rate, note Harrison and Sharpe (2009:58), is the most common measure of the total impact that taxes and allowances have on the return to marginal investments. The theoretical marginal effective tax rate (METR) on investment is the effective tax rate of investing one additional dollar in a given asset. All else constant, a firm should invest in jurisdictions and assets with low METRs, as a decrease in the METR leads to an increase in the marginal return on an investment. Taxes on capital lower the return that investors receive from capital investment, and in this way, taxes can reduce investment and result in lower capital intensity. As previously mentioned, lower capital intensity leads to lower labour productivity.

Chart 48: Marginal Effective Tax Rate on Capital, Forestry, Ontario, 2006-2014



Source: Mintz and Chen unpublished data.

Since 2010, forestry has faced historically low METRs of about 10 per cent, well below the level in 2006 (35.1 per cent) (Chart 49).[25] Despite low METRs and a favourable exchange

[25] The federal government introduced the fast write-off for manufacturing and processing assets (class 43) in 2007.

rate in terms of importing, forest products sector firms in Ontario still demonstrated low investment levels. However, METRs in Ontario were high relative to METRS in Quebec, where METRs for forestry have been negative since 2009.

Even with METRs that encourage high levels of investment, firms in the forest products sector underinvested. Had METRs been higher, it is likely that the capital stock used by forest products sector firms would have deteriorated much more quickly. However, low investment despite low METRs is unsurprising, since tax rates are only one factor affecting investment and they are much less important than the expected rate of return, which reflects prospects for sales and is dependent on macroeconomic conditions.

b. Regulation

Harrison and Sharpe (2009:60) point out that government regulation can have both positive and negative effects on productivity growth. For example, government regulations that restrict certain types of logging practices for safety or environmental reasons or that require stringent controls on air and water emissions from paper plants can increase the operating and capital costs and thereby reduce labour, capital and multifactor productivity. Alternatively, government regulations can force firms to take actions they would not normally take. These actions may have unexpected positive consequences for productivity and competitiveness, particularly if other countries eventually adopt the same regulations, giving the early adopters an advantage. Of course, the evaluation of the effectiveness of government regulation must go beyond the impact of the regulations on productivity, and must also factor in the societal benefits of less pollution and other non-economic benefits.

De Avillez (2014:134) notes that regulation plays an important role in the Canadian forest products sector because around 93 per cent of forested land is publicly owned, mostly by provincial governments (FPAC, 2005:10). FPAC (2005) identifies three key areas of concern with respect to government regulation in the forest products sector. First, FPAC argues that the *Competition Act* fails to recognize the global nature of the sector and unnecessarily obstructs consolidation. Second, FPAC argues that overlapping jurisdictions of the federal and provincial governments create confusion and redundancy in forestry regulation. Finally, specific policies tie access to resources to the maintenance of certain production facilities, presumably in an effort to prevent job losses among workers in the forest products sector. De Avillez (2014:135-136) deeply expands on these three issues and how they have affected the forest products sector.

c. Economies of Scale

Harrison and Sharpe (2009:61) note that one potential cause of lagging productivity in the forest products sector in Canada is the lack of large companies and large establishments.

Large plants can offer economies of scale in the use of resources, leading to higher productivity. Not only is plant size a potential productivity driver, firm size can be as well.

According to the Forest Products Industry Competitiveness Task Force (2007), significant advantages enjoyed by large firms in the forest products sector include a lower cost of capital, greater scale economies in production and marketing, and more efficient risk management of innovation and major capital projects. Similarly, FPAC (2005:11) argues that consolidation in the sector could offer "critical competitive advantages" such as increased efficiency (via economies of scale), asset, product or geographic diversification, and lower capital costs. Large firms are also able to attract more capital for innovative investments.

With all of the advantages of consolidation, it is rational for forestry firms to want to exploit them. However, Harrison and Sharpe (2009:61) note that the Canadian forest products sector is not exploiting the advantages of scale. By global standards, Canadian forest products firms are generally small. Furthermore, Canadian plants tend to also be small by international standards. Nonetheless, the degree to which this lack of consolidation is due to constraints imposed by the *Competition Act* is unclear.

Statistics Canada provides data on the number of establishments by industry. Establishment trends are consistent with trends in real GDP. In particular, the number of establishments in the forest products sector fell significantly from 4,428 establishments in 2005 to 3,775 establishments in 2010, which coincided with declining real GDP during this period.

Table 24: Number of Establishments, Ontario, 2004-2010

	Forest products sector	Logging	Wood product manufacturing	Paper manufacturing
2004	3,598	1,352	1,713	533
2005	4,428	2,263	1,671	494
2006	4,113	2,049	1,595	469
2007	4,115	2,007	1,656	452
2008	4,018	1,912	1,672	434
2009	3,830	1,784	1,619	427
2010	3,775	1,754	1,608	413

Source: Statistics Canada

When the number of establishments is combined with the data on real value-added by industry, it is possible to assess how average real value-added per establishment in the forest products sector has changed over time. Unfortunately, due to changing methodologies and terminated time series, the estimates must be interpreted with caution and only extend to 2010.

In logging, the average establishment was very small. On average, logging establishments

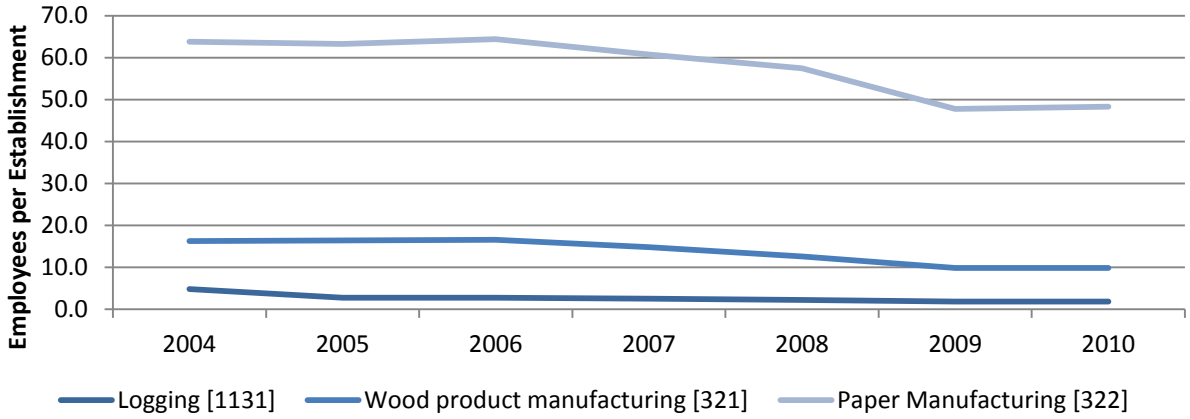
had real value-added of $206,000 and 1.8 employees in 2010 (Chart 50 and Chart 51). The average most certainly masks a significant number of larger establishments, but nevertheless, it suggests that the typical logging establishment in Ontario is very small. Wood product manufacturing shows more promising results in terms of the number of employees per establishment (9.8 employees) and in terms of real value-added per establishment ($777,000) in 2010. Paper manufacturing exhibited the highest number employees per establishment and the most value-added per establishment. In 2010, there were 48.3 employees per establishment and real value-added per establishment was $6,669,000.

In short, economies of scale can drive productivity growth. However, in Ontario, it is unlikely that economies of scale explain the recently high levels of multifactor productivity in wood product manufacturing. Limited scale economies may actually explain poor growth in forestry and logging and paper manufacturing, especially since establishment size in terms of employees per establishment and real-value added per establishment has fallen since 2004.

Chart 49: Real Value Added Per Establishment, Forest Products Sector, Ontario, 2004-2010

Source: CSLS calculations based on Statistics Canada data.

Chart 50: Employees Per Establishment, Ontario, 2004-2010



Source: CSLS calculations based on Statistics Canada data.

d. Returns to Scale

The standard theoretical framework used to calculate MFP growth assumes constant returns to scale (CRS). CRS means that a doubling of inputs leads to a doubling of outputs. If this assumption is false, productivity gains that are generated by increasing returns to scale (IRS) appear as part of MFP growth. IRS means that a doubling of inputs more than doubles output.

De Avillez (2014) notes that the benefits associated with IRS are also linked to the business cycle. In the presence of IRS, economic booms can yield significant productivity gains, since production has to increase to meet the strong demand; conversely, economic downturns lead to productivity losses. In general, De Avillez (2014) notes that larger firms (or production plants) tend to benefit more from IRS, since they can readily increase their use of labour and capital inputs without being subject to short- or medium-term capacity constraints.

Existing literature has highlighted the importance of IRS in the forest products sector. However, there are not actual estimates of the impact that these IRS have had on productivity in the forest products sector. De Avillez (2014) highlights that it would be possible to measure the impact of IRS on productivity in the forest products sector using econometrics; nevertheless, this is beyond the scope of this paper.

In sum, IRS in the forest products sector may explain a portion of the strong multifactor productivity growth that is seen in the forest products sector, but the actual amount it is responsible for has not been estimated in this report.

viii. Key Points

This section focused on investigating the various factors behind the above-average labour productivity growth experienced by the wood product manufacturing and the below-average labour productivity growth in forestry and logging and paper manufacturing in Ontario between 2000 and 2013. A simple growth accounting exercise showed that most of the observed labour productivity growth was driven by multifactor productivity growth. By definition, multifactor productivity growth is a residual, representing output growth that is not accounted for by measured input growth. It is often seen as a proxy for disembodied technological change, but the reality is that it encompasses a variety of different factors, including technical and organizational improvements, capacity utilization, returns to scale, economies of scale, and labour composition.

Overall, improvements in technology seem to have played a minor role in driving productivity growth in the Canadian forest products sector, which is suggestive for the forest products sector in Ontario. Research suggests that Canada conducts state-of-the-art research in several areas related to forest products. Furthermore, Ontario had high R&D intensity in the three industry groups in the forest products sector. It is crucial to keep in mind, however, that R&D

intensity has been declining in recent years and that investment in physical capital (M&E, building construction, and engineering construction) has been declining. This suggests that a number of firms in Ontario are using output capital assets that do not embody the latest technological innovations, which may explain part of the slowdown in labour productivity growth from 1997-2000 to 2000-2013.

More importantly, labour productivity appears to have been driven by demand conditions in recent years. The falloff in output growth from 1997-2000 to 2000-2013 largely explains the coincident falloff in labour productivity, as suggested by Verdoorn's law. However, the forest products sector continued to experience labour productivity growth above the all-industry average in 2000-2013 despite the fact that many factors were unfavourable for labour productivity growth: low R&D, low investment, low profits, low foreign direct investment, deteriorating demand conditions, and so on. The existence of above-average labour productivity growth in Ontario's forest products sector despite large declines in real GDP can be explained by the need to survive in the face of rapidly deteriorating demand conditions. Forest products firms simply had to cut costs in order to survive.

V. Toward Better Productivity Performance in the Forest Products Sector

In this section, forecasts for the macroeconomy and the forest products sector are examined. In addition, public policy and private sector initiatives and perspectives are discussed, and recommendations for improving labour productivity growth in the sector are provided.

A. Forecasts

According to the Standing Committee on Agriculture and Forestry (2009:9), the current problems in the forest system can be explained largely by the decreased demand for products made from Canadian wood, although the reasons for the reduction in demand vary from one product to another. Therefore, the future path of the forest products sector in Canada relies on an awareness of the continually evolving macroeconomic environment and an ability to adapt to changing demand conditions.

Since the end of the 2008-09 recession, there have been signs that the confluence of negative factors affecting the Canadian forest products sector is beginning to take a 180-degree turn and that the economic outlook for the Canadian forest products sector has improved considerably, as illustrated by the following:

- Economic growth in the United States is quickly accelerating, spurred on by quantitative easing. In the third quarter of 2014, the economy grew at a 3.9 per cent annual rate, while it grew 4.6 per cent in the second quarter (BEA, 2014). According to the OECD's (2014) forecast, U.S. growth is projected to pick up from 2.2 per cent in 2014 to 3.1 per cent in 2015 and 3.0 per cent in 2016. Strong growth in the United States is promising from the perspective of demand for forest products.

- Housing starts in the United States picked up in 2013, increasing demand for Canadian lumber and driving up lumber prices (Hasselback 2014). According to The Conference Board's (2014) forecast for the U.S. economy, housing starts will pick up from 0.93 million units in 2013 to 1.01 million units in 2014 and 1.20 million units in 2015.

- The exchange rate fell in line with crude oil prices to about $0.80 U.S. dollars per Canadian dollar in July 2015 after hovering close to parity from 2010 to 2014. Declining crude oil prices have reduced transportation costs. A lower exchange rate and lower transportation costs will make Canadian exports cheaper for U.S. customers.

- Energy prices, one of the largest costs faced by forest products sector firms, have also started to decrease.

- Forestry commodity prices have been abnormally high, given the state of the economic cycle. According to Ignjatovic (2014), lumber prices are expected to increase from $384/mt in 2014 to $411/mt in 2015 and $441/mt in 2016. Similarly, newsprint prices are expected to increase from $605/mt in 2014 to $610/mt in 2015 and $614/mt in 2016. In contrast, pulp prices are expected to decrease from $1,022/mt in 2014 to $988/mt in 2015 and $1,003/mt in 2016.

- New markets for Canadian forest products have been opening in Asia, especially in China and India, both of which continue to exhibit promising growth. Their growth has supported the forest products sector in Western Canada by propping up export demand in recent years.

Despite these signs of a positive turnaround, there are still a few less positive factors on the horizon, namely:

- The southern United States is starting to play an important role in lumber production, which adds a higher degree of competition to the international market, especially for provinces with forest products sectors that export mainly to the United States.

- Paper manufacturing will need to shed excess capacity by moving away from newsprint. The structural shift will continue its forward momentum with the increasing adoption and introduction of new electronic devices and electronic media.

- While there has been a reduced dependency on the United States in terms of trade in the forest products sector in Quebec, Ontario has not significantly diversified away from the U.S. economy.

B. Context for Productivity Improvement

The Canadian Council of Forest Ministers (CCFM) was established in 1985 to provide the federal, provincial, and territorial governments with an opportunity to work together to address forestry related matters. In their long-term strategic vision for sustainable forest management in Canada (*A Vision for Canada's Forests: 2008 and Beyond*), the CCFM identified forest sector transformation as a priority of national importance to maintain a prosperous forest sector. While diversification into new areas is important to maintain a strong forest sector, primary manufacturing will continue to play a major role within the sector.

The CCFM identified several opportunities for forest sector transformation, including the development of a bioeconomy, increasing the production of value-added wood products, and increasing the production of non-timber forest products.

The term bioeconomy describes an economy based on the manufacturing and trade of goods and services made from renewable resources. While the bioeconomy includes traditional wood products, the emerging bioeconomy uses resources from Ontario's forests to develop new bioproducts (e.g. bioplastics and biofuels). The developing bioeconomy is expected to increase the benefits derived from Ontario's forests, help diversify the forest sector, and make it more resistant to economic downturns.

A promising aspect of Ontario's bioeconomy is the use of forest biomass to generate energy. Ontario's pulp and paper sector has increased the use of forest biomass for energy. In 2007, 54 per cent of the energy used by Ontario's pulp and paper sector was derived from forest biomass. Ontario Power Generation is also implementing the use of forest biomass to generate electricity in some of its coal-fired generating stations.

Between 2004 and 2008, several initiatives were implemented to revitalize the forest sector. Some of the initiatives were designed to diversify the forest sector into new areas while others supported Ontario's existing forest sector. A number of the initiatives were initiated in response to the Minister's Council on Forest Sector Competitiveness. The Council was established by the Minister of Natural Resources in November 2004 to advise the government on ways to strengthen Ontario's forest industry. The Council's final report was released in May 2005 and is available on the website of the Minister of Natural Resources. Initiatives implemented between 2004 and 2008 included:

- **Forest Sector Prosperity Fund** ($150 million) and **Loan Guarantee Program** ($350 million): The two initiatives were established to support the forest sector and increase investment in several areas including new value-added manufacturing, increased fibre use efficiencies, improved energy efficiency, and the development of co-generation.

- **Northern Pulp and Paper Electricity Transition Program**: The fund provided $140 million for electricity cost relief to northern pulp and paper mills while mills transitioned to greater electricity efficiency.

- **Centre for Research and Innovation in the Bio-Economy**: A $25 million investment helped establish the Centre for Research and Innovation in the Bio-Economy (CRIBE) to conduct research into new products and processes that use wood fibre as a raw material.

- **Provincial Forest Access Roads Funding Program**: The program was established in 2005 to support the construction and maintenance of primary and secondary forest access roads. By 2008, $178 million was contributed towards the public forest road infrastructure.

- **Ontario Wood Promotion Program**: A continuous investment of $1 million per year was provided to expand markets for the province's wood products and increase production of value-added wood products including funding for the Ontario Wood Product Export Association to develop and promote international awareness of Ontario's wood products industry.

In addition to the initiatives discussed above, the Provincial Wood Supply Competitive Process and the Forest Tenure and Pricing Review were initiated in 2009. The Provincial Wood Supply Competitive Process was launched to attract new investment in the forest sector by allocating previously unutilized Crown wood volumes. The Forest Tenure and Pricing Review is expected to help re-energize Ontario's forest sector by creating new jobs and attracting new investment.

On top of the developments and transitions discussed above, there is a general belief that rearranging land tenure agreements would help revitalize the industry. Bullock (2013:272) argues that "a perceived need to reform forest governance is at the centre of a complex and contentious debate over how best to stimulate northern Ontario's failing forest sector and northern communities." Bullock (2013:282) states that "central to the prognosis is that a forest governance system is needed that would empower local actors and open up the industry to diversify products and markets, recirculate benefits, and foster the development of northern social and physical infrastructure. In turn, this would decrease dependence and burden on the provincial government, southern Ontario, and foreign companies and market."

Bullock (2013:284) points out that there are at least two options for decision makers pressed with the task of mitigating community and sectoral crises. One option is "to change the current actions underpinning forestry practice and hope for a different outcome that better fits with ingrained expectations. A decade of additive provincial and federal policy work has saved neither the forest industry nor communities… another and less obvious option is to change the thinking behind the actions – to reframe expectations according to new values and assumptions, which in turn will lead to the pursuit of a different course of action and the eventual formation of new place-based forest community identities."

Bullock (2013) argues that elements of a new forest governance model for Northern Ontario may include:

- Reform of the provincial tenure system to create opportunities for new entrants and meaningful local decision making;[26]

[26] See Kuitenbrower (2015) for an example how a private forest in the Haliburton Woods has bucked the overall industry trend and prospered.

- Communities thinking for themselves;
- A possible withdrawal of the capital and expertise of existing forestry companies;
- Much greater participation by Aboriginal communities in the forestry sector;
- The development of local capacity to participate in decision making through on-the-job training, community workshops, and youth education;
- Multi-party collaboration among all interested parties to share resources and advance a common vision based on shared appreciations and interests;
- Development of regional governance institutions (e.g. research institutes, development funds, stakeholder advisory bodies); and
- The buy-in of local enterprise and business leaders to provide business expertise.

Haley and Nelson (2007) argue that the tenure system has constrained diversification and innovation. Access to fibre for new entrants is limited and there are few incentives to develop nonconventional forest products. They note that Ontario's tenure policies are based on the notion of sustained yield harvesting intended to ensure steady fibre flows to designated processors. This means that these policies emphasize timber harvesting rights and long-term security for large investors through 'evergreen' leases renewed every five years. In addition, 80 per cent of annual fibre allocations are associated with large-scale processing facilities that by design require minimum fibre volume to be economically viable.

C. Private Sector

Fully addressing these issues is crucial if the forest products sector in Canada wants to maintain international competitiveness and domestic strength. In addition, since FPAC has set output, employment and environmental goals for the year 2020 under the title *Vision 2020 Challenge*, addressing these future concerns seriously is all the more important since productivity gains and a healthy market demand can help ensure that the goals outlined in this publication are attained by 2020. In particular, FPAC (2014) highlights three main goals for the Canadian forest products sector in the next five years: 1) generate an additional $20 billion in economic activity from new innovations and new markets; 2) deliver a further 35 per cent improvement in the sector's environmental footprint; and 3) renew the workforce with at least 60,000 new recruits, including women Aboriginals and new Canadians. De Avillez (2014) outlines how productivity gains in the forest products sector in Canada can help achieve these objectives. Once again, since Ontario is a crucial part of Canada's forest products sector, the

observations concerning productivity's role in delivering these objectives applies at the provincial level.

The forest products sector in Ontario will only be able to prosper if firms in the forest products sector invest more heavily than they have in the 2000s when they underinvested, resulting in the use of out-of-date equipment. In order to reap all of the benefits from recent technological advances and ensure sustainability in the long run, forest products sector firms should invest more in physical capital. Fortunately, forest products sector firms have demonstrated a strong performance in terms of R&D intensity in the past, so returning to high levels of investment should not be overly difficult, especially given the recently low levels of marginal effective tax rates.

Furthermore, in order to stay competitive on the international market, the forest products sector in Ontario must lower unit labour costs (Appendix 1). If productivity gains begin to improve, increasing unit labour costs will reduce, thereby improving the international competitiveness of the forest products sector in Ontario. Unfortunately, the forest products sector in Ontario has not had very strong productivity gains in recent years, so increasing unit labour costs may present a major concern. In contrast, the decline in the value of the Canadian dollar in 2014-15 will reduce unit labour costs in Ontario, which in turn improves cost competitiveness.

D. Public Policy

As previously discussed, policies have a substantial role in influencing decisions at the firm level. In Ontario, the forest products sector is highly regulated. Ensuring that these regulations are providing the right incentives is important to ensuring that the forest products sector in Ontario recovers from the perfect storm and returns to full potential.

Roberts and Woodbridge (2008) discuss the future opportunities for the forest products industry in New Brunswick in detail. Many of the opportunities available for New Brunswick are equally available for Ontario, and hence, this paper deserves serious consideration. First, Roberts and Woodbridge (2008:4) note that "a competitive sawmilling segment should be seen as the cornerstone for a competitive forest products sector." It has been shown that "sawmilling typically provides the highest return-to-log, while generating by-products, upon which the province's pulp and paper, nonstructural panel and emerging bio-energy segments depend." Hence, public policy should encourage the maintenance of a healthy sawmilling industry, since there are positive externalities for the forest products sector as a whole from such endeavours.

Roberts and Woodbridge (2008) also note that bio-chemicals produced in bio-refineries are just around the corner and that a "bio-refinery can take advantage of the differences in biomass components and intermediates and maximize the value derived from the biomass

feedstock by producing multiple products." Essentially, "a bio-refinery is a facility that integrates biomass conversion processes and equipment to produce fuels, power and chemicals from biomass." Public policies that tap into and encourage these bio-refineries may give the forest products sector in Ontario a boost.

However, it is important to note that there is a delicate balance between using wood to create energy as opposed to forestry products. According to Roberts and Woodbridge (2008:4), "governments should be careful how [they] encourage the bio-energy sector" because European data indicate that "a given volume of wood generates eight times more value-added and thirteen times more employment when used in the production of pulp and paper as opposed to energy". Hence, it is clearly important to stress the use of wood in pulp and paper and avoid encouraging the energy sector's use of wood if the forest products sector is to regain vigour in terms of both GDP and employment, but it may be equally important to encourage investment in bio-refineries as a way to diversify the production of forest products in Canada and boost demand for Canadian forest products.

Butler, Cheetham and Power (2007) put forward a number of specific recommendations to revive forestry in Northern Ontario, including the following:

- The establishment of a Northern Investment Fund, with a government commitment of $500 million per year for five years;

- The return of energy to its historical role as a regional development tool for northern Ontario with regional energy pricing;

- Reform of the current tenure (licensing) system to ensure those who invest in silviculture will benefit from those investments in 40 years;

- The re-design of existing community adjustment programs and services to better meet the needs of employees, communities and families impacted by mill closures;

- The development by governments of a strategy to revitalize communities impacted by the closures in the forestry industry; and

- The creation by the Government of Canada of a national forestry summit that brings together all stakeholders to develop a sustainable forestry strategy.

VI. Conclusion

A. Summary of Results

Despite experiencing massive declines in real GDP, the Ontario forest products sector was able to generate positive productivity growth between 2000 and 2013 that was above the all-industry average in Ontario. However, labour productivity growth in 2000-2013 was much lower than in 1997-2000, which reflected the large falloff in demand between these two periods. Labour productivity in Ontario in the 2000-2013 period was the lowest among the four major forest products producing provinces.

Periods of weak or negative output growth are generally associated with weak or negative labour productivity growth, just as periods of strong output growth are associated with robust productivity gains; this relationship is known in the literature as Verdoorn's law. As suggested by Verdoorn's law, there was a positive relationship between output growth and labour productivity growth in the Ontario forest products sector between 1997 and 2013. In particular, both labour productivity growth and output growth were strong (4.7 and 4.3 per cent per year, respectively) from 1997 to 2000, while both labour productivity growth and output growth were considerably weaker (-3.8 and 1.0 per cent per year, respectively) from 2000 to 2013.

Clearly, a perfect storm hit the industry in 2000-2013: high exchange rates, high energy prices, the collapse of the U.S. housing market, and the global recession stemming from the 2007-08 financial crisis in the United States. In addition, there was a structural shift from pulp and paper products to electronic devices and electronic media. All of these factors led to large declines in output and employment in Ontario's forest products sector.[27]

Given the massive downturn in the forest products sector one might have expected a poorer productivity performance for the sector in 2000-2013. However, sharp decreases in demand can still be associated with positive labour productivity growth if firms respond to changing demand by lowering hours worked faster than output is falling. This is especially likely to occur if firms face dramatic price or demand "shocks", which force firms to reduce inefficiencies in order to survive. This appears to have been the situation in Ontario's forest products sector, although less than in Quebec (Thomas, 2015).

A surge in labour productivity growth, everything else being equal, reduces unit labour cost growth and makes firms more cost competitive, maintaining demand for its products and hence dampening declines in output (but not necessarily employment). Equally, a fall in labour

[27] Although the focus of this report is productivity, it is important to consider the human cost associated with the perfect storm that afflicted the forest products sector, as thousands of Canadians lost their jobs. The human cost may have been particularly high in Northern Ontario, given the low availability of high-paying jobs in the region.

productivity, everything else being equal, has the opposite effect. As this report has shown, the Ontario forest product sector was not overly successful in improving its labour productivity after 2000 and this development resulted in a larger fall in output in the sector than in other provinces (such as Quebec) that were more successful on the productivity front. However, the challenges facing the forest products sector go beyond productivity and a full treatment is beyond the scope of this report.

Furthermore, Ontario's forest products sector underinvested in its capital stock in the face of weak demand. The only component of capital stock to exhibit significant growth throughout the period was intellectual property products; all other components demonstrated severe declines. Since investment was not strong enough to offset depreciation, the average age of capital equipment has increased and the sector is continuing to use outdated equipment.

The Bank of Canada (2014:25) has noted that in manufacturing industries output can be expected to grow, but that it is unlikely that output will quickly reach previous levels because of reduced capacity. This inability to regain previous output levels stems from underinvestment in plants and equipment in Canada, often because firms decided to invest in more favourable locations abroad. This is particularly true in the forest products sector, resulting in a number of operations becoming obsolete due to insufficient investment.

B. Data Issues

This report relies extensively on Statistics Canada data. A number of concerns with data availability and reliability were encountered in producing this report. These issues are discussed below because the analysis provided in this report is contingent on the quality of the data made public by Statistics Canada.

One major concern is the lack of data availability, which derives from two main sources: 1) confidentiality restraints mean that statistics occasionally remain unpublished; and 2) low interest or lack of funding implies that Statistics Canada does not produce or release data.

The first major area driving the lack of data availability is confidentiality restrictions. The *Statistics Act* has prevented Statistics Canada from releasing a large quantity of estimates. In addition, the application of the *Statistics Act* appears to have become even more stringent in recent years. Some time series provide estimates only until the mid-2000s, after which confidentiality restraints apply and data are not available. Concerns with the lack of data deriving from privacy are not applicable at the aggregate level because of the large sample size, but they are especially problematic at the provincial and industry level. Since this report deals with three-digit NAICS industries at the provincial level, there were a number of instances where data were suppressed. The most glaring case was investment and depreciation, where Ontario had a number of three-digit NAICS industries suppressed. In terms of the forest products sector, paper

manufacturing was suppressed in Quebec, while wood productivity manufacturing was suppressed in Ontario. Forestry and logging was suppressed in both provinces.

The second reason for limited data is Statistics Canada's decision not to release available data, either because of perceived low interest by users or lack of resources on the part of the agency. In particular, Statistics Canada does not always publish data on CANSIM at the provincial level concerning variables of interest. The most important examples are profits by three-digit NAICS industry and province, and labour productivity by three-digit NAICS industry and province.[28]

Another major concern is reliability, which is driven by inconsistency, revisions and small sample sizes. In particular, the termination of useful time series and lack of explicit linkages between time series that replace them can cause severe reliability concerns. In this report, the obvious example is the estimates on the number of establishments. This time series was terminated in 2010, but the table to which it belongs continues to be updated. The reason for this termination is unclear. The number of establishments is now made available in another time series, but this time series is not directly comparable with the previous time series, which limits long-term analysis of trends. In many cases, the replacement of a time series is necessary, to reflect new methodological or definitional information. However, Statistics Canada makes little effort to ensure comparability across these different time series. In cases where time series are not comparable, Statistics Canada should attempt to make data available for as many years in the past as possible, or provide direction to researchers on how to make the linkages between time series to allow for analysis over time.

Revisions are also an important source of data reliability issues. Statistics Canada often revises data, which is important, since the revised estimates will reflect the most up-to-date information and provide the most accurate statistical picture. Unfortunately, however, these revised estimates can often change findings quite dramatically. Hence, it is important to be aware of the possibility of revision and to ensure that new estimates have not been made publicly available when reviewing an analysis.

The final area that lies behind limited data reliability is the quality of estimates, which is heavily influenced by sample size. This issue rests mainly with the Labour Force Survey (LFS) in terms of this report.[29] The LFS survey provides the most up-to-date information on Canada's labour market, but unfortunately, the data that are made available are not always the most reliable at the detailed industry level because of small sample size.

[28] Labour productivity estimates can be constructed manually using hours worked and real GDP estimates, which are available at the three-digit NAICS level by province; however, at the two-digit NAICS level, these estimates are freely available and ready-made for the provinces.
[29] The LFS is not directly used for any analysis in the report, but estimates are provided in the database.

C. Future Research

During this report's writing and editorial process, a number of future research topics were identified. Some of these research topics relate directly to this particular study, while other research topics branch off in a variety of interesting directions.

There are many future research possibilities relating to productivity in the forest products sector in Canada. First, this report could itself be updated to reflect new data for 2014 and any potential revisions to data by Statistics Canada. These updates could also be reflected at the national level (De Avillez, 2014) and at the provincial level for this report on Ontario and the report on Quebec (Thomas, 2015). Moreover, when data are made available and obtained for educational attainment and profits by three-digit NAICS industry at the provincial level, this information could be appropriately integrated into the section discussing productivity drivers.

Second, an analysis of productivity trends in the forest products sector could also be undertaken for British Columbia and other Canadian provinces. In addition to updating data and expanding the study to other provinces, a third future area of research would be the production of a number of comparative reports which look at important differences between provinces in terms of productivity trends and productivity drivers.

In addition to the topics outlined above, there are some related issues that could be addressed in future reports. For example, there appears to be a compositional effect on productivity both within the forest products sector as a whole and within its three industry groups. Investigating the importance of these effects on productivity may help identify exactly where productivity gains are coming from and where productivity growth has been lagging.

There are also a number of additional topics whose explanation could shed light on productivity in the forest products sector in Ontario:

- It would be informative to investigate how patterns in firm data, provided by Statistics Canada, could be integrated into the analysis to shed more light into the drivers behind productivity and the responses made at the firm level.

- Insight could be gleaned from integrating information relating to the behaviour of the biggest players in the forest products sector (e.g. Resolute, Cascades, Tembac and Kruger) with the productivity patterns exhibited by Statistics Canada data. Information concerning market shares and layoffs by firm, as well as location, costs and profitability would need to be obtained.

- Unpacking the impact of recycling on productivity growth in the forest products sector.

D. The Future of the Forest Products Sector

To maintain competitiveness, the industry must begin by investing in state-of-the-art equipment to improve productivity even further and in a more sustainable fashion. If the forest products sector in Ontario revitalizes its capital stock, it will be able to make significant productivity gains in order to compete with low-cost competitors. Nonetheless, productivity is only one determinant of competitiveness, and an overall strategy for the future of the forest products sector should look beyond productivity to other factors affecting competitiveness.

The forest products sector should also understand precisely which niche each jurisdiction fits into in the international market to ensure that business plans are accordingly developed, especially since new competition has entered the international market in recent years and will likely continue to present itself in the future. Successfully entering new markets, like India, may also partially offset increased competition from new rivals.

Finally, and likely most importantly, the forest products sector in Ontario should leverage the development of new products.

In sum, the industry has undergone a significant transformation in recent years. Capacity has been shed, leaving behind an industry that is much smaller than in the past. It remains to be seen whether the forest products sector in Ontario can remain competitive by improving productivity growth in the future. The sector will likely never return to what it used to be, but the forest products sector in Ontario is not likely to disappear. Despite its smaller size, the forest products sector in Ontario will continue to have the potential to serve as a crucial component to the overall economic fabric of the province, providing high-wage employment in many rural regions in Ontario.

Since the mid-2000s, the Ontario forest products industry has been largely an industry in decline or a sunset sector, although there has been some transition, with the development of new products. It is likely that the decline is now largely over and transition will assume much greater importance. Going forward, strong labour productivity growth will be essential for the Ontario forest products sector to make the transition to a vibrant and growing sector.

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