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**Explaining the Post-2017 Fall in  
Productivity in the Transport Sector in  
Canada**

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# **Explaining the Post-2017 Fall in Productivity in the Transport Sector in Canada**

## **Abstract**

Productivity growth in Canada has been abysmal in Canada in recently years. Using either 2017 or 2019 as a base, output per hour growth in this country has been by far the weakest in the G-7. For two-digit NAICS industries, the transportation and warehousing sector has experienced the worst labour productivity performance, down 4 per cent per year since 2017, compared to a 0.6 per cent increase for the business sector. This massive drop in productivity has resulted in the level of output per hour in the transportation sector falling from 93 per cent of the business sector average in 2017 to 77 per cent in 2023. This one sector reduced business sector productivity growth by about 0.2 percentage points per year. The objective of this report is to shed light on the nature of this fall in productivity growth in the transportation and warehousing. Three of the nine three-digit transportation sector industries are found to account for over 78 per cent of the fall in labour productivity growth in the sector, namely air transport, public transit and trucking. The report provides a detailed analysis of how and why productivity fell in these industries.

# Explaining the Post-2017 Fall in Productivity in the Transport Sector in Canada

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# Explaining the Post-2017 Fall in Productivity in the Transport Sector in Canada

## Executive Summary

Productivity growth in Canada has been abysmal in Canada in recently years. The weakest in the G-7. For two-digit NAICS industries, the transportation and warehousing sector has experienced the worst labour productivity performance. This situation is particularly concerning to Transport Canada, which commissioned the Centre for the Study of Living Standards to investigate the issue. The objectives of this report are to shed light on two questions:

- What factors could explain the decline in labour productivity and multifactor productivity in the transportation sector in Canada, especially since 2017?
- What can explain the differences in the productivity indicators by sub-industries?

The structure of this report is three-fold. The first part documents productivity developments in the transport sector across a number of dimensions for the 2017-2023 period and in a longer-run historical perspective. Part two accounts for these developments by using different decomposition methodologies. The third part develops a narrative that sheds light on transport sector productivity performance through an examination the different factors that have driven these developments.

Labour and multifactor productivity (MFP) in the transport sector in Canada outperformed that of the business sector up to 2017. Since 2017, the situation has reserved dramatically. Output per hour in the transport sector fell 2.9 per cent per year between 2017 and 2023, compared to a 0.17 per cent increase for the business sector. This massive drop in productivity has resulted in the level of output per hour in the transportation sector falling from 93 per cent of the business sector average in 2017 to 77 per cent in 2023. The fall in productivity in the transport sector reduced business sector labour productivity growth by 0.20 percentage points per year.

Multifactor productivity in the transport sector plummeted 6 per cent between 2017 and 2022, the most recent year for which MFP data are available. In contrast, in the business sector MFP fell by 0.4 per cent per year in the same period.

Despite the much larger fall in output in transportation and warehousing (-0.2 per cent) than in the business sector (1.4 per cent) in 2017-2023, total hours worked grew significantly faster than in the business sector, 2.8 per cent per year versus 1.2 per cent. The faster growth in hours than in output in transportation and warehousing explains its fall in productivity of 2.9 per cent per year. The 1.6 percentage points slower annual output growth in the transportation and warehousing compared to the business sector in 2017-2023 is largely explained by the much larger collapse of output in 2020. The pandemic had much direr consequences for transportation and warehousing than other sectors of the economy.

Since 2017, seven of nine transport industries experienced a fall in output per hour of at least 2 per cent per year. The largest fall was in air transport, down 8.6 per cent per year from 2017 to 2023, followed by transit, ground passenger and scenic and sightseeing transportation, down 3.8 per cent per year. Trucking also suffered a significant decline, with output per hour falling 3.1 per cent per year.

Trucking was responsible for 37.1 per cent of the fall in output per hour in 2017-2023 in the transport sector, followed by air transportation at 21.3 per cent and transit, ground passenger and scenic and sightseeing transportation at 20.4 per cent.

While labour productivity also fell in the transport sector in the United States between 2017 and 2023 by 1.6 per cent per year (the latest available data), the industry patterns differed significantly. Like Canada, labour productivity in air transport decreased in the United States but the rate of decline was much less at 2.9 per cent per year (compared to 8.6 per cent per year in Canada). Similarly, trucking experienced a fall in productivity of mere 1.4 per cent in the United States (compared to 3.1 per cent per year in Canada). In contrast to Canada, urban transit systems experienced a significant increase in labour productivity at 9.6 per cent per year. The three-digit transport industry with the worst labour productivity performance in the United States was courier and messengers down 5.8 per cent per year followed by pipeline transportation down 4.5 per cent per year.

Over the 2017-2020 period, Canada was in the middle of the pack in terms of labour productivity performance in the transport sector among G-7 countries, outperforming France, Japan and the UK, but doing worse than Italy, the United States and Germany. This was not case for MFP, where Canada had the worst performance.

From 2000 to 2017 output per hour in air transport in Canada more than doubled, growing 10 per cent per year. Larger planes, higher load factors, more efficient scheduling, more effective use of staff brought about by new technologies, among other factors, likely contributed to this productivity bonanza. The post-2017 collapse of labour productivity in air transportation in Canada is largely explained by the pandemic. In the pandemic years of 2020 and 2021, most airlines continued to maintain operations despite very limited traffic and high fixed labour costs. It is not surprising that productivity plummeted. The airlines were only able to continue operations with government subsidies. As real output rebounds, productivity will revive, as it did in 2022 and 2023. Real output in air transportation in the United States rebounded from the pandemic much faster in than in Canada, as travel restrictions and lockdowns were lifted sooner.

Like air transportation, urban transport systems were severely affected by the pandemic. Output plummeted 68 per cent in 2020 due to work from home because of the closing of workplaces due to the pandemic meant fewer people were using public transit. For many reasons public transit authorities cannot adjust hour worked to changes in falls in demand for transit services. Routes must be maintained even though ridership is down significantly. This results in very large falls in productivity.

Truck transportation was not as affected by the pandemic as air transportation and urban transit systems. Trucking enjoyed strong productivity gains from 2000 to 2017 due to the introduction of double trailers (Longer Combination Vehicle or LCVs), more efficient load scheduling through computerization, and better highways. Productivity growth in trucking fell after 2017 due to a number of factors, including labour shortages reflecting low wages and challenging working conditions, increased border restrictions, and greater traffic congestion, particularly in major metropolitan centres such as the Greater Toronto Area.



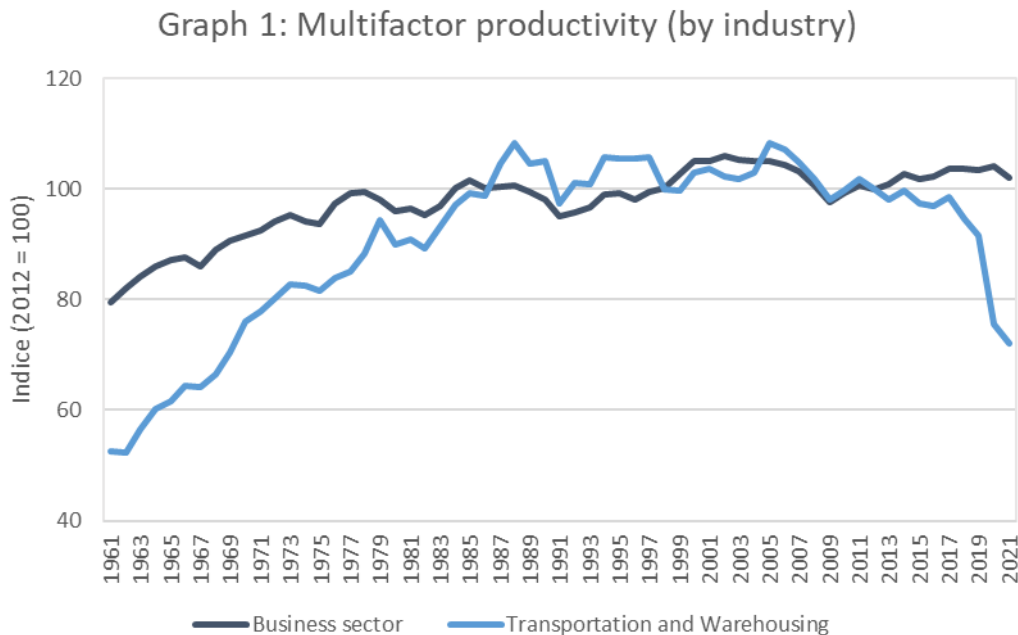
# Explaining the Post-2017 Fall in Productivity in the Transport Sector in Canada<sup>1</sup>

## Introduction

The Centre for the Study of Living Standards was approached by Transport Canada to examine developments related to productivity in the transportation and warehousing sector in Canada. This request was motivated by a sharp decline in both labour and multifactor productivity in the sector since 2017, as evidenced by the two graphs below.

The objectives of this research project are to shed light on the following questions:

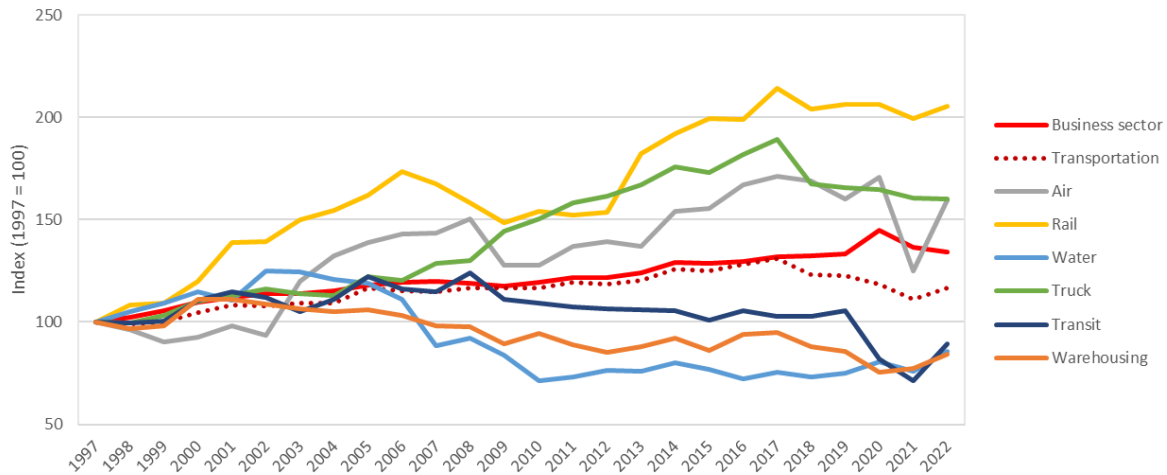
- What factors could explain the decline in labour productivity and multifactor productivity in the transportation sector in Canada, especially since 2017?
- What can explain the differences in the productivity indicators by sub-industries?



Source: Stats Can Table 36-10-0208-01

<sup>1</sup> This report was written by Andrew Sharpe and Alisaleh Shariati. CSLs thanks Transport Canada for financial support and comments on earlier drafts. The database that was used to conduct the analysis in this report is available at [https://www.csls.ca/data/Transport\\_Canada\\_Data\\_Appendix.xlsx](https://www.csls.ca/data/Transport_Canada_Data_Appendix.xlsx)  
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Graph 2: Labour productivity by sub sector



Source: Stats Can, Table 36-10-0480-01

In 2016, the Centre for the Study of Living Standards released a report (McKellips and Calver, 2016) done for Transport Canada on productivity trends in the transport sector. The key finding of the report was that the transport sector had enjoyed average productivity growth. Times have changed.

The transport and warehousing industry in Canada have experienced an abysmal labour productivity performance since 2017. Output per hour has fallen 18 per cent from \$54.30 (2017 dollars) in 2017 to \$45.60 in 2023 (the most recent year for which annual productivity estimates are available from Statistics Canada), a 2.87 per cent average annual rate of decrease. This is by far the worst performance among all the two-digit NAICS industries.<sup>2</sup> Multifactor productivity growth in the transport sector has also fallen dramatically, again the largest decline of any two-digit industry. Two transport sub-industries suffered particularly large falls in labour productivity over the 2017-2023 period, with output per hour down 41 per cent in air transportation and 20 per cent in public transit.

The structure of this report is three-fold: first, to document productivity developments in the transport sector across a number of dimensions for the 2017-2023 period and in a longer-run historical perspective; second, to account for these developments by using different decomposition methodologies; and third, to develop a narrative that sheds light on transport sector productivity performance through an examination the different factors that have driven these developments.

Part one provides a comprehensive analysis of the productivity performance of the transportation and warehousing sector in Canada, with an emphasis on the post-2017 period. It will address the research question of how well the transport sector has done in terms of both the level and growth rate of labour and total factor productivity in Canada and by province compared to other two-digit NAICS industries and compared to the transport sector in other developed countries. It will also examine the productivity performance of the three-digit NAICS industries within in Canada and by province. This part will also provide context for the analysis of labour productivity growth by looking at both output and labour input trends in transport industries.

<sup>2</sup> This excludes “Holding Companies” which is a minor industry in terms of its share of output and employment in the business sector industries.



Part two addresses the research question of what accounts for the productivity performance of the transport sector using different methodologies. It first provides estimates of the contributions of labour quality, capital intensity and total factor productivity to changes in labour productivity in Canada. Second, it shows the relative importance of within-industry productivity growth versus re-allocations of workers between industries to productivity growth in both the transport sector and detailed transport industries. The report will also address the distribution of productivity gains and losses in the transportation sector. Productivity gains can go to workers in the form of higher wages, to employers in the form of higher profits, and to the users of the transport services in the form of lower prices. Productivity losses have the opposite effects. Through an examination of wages and profits in both absolute and relative terms and in the prices of transport services one can ascertain if the changes were evenly distributed.

Part three address the research question of factors that explain the fall in productivity growth in Canada since 2017, with a focus on explaining developments in industries that were most responsible for the fall, namely air transportation, urban transit systems, and trucking.

Statistics Canada provides a wealth of data on transport sector productivity at both the national and provincial level and for the aggregate transport sector and NAICS sub-industries especially, since 1997. Estimates at the detailed industry level are available for labour productivity (Statistics Canada Table 36-10-0480-01) and for multifactor productivity at the two-digit industry level (Table 36-10-208-01).

## **Part One: Documenting Productivity and Related Variable Developments in the Transportation and Storage**

### **Historical Context**

It is widely recognized that Canada's productivity performance has deteriorated over time and is currently very weak. Growth in business sector output per hour averaged 3.6 per cent per year in 1961-73, then fell by half to 1.7 per cent in 1973-2000, then falling again to around 1 per cent in the post-2000 period. Business sector multifactor productivity growth followed a similar pattern, although at lower growth rates (1.5 per cent in 1961-73, 0.5 per cent in 1973-2000 and virtually zero after 2000).

Productivity in the transportation and warehousing sector has followed the same path, although often at a higher growth rate. Output per hour in the transport sector averaged 5 per cent in 1961-73, falling to 2 per cent in 1973-2000 and since 2000 by 0.5 per cent. But unlike the business sector, there appears to have been a structural break in productivity growth in the transport sector in 2017. From 2000 to 2017 output per hour in the transport sector advanced at a 1.2 per cent per year. But from 2017 to 2023, it fell 2.87 per cent per year. Multifactor productivity in the transport sector has followed a similar path to labour productivity. After averaging 3.9 per cent in 1961-1973, it fell to 1.5 per cent in 1973-2000 and -0.5 per cent after 2000. Again, the post-2000 period has seen a structural break, with MFP falling only 0.1 per cent annually in 2000-2017 compared to 6.1 per cent per year in 2017-2022.

There is a large literature of the possible reasons for two-stage deceleration in productivity growth at both the aggregate and industry level first after 1973 and then again after 2000. Many analysts see the slowdown in the pace of underlying technical change as the main cause, but there is not a consensus on this. In any case, this is not the focus of this report.

Rather, the report documents and then seeks to shed light upon the reasons for the large fall in transport sector productivity in Canada. Questions that will be explored include whether this post-2017 productivity bust in the Canadian transport sector is found in other sectors, is broadly based across all provinces, is unique to Canada or found in other countries. The three-digit transport industries that are responsible for the fall in productivity in the overall transport sector will also be identified and analyzed.

### **Productivity Developments in Two-digit NAICS Industries in Canada**

#### Labour productivity growth rates

Output in an economy or sector is determined by changes in the number of hours worked and the average output produced per hour worked, defined as labour productivity. So, changes in the growth rate of output are a function of the growth rate of total hour worked and labour productivity. This means labour productivity growth is equal to the rate of growth of output minus the rate of growth of hours. For the analysis of productivity developments, it is important to understand trends in output and labour input.

## Output

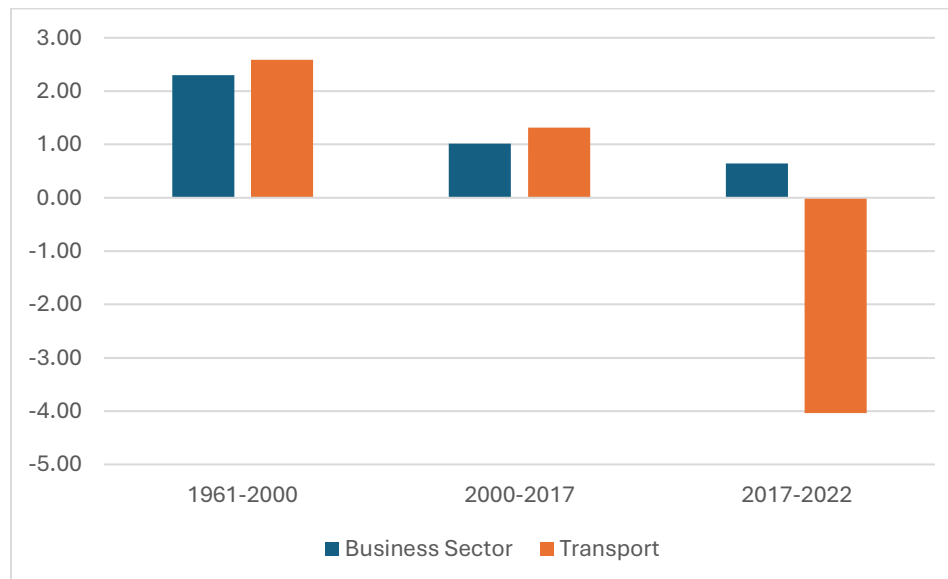
Real output, expressed in chain 2017 dollars, in the business sector advanced at a 1.4 per cent average annual rate from 2017 to 2023. With annual growth of 2.7 per cent in 2018 and 2.1 per cent in 2019, real output plummeted 6.5 per cent in 2020 because of the pandemic, then rebounded 5.6 per cent in 2021 and a further 4.4 per cent in 2022. However, in 2023, the rate of output growth in the business sector slowed down significantly to 0.74 per cent.

In contrast to the business sector, output in transportation and warehousing fell 0.2 per cent per year from \$90.4 billion 2017 dollars in 2017 to \$89.5 billion in 2023. This was second largest fall in output growth over the period, with only accommodation and food services registering a larger fall (-0.6 per cent). The fall in output in transportation and warehousing made a -0.7 per cent contribution to the overall change in business sector output (a decline of \$1 billion out of an increase of \$129 billion).

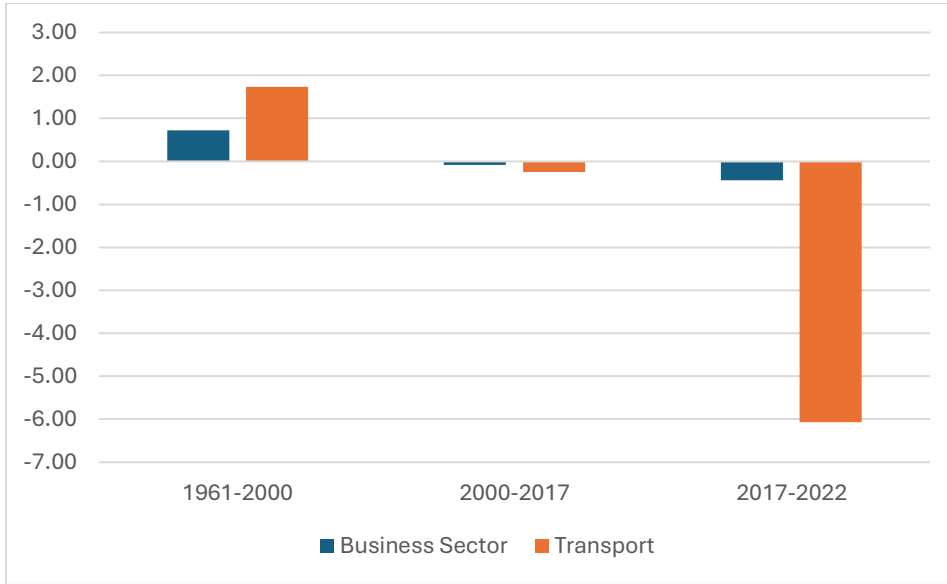
The annual pattern of changes in output in transportation and warehousing was similar to that of the business sector (Chart 1, Panel A), with two exceptions. First, the fall in output in 2020 was nearly four times greater: 23.5 per cent versus 6.5 per cent. Second, the output recovery in 2023 was eight times stronger: 6 per cent 0.74 per cent, and three times stronger in 2022 (13.6 per cent versus 4.4 per cent). The 1.6 percentage slower annual output growth in the transportation and warehousing compared to the business sector in 2017-2023 is thus explained by the much large collapse of output in 2020. The pandemic had much direr consequences for transportation and warehousing than other sectors of the economy.

*Graph 3- Historical Evolution of Labour and Multifactor Productivity Growth Rates, Business Sector and Transportation and Warehousing, Canada, 1961-2022*

*Panel A: Labour Productivity*



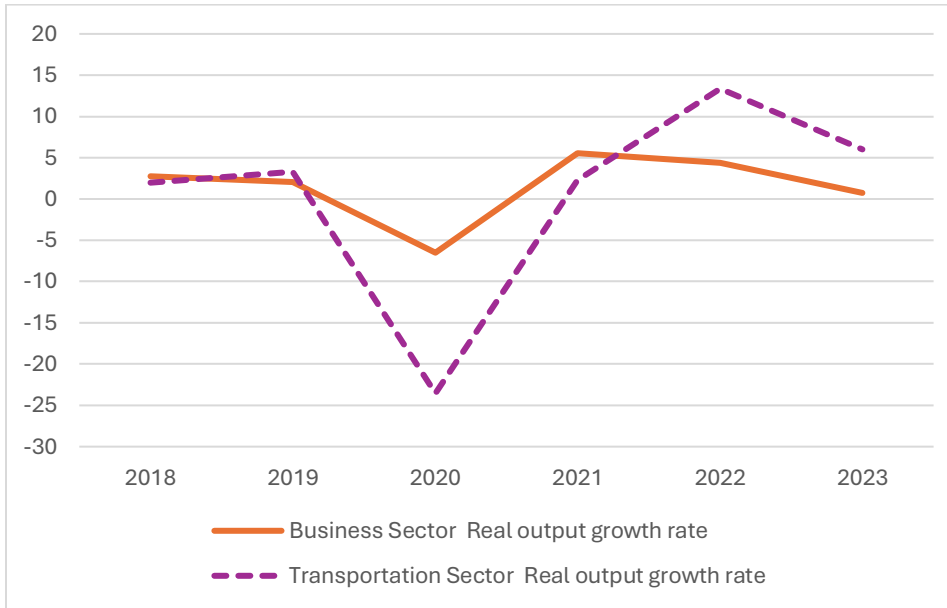
Panel B: Multifactor Productivity



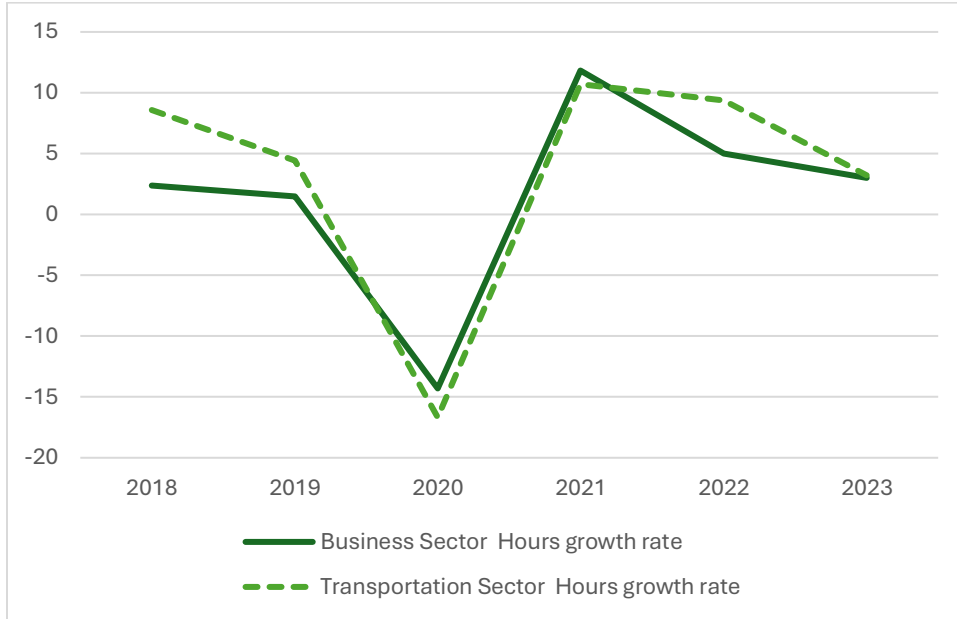
Source: Statistics Canada, Table: 36-10-0208-01

Chart 1- Annual Changes in Output, Hours and Labour Productivity in the Business Sector and Transportation Industry, Canada, 2017-2023

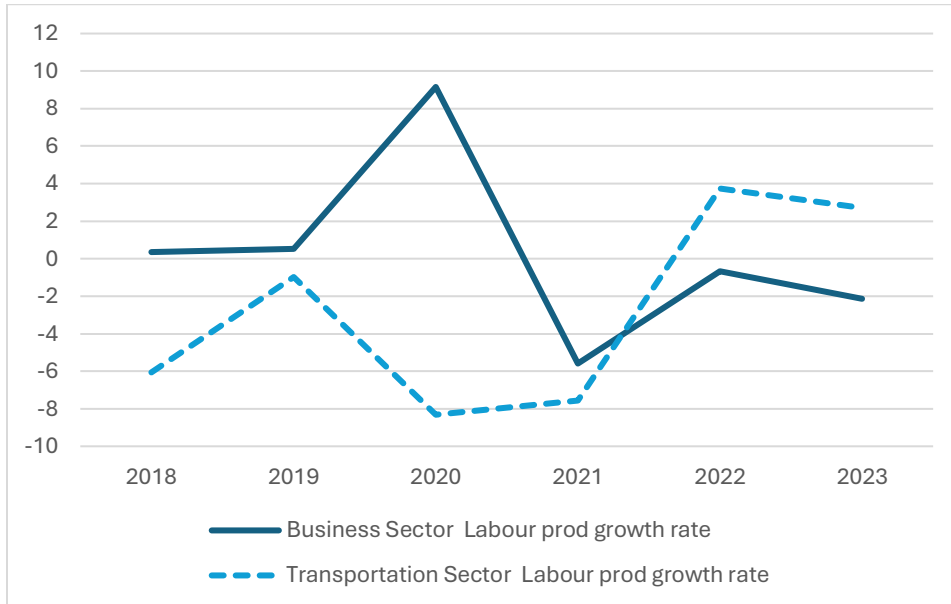
Panel A: Real Output



Panel B: Hours



Panel C: Labour Productivity



Source: CSLs calculations, Statistics Canada, Table: 36-10-0480-01

Hours Worked

As Chart 1, Panel B illustrates, total hours worked advanced at a 1.2 per cent average annual rate in the business sector from 2017 to 2023. Employment grew at the same rate as average hours worker remain unchanged. This annual pattern of changes in total hours worked was similar to that of output, with moderate growth in 2018 and 2019 (2.4 and 1.5 per cent respectively), a very large fall in 2020

during the pandemic of 14.3 per cent, followed by a strong rebound in 2021 (11.8 per cent) and continued growth in 2022 (5.0 per cent) and 2023 (3.2 per cent). The much larger fall in hours worked than output in 2020 lead to a very large increase in labour productivity that year (9.2 per cent).

Despite the fall in output in transportation and warehousing (-0.2 per cent) compared to the increase the business sector (1.4 per cent) in 2017-2023, total hours worked grew significantly faster than in the business sector, 2.8 per cent per year versus 1.2 per cent. The faster growth in hours than in output and the decline of output in transportation and warehousing explains from an accounting perspective, the fall in productivity of 2.9 per cent per year.

The annual pattern of growth rates of total hours in transportation and warehousing from 2017 to 2023 differed markedly from that of the business sector in two years. In 2018, total hours in transportation and warehousing rose 8.5 per cent, compared to only 2.4 per cent in the business sector, as output growth rates were similar (2.0 per cent versus 2.7 per cent respectively). The reasons for this divergence will be discussed later in the report. This resulted in a 6.1 per cent fall in productivity in transportation and warehousing in 2018 compared to a 0.3 per cent rise in the business sector. This also contributed significantly to the large fall in productivity growth over the period. In 2022, hours growth was also much stronger in transportation and warehousing than in the business sector 9.3 per cent versus 5.0 per cent, contributing to 1.8 percentage points per year faster growth in hours compared to the business sector between 2017 and 2023.

To summarize, developments in output and hour worked in the business sector and transportation and warehousing were very different over the 2017-2023 period, resulting in a very large divergence in productivity growth. Output rose in the business sector (1.4 per cent per year) while it fell in transportation and storage (-0.2 per cent), hours worked rose in both sectors but more than twice as fast in transportation and storage (2.8 per cent versus 1.2 per cent). This resulted in positive, but weak productivity growth in the business sector (0.2 per cent), but a large fall in productivity in transportation and storage (-2.9 per cent).

The weaker output growth in transportation and storage in 2017-2023 relative to the business sector is largely explained by the massive fall of 23.5 per cent in output in 2020. The stronger hours growth in transportation and storage in 2017-2023 reflects the very strong hours growth in the pre-pandemic year of 2018 and in the post-pandemic year of 2022.

### **The Contributions of the Transportation Sector to Output, Labour Input and Labour Productivity in Canada at the Two-Digit NAICS Level, 2017-2023**

It is important to situate the relative size and economic performance of transportation and warehousing, referred to here as the transportation sector or industry, within the overall business sector and compared to other two-digit industries.<sup>3</sup>

Table 1 provides estimates of real output (2017 chained dollars) for the business sector and 19 business sector industries in 2017 and 2023. The relative importance of the transportation sector fell in Canada from 6.2 per cent of business sector real value added in 2017 (\$90.4 billion) to 5.4 per cent in 2023

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<sup>3</sup> This only accounts for the direct impact of transport sector labour productivity on aggregate business sector productivity. There are potential indirect labour productivity implications that this analysis ignores. For example, a less productive transport sector can lower the productivity of other sectors such as manufacturing by negatively affecting their supply chains.

(\$89.5 billion), the largest fall experienced by any of the two-digit industries. This decline in turn was driven by the fall of output of 0.2 per cent per year, compared to the business sector output growth of 1.4 per cent. Only one industry experienced a larger fall in output, accommodation and food services down 0.6 per cent per year. The transportation sector contributed -0.7 per cent to the growth in business sector output between 2017 and 2023.

*Table 1- Absolute and Relative Change in Real Output, Measured by Real Value Added, 2-digits NAICS Industries, Canada, 2017-2023 (compound growth rate)*

2-digit Industry	Real Output (Billions of dollars)		Share of Output (%)		Change in Output (Billions of dollars)	Growth rate of Output (%)	Contribution to Growth (pp.)
	2017	2023	2017	2023			
Business sector	1,460.2	1,589.4	100	100	129	1.4	100
Agriculture, forestry, fishing and hunting	39.5	39.3	2.7	2.5	-0	-0.1	-0.2
Mining and oil and gas extraction	104.9	112.4	7.2	7.1	8	1.2	5.8
Utilities	40.8	41.8	2.8	2.6	1	0.4	0.7
Construction	151.3	164.8	10.4	10.4	14	1.4	10.5
Manufacturing	207.3	213.2	14.2	13.4	6	0.5	4.6
Wholesale trade	105.5	119.2	7.2	7.5	14	2.1	10.7
Retail trade	102.1	114.5	7.0	7.2	12	1.9	9.6
<b>Transportation and warehousing</b>	<b>90.4</b>	<b>89.5</b>	<b>6.2</b>	<b>5.6</b>	<b>-1</b>	<b>-0.2</b>	<b>-0.7</b>
Information and cultural industries	59.2	70.8	4.1	4.5	12	3.0	9.0
Finance and insurance	132.1	153.5	9.0	9.7	21	2.5	16.6
Real estate, rental and leasing	93.6	99.8	6.4	6.3	6	1.1	4.8
Professional, scientific and technical services	118.9	156.5	8.1	9.8	38	4.7	29.1
Administrative and support, waste management and remediation services	55.8	55.2	3.8	3.5	-1	-0.2	-0.5
Educational services	4.1	6.0	0.3	0.4	2	6.5	1.5
Health care and social assistance	57.1	63.5	3.9	4.0	6	1.8	4.9
Arts, entertainment and recreation	13.1	14.1	0.9	0.9	1	1.2	0.8
Accommodation and food services	45.6	43.9	3.1	2.8	-2	-0.6	-1.3
Other private services	30.0	32.4	2.1	2.0	2	1.3	1.8

Source: Statistics Canada, Table: 36-10-0480-01

Table 2- Absolute and Relative Change in Total Hours Worked, 2-digits NAICS Industries, Canada, 2017-2023 (compound growth rate)

2-digit Industry	Hours of Work (millions)		Share of Hours (%)		Change in hours of work (millions)	Growth rate of Hours of Work (%)	Contribution to Growth (pp.)
	2017	2023	2017	2023			
Business sector	24,962	26,882	100	100	1,920	1.2	100
Agriculture, forestry, fishing and hunting	745	671	3.0	2.5	-74	-1.7	-3.9
Mining and oil and gas extraction	503	572	2.0	2.1	69	2.2	3.6
Utilities	195	212	0.8	0.8	18	1.5	0.9
Construction	2,781	3,394	11.1	12.6	613	3.4	31.9
Manufacturing	3,044	3,171	12.2	11.8	127	0.7	6.6
Wholesale trade	1,551	1,651	6.2	6.1	100	1.1	5.2
Retail trade	3,220	3,213	12.9	12.0	-7	0.0	-0.4
<b>Transportation and warehousing</b>	<b>1,664</b>	<b>1,964</b>	<b>6.7</b>	<b>7.3</b>	<b>300</b>	<b>2.8</b>	<b>15.6</b>
Information and cultural industries	613	694	2.5	2.6	81	2.1	4.2
Finance and insurance	1,606	1,709	6.4	6.4	103	1.0	5.4
Real estate, rental and leasing	617	627	2.5	2.3	10	0.3	0.5
Professional, scientific and technical services	2,074	2,688	8.3	10.0	614	4.4	32.0
Administrative and support, waste management and remediation services	1,507	1,524	6.0	5.7	16	0.2	0.8
Educational services	158	177	0.6	0.7	19	1.9	1.0
Health care and social assistance	1,123	1,304	4.5	4.9	182	2.5	9.5
Arts, entertainment and recreation	393	405	1.6	1.5	12	0.5	0.6
Accommodation and food services	1,875	1,732	7.5	6.4	-143	-1.3	-7.4
Other private services	1,119	1,106	4.5	4.1	-12	-0.2	-0.6

Source: Statistics Canada, Table: 36-10-0480-01

Table 2 provides estimates of total hours worked for the business sector and 19 business sector industries in 2017 and 2023. In contrast to its output share, the relative importance of the transportation sector in terms of total hours worked rose in Canada from 6.7 per cent of business sector hours worked in 2017 to 7.3 per cent in 2023, the third largest increase experienced by any of the two-digit industries.



Only construction and professional, scientific and technical services experienced larger increases in their hours share. This rising hour share in transportation was caused by the increase in hour worked by 2.8 per cent per year, again the third largest rate of increase after construction (3.4 per cent) and professional, scientific and technical services (4.4 per cent). The transportation sector was responsible for 15.6 per cent of total hours growth in business sector output between 2017 and 2023. While well less than the 32 per cent contributions from construction and professional, scientific and technical services respectively, this contribution was very disproportional at more than twice times its hours share.

As hour worked per worker are higher in transportation than in the overall business sector, the employment share of transportation in the total business sector is slightly lower than the hours share (6.6 per cent versus 7.3 per cent in 2023). However, as shown in Appendix Table A1, trends in employment in transportation between 2017 and in 2023 were virtually the same as total hours worked. Average hours worked was the same 2017.

Table 3 provides estimates of output per hour for the business sector and 19 business sector industries in 2017 and 2023. Output per hour in transportation fell from \$54.30 (2017 dollars) in 2017 to \$45.60 in 2023, a drop of 16 per cent or average annual decline of 2.87 per cent. The relative labour productivity level in transportation fell from 92.8 per cent of the business sector average to 77.2 per cent over the period. This development reflects the much slower output per hour growth transportation compared to the business sector (-2.87 per cent versus 0.17 per cent).

As Chart 2 illustrates, transportation sector had by far the worst labour productivity performance of any two-digit NAICS industry (except the holding companies which represent a minor share of the business sector) between 2017 and 2023. The sector contributed - 0.19 percentage points to the change in business sector productivity accounting for -111 per cent of the 0.17 average annual rate of increase. If output per hour growth in transportation had been at the business sector average labour productivity growth from 2017 to 2023, the latter would have been around 0.36 percentage points higher per year. In other words, the weakening of Canadian productivity growth in recent years is in large part related to developments in the transportation sector. The transportation sector also recorded the worst labour productivity performance among the 24 two-digits NAICS industries in all ten provinces. The second worst performance was in the construction sector, down 1.86 per cent per year. Output per hour advanced at a 0.17 per cent average annual rate in the business sector in Canada.

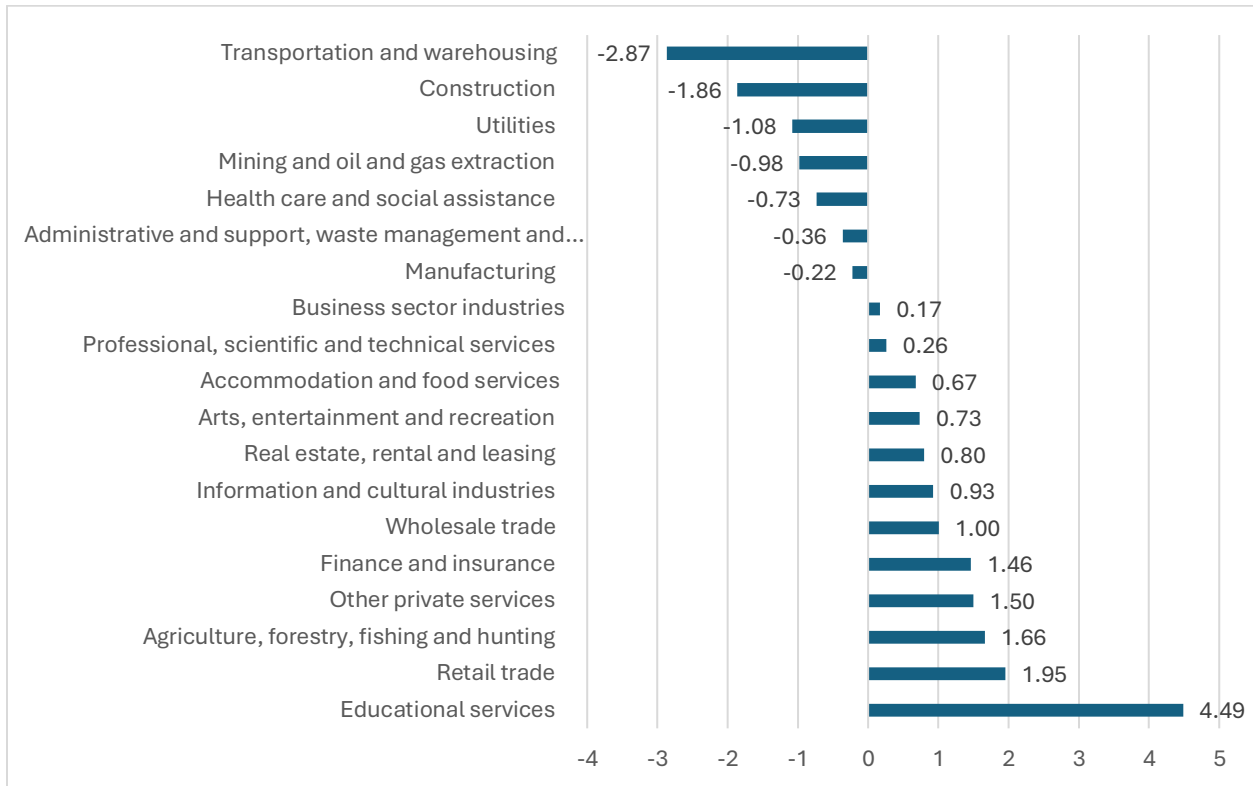
Just as it did at the national level, output per hour in the output per hour in the transport sector experienced a large fall in all provinces in 2017-2022, ranging from -2.1 per cent per year in Prince Edward Island to -5.2 per cent in Ontario (see Chart 3).

Table 3- Absolute and Relative Change in Labour Productivity, 2-digits NAICS Industries, Canada, 2017-2023  
(compound growth rate)

2-digit Industry	Labour Prod. (Dollars per Hour)		Relative Labour Prod. (%)		Change in Labour Prod. (Dollars per hour) (5) = (2) - (1)	Growth rate of Labour Prod. (%) (6)	Contribution to Growth (pp.) (7)	Contribution to Growth (%) (8) = (7)/0.17
	2017 (1)	2023 (2)	2017 (3) = (1)/58.50	2023 (4) = (2)/60.40				
<b>Business sector</b>	58.5	59.1	100	100	0.60	0.17	0.17	100
Agriculture, forestry, fishing and hunting	53.0	58.5	90.6	99.0	5.50	1.66	0.05	29.1
Mining and oil and gas extraction	208.2	196.3	355.9	332.1	-11.90	-0.98	-0.02	-11.6
Utilities	209.8	196.6	358.6	332.7	-13.20	-1.08	-0.01	-4.9
Construction	54.4	48.6	93.0	82.2	-5.80	-1.86	-0.21	-121.8
Manufacturing	68.1	67.2	116.4	113.7	-0.90	-0.22	-0.03	-15.9
Wholesale trade	68.0	72.2	116.2	122.2	4.20	1.00	0.06	36.6
Retail trade	31.7	35.6	54.2	60.2	3.90	1.95	0.25	148.0
<b>Transportation and warehousing</b>	<b>54.3</b>	<b>45.6</b>	<b>92.8</b>	<b>77.2</b>	<b>-8.70</b>	<b>-2.87</b>	<b>-0.19</b>	<b>-112.3</b>
Information and cultural industries	96.5	102	165.0	172.6	5.50	0.93	0.02	13.4
Finance and insurance	82.3	89.8	140.7	151.9	7.50	1.46	0.09	55.3
Real estate, rental and leasing	151.7	159.1	259.3	269.2	7.40	0.80	0.02	11.6
Professional, scientific and technical services	57.3	58.2	97.9	98.5	0.90	0.26	0.02	12.7
Holding companies	51.6	21	88.2	35.5	-30.60	-13.91	-0.10	-57.3
Administrative and support, waste management and remediation services	37.0	36.2	63.2	61.3	-0.80	-0.36	-0.02	-12.9
Educational services	25.9	33.7	44.3	57.0	7.80	4.49	0.03	16.7
Health care and social assistance	50.9	48.7	87.0	82.4	-2.20	-0.73	-0.03	-19.4
Arts, entertainment, and recreation	33.4	34.9	57.1	59.1	1.50	0.73	0.01	6.8
Accommodation and food services	24.3	25.3	41.5	42.8	1.00	0.67	0.05	29.8
Other private services	26.8	29.3	45.8	49.6	2.50	1.50	0.07	39.4

Source: Statistics Canada, Table: 36-10-0480-01

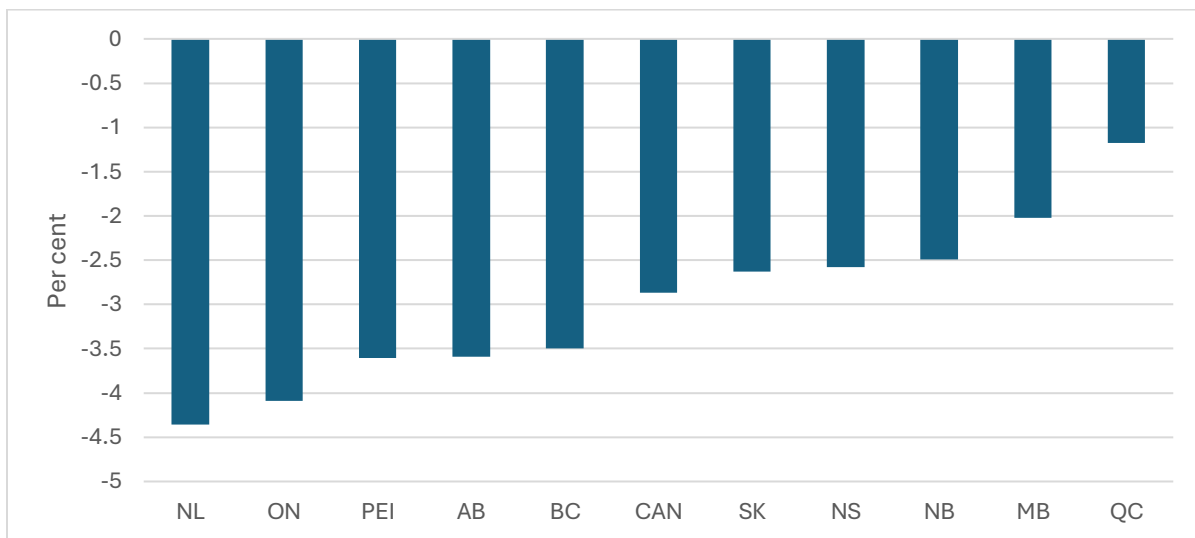
Chart 2-Labour Productivity, 2-digits NAICS Industries, Canada, 2017-2023 (compound growth rate)



Note: The "Holding Companies" Industry (NAICS code 5511 13) is not included in the chart.

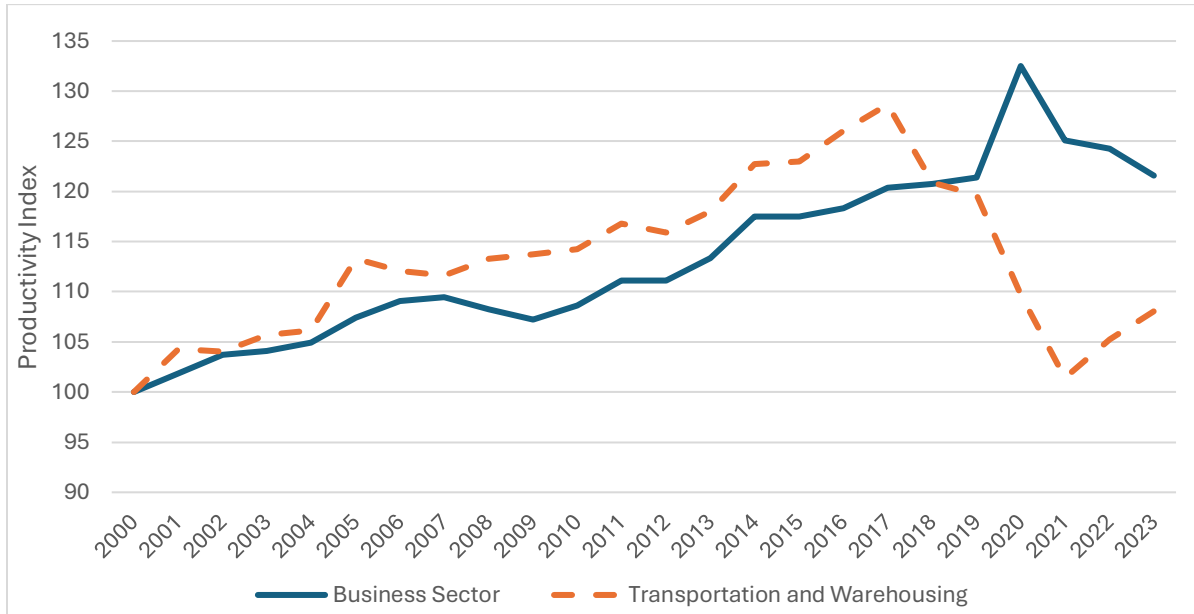
Source: Statistics Canada, Table: 36-10-0480-01

Chart 3: Labour Productivity Growth in Transportation and Warehousing Sector by Province, 2017-2022



Source: Statistics Canada, Table: 36-10-0208-01

Chart 4- Labour Productivity Growth, Business Sector and Transportation and Warehousing, Canada, 2000-2023 (Index, 2000=100)



Source: Statistics Canada, Table 36-10-0480-01

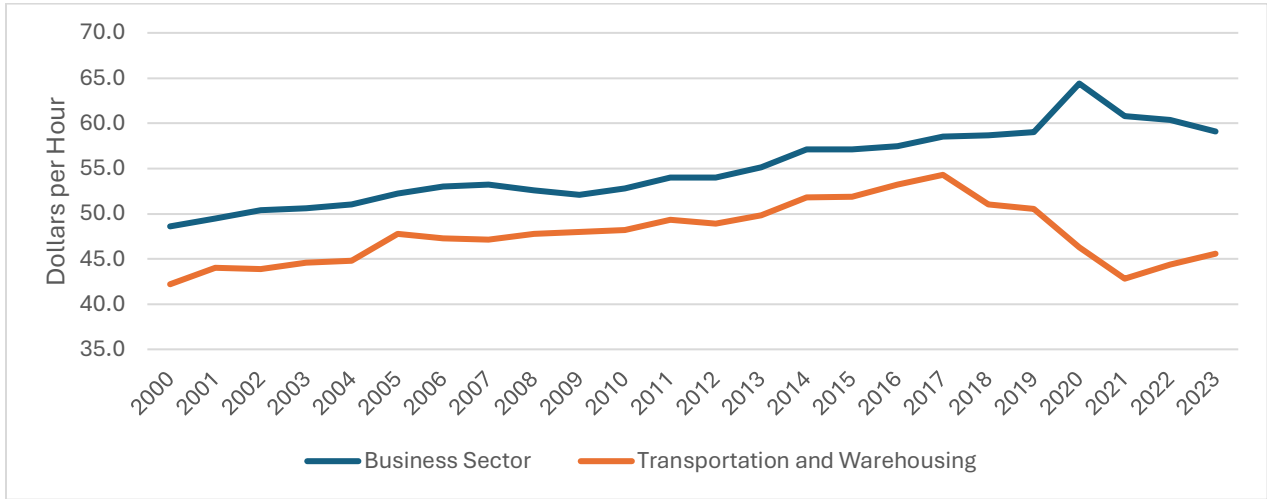
Chart 4 demonstrates the evolution of productivity growth in transportation and warehousing in comparison to the overall business sector since 2000. The transportation sector outperformed the overall business sector in terms of productivity growth since mid-2000s until 2017 when it experienced a sharp decline while the business sector underwent a significant growth until 2020.

#### Labour Productivity levels

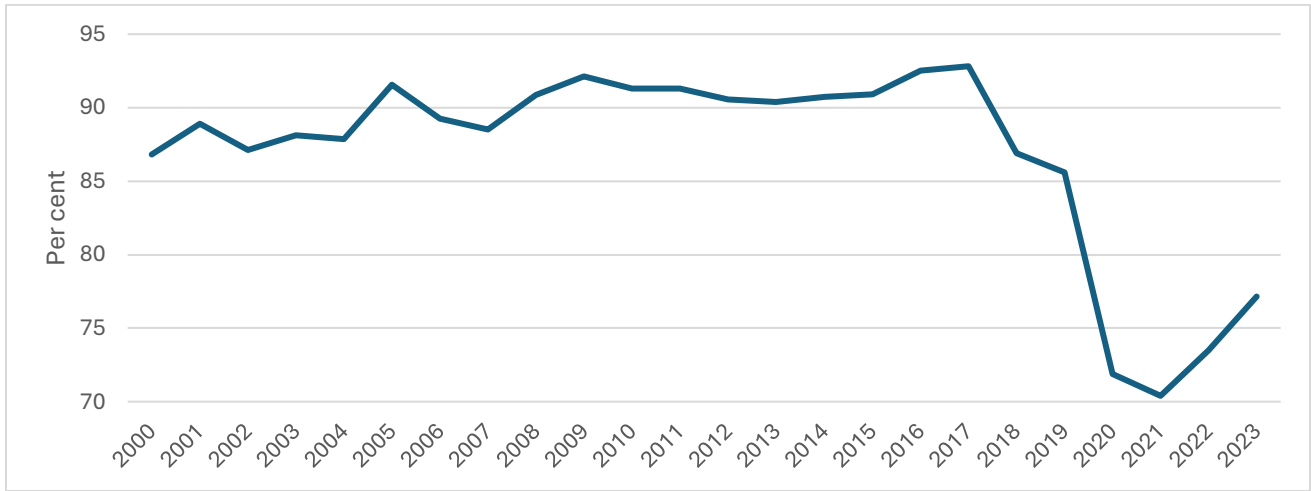
As Chart 5, panel A shows, in 2023, the level of value added per hour worked in the transport sector, expressed in 2017 dollars, was \$45.6. This was the tenth lowest among the 24 two-digit industries for which data are available and 77 per cent of the business sector average of \$59.1 (Chart 6). The level of labour productivity in the transport sector in Canada peaked in 2017 at \$54.3 at 93 per cent of the business sector. Chart 5, Panel B shows the relative productivity level of the transportation sector as a per cent of overall business sector. It confirms the significant relative productivity decline of the transportation industry compared to the business sector after 2017.

Chart 5: Transportation and Warehousing and Business Sector Labour Productivity (Ratio of real value added and hours worked), Canada, 2000-2023

Panel A: Labour Productivity Levels, Chained (2017) Dollars per Hour



Panel B: Labour Productivity Levels of Transportation and Warehousing Sector as a Percent of Business Sector (=100)

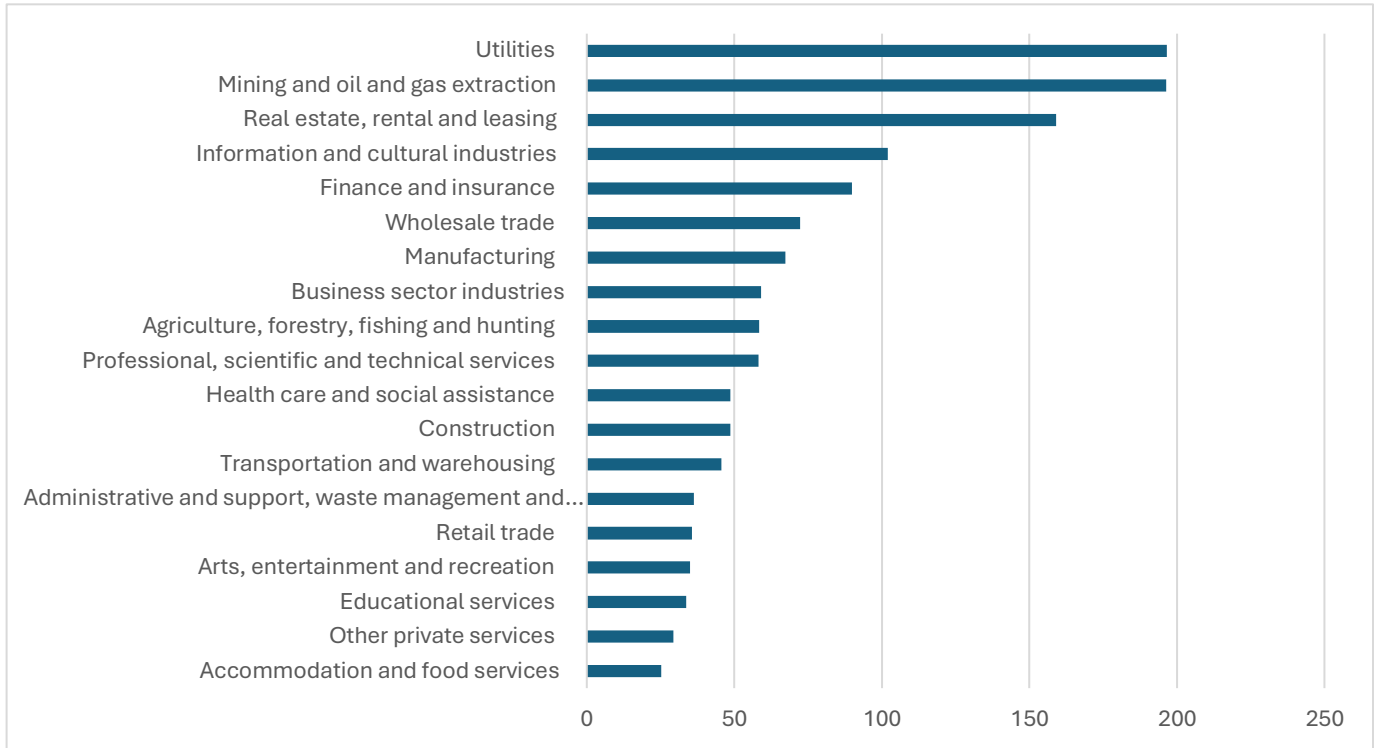


Note: Real value added for each industry and each aggregate is constructed from a Fisher chain index. The y axis represents the labour productivity level in the transportation sector relative to the labour productivity level in the business sector.

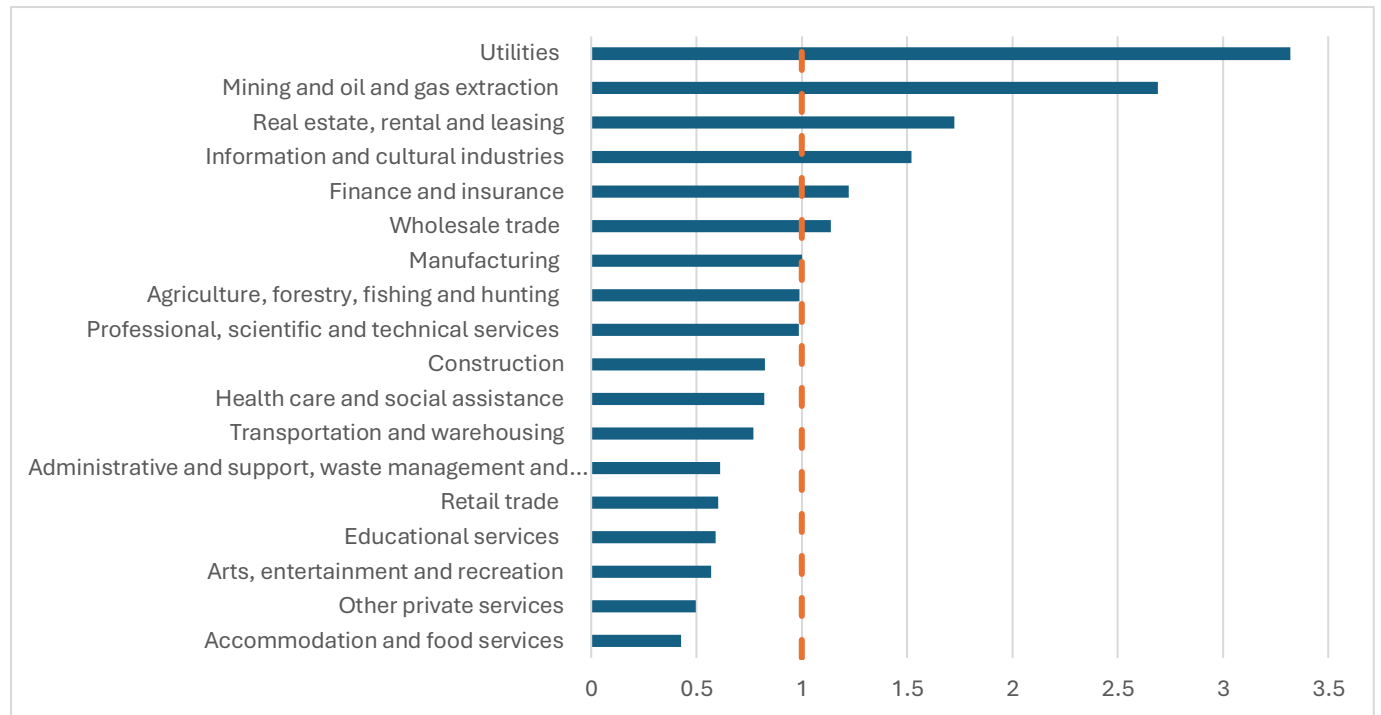
Source: Statistics Canada, Table: 36-10-0480-01.

Chart 6- Labour Productivity of 2-digits NAICS Industries, Canada, 2023

Panel A: Labour Productivity Levels (Chained (2017) dollars per hour)



Panel B: Labour Productivity Relative to the Business Sector (Business Sector = 100)



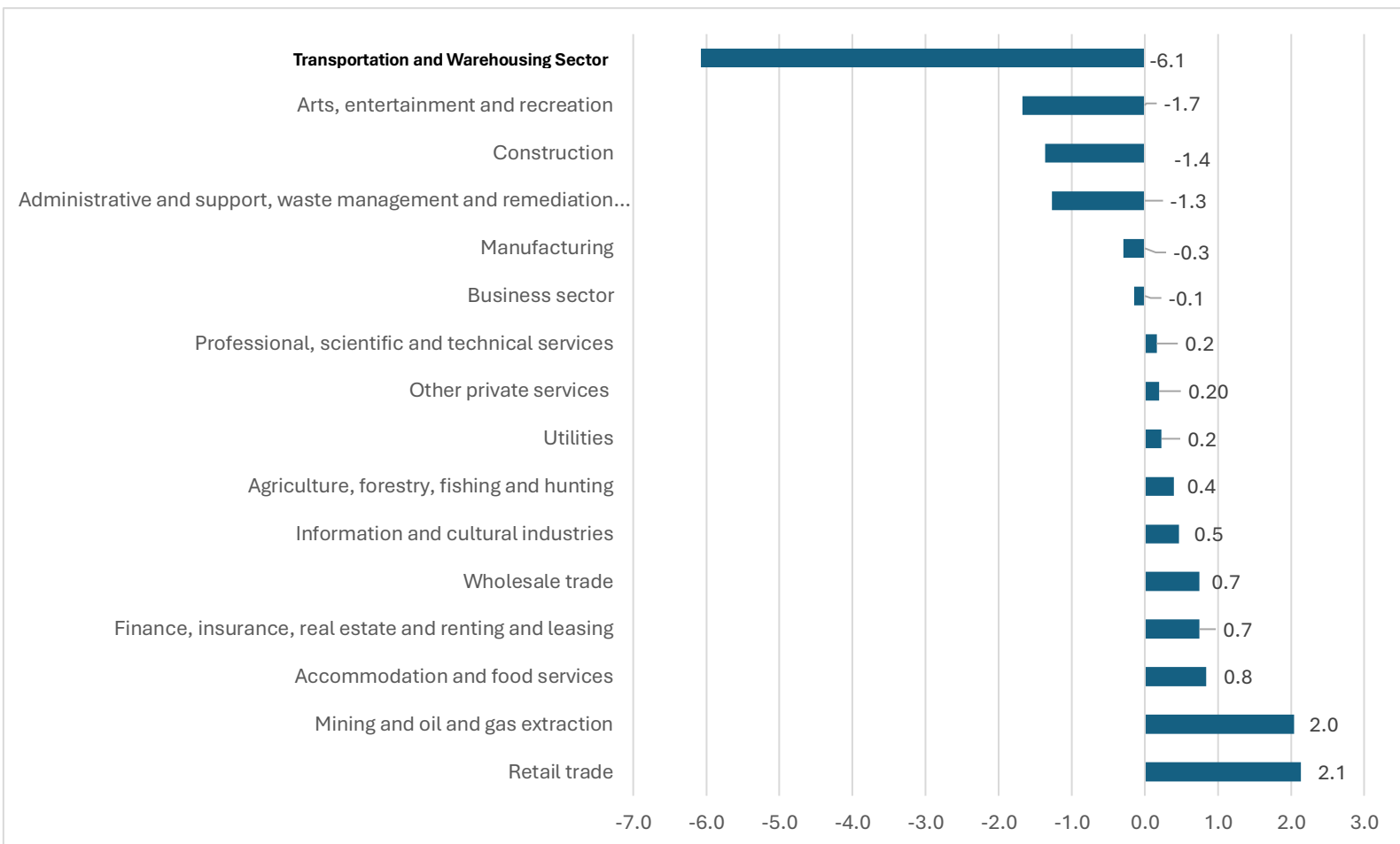
Note: The "Holding Companies" Industry (NAICS code 5511 13) is not included in the chart.

Source: Statistics Canada, Table: 36-10-0480-01

### Multifactor Productivity

Statistics Canada publishes multifactor productivity estimates for 16 two-digit NAICS industries in Canada. As shown in Chart 7, multifactor productivity in the transportation and warehousing experienced a 6.1 per cent average annual rate of decrease between 2017 and 2022. This was the worst productivity performance of any two-digit sector. The second worst performance was in arts, entertainment, and recreation, down 1.7 per cent per year. Multifactor productivity fell at a 0.1 per cent average annual rate in the business sector.

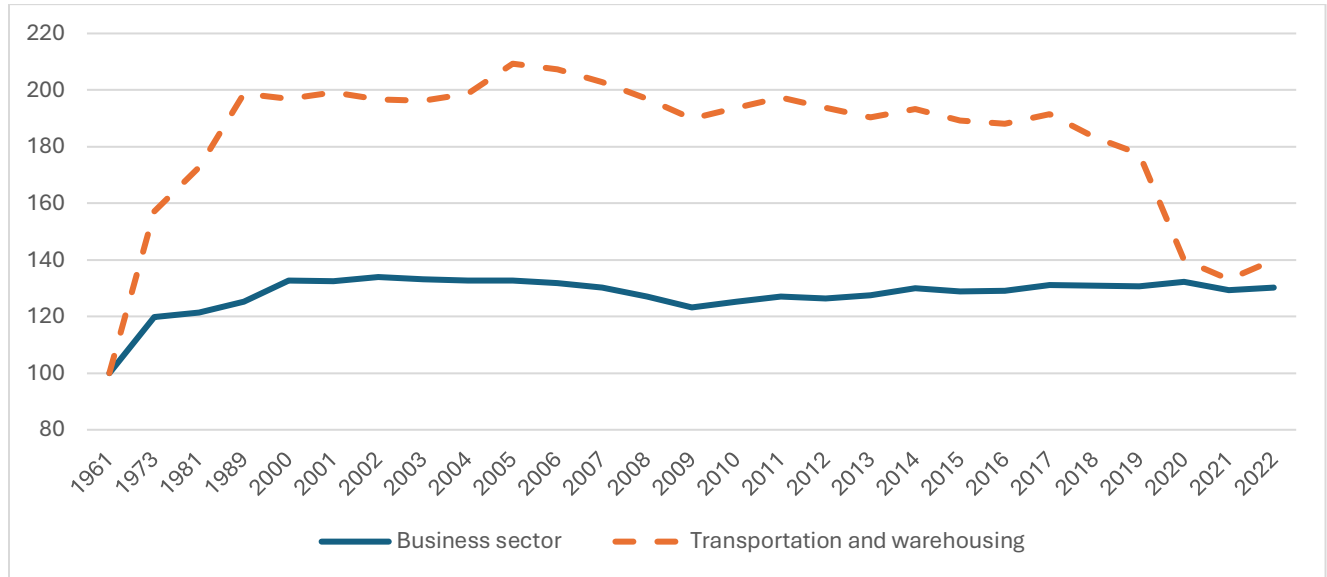
*Chart 7-Multifactor Productivity, 2-digits NAICS Industries, Canada, 2017-2022 (compound growth rate)*



Source: Statistics Canada. Table 36-10-0208-01

The post-2017 collapse in productivity in the transport sector is unique from a historical perspective. Chart 8 shows the level of labour productivity in the business and transport sector in Canada from 1961 to 2022 indexed to 100 in 1961. One sees clearly the considerably faster growth of labour productivity in the transport sector compared to the business sector from 1961 to the mid-1980s, followed by similar growth. One sees that the index (1960 = 100) of multifactor productivity in the transport sector in 2022 was 140, down from 191 in 2017, and little above that for the business sector at 130. The faster multifactor productivity growth in the transport sector relative to the business from 1961 to the mid-1980s has largely offset by the post-2017 collapse.

Chart 8- Multifactor Productivity, Business and Transportation Sectors, Canada, 1961-2022 (Index, 1961=100)



Source: Statistics Canada, Table: 36-10-0480-0

### Productivity Developments in Three-digit Transport Industries

Statistics Canada publishes for the 1997-2023 periods estimates of labour productivity for the 9 three-digit NAICS transport industries. Since 2017, seven transport industries have experienced a fall in output per hour of at least 2 per cent per year. The largest fall was in air transport, down 8.6 per cent per year from 2017 to 2023, followed by transit, ground passenger and scenic and sightseeing transportation, down 3.8 per cent per year. Trucking also suffered a significant decline, with output per hour falling 3.1 per cent per year. These three industries account for the lion's share of the fall in productivity in the transport sector and will be discussed in detail later in the report. The other four transport industries with negative productivity growth since 2017 are postal services and couriers and messengers (-2.9 per cent per year), water transportation (-2.3 per cent per year), rail transportation (-2.1 per cent per year), warehousing and storage (-2.0 per cent per year) and support services for transportation (-1.8 per cent per year).

### Output

Real output in transportation and warehousing fell 0.2 per cent per year between 2017 and 2023. By far the greatest falls were in air transportation, down 6.1 per cent per year and in transit, ground passenger and scenic and sightseeing transportation, down 4 per cent per year. More than all the decline in output in this latter industry was in urban transit systems, with real output down at by 7.1 per cent per year. These two industries more than accounted for all of the fall of \$5.6 billion (622.2 per cent) in real output in the transportation industry between 2017 and 2023.<sup>4</sup>

<sup>4</sup> The major offsetting contributions to these two industries were pipeline transportation (147.3 per cent) and warehousing and storage (264.3 per cent).



Three other transport industries also experienced falls in output between 2017 and 2023, namely support for transportation activities (-0.5 per cent per year), truck transportation (-0.4 per cent). There was no change in output in rail transportation and water transportation between 2017 and 2023. In contrast, the warehousing and storage industry posted very strong growth of 8.8 per cent per year as warehousing activity exploded because of increased on-line shopping, in part related to the pandemic. The current NAICS codes allocate Amazon and other on-line merchants to warehousing, and not to wholesale or retail trade. Real output also increased in pipeline transportation (2.3 per cent per year) and in postal services and couriers and messengers (1.4 per cent per year).

### **Hours Worked**

Table 4 provides data on hours worked in two-digit transportation and warehousing and the nine three-digit industries in this sector in 2017 and 2023. By far the most important industry in terms of hours worked (and employment- see Appendix Table A2) in this sector is trucking, which in 2023 accounted for 34.2 per cent of total hours worked. This was followed by support activities for transportation (15.2 per cent), postal services, couriers and messengers (14.9 per cent), ground passenger and scenic and sightseeing transportation (12.9 per cent), and warehousing and storage (8.7 per cent).

In contrast to the decline in real output between 2017 and 2023 in the transportation sector, total hours worked actually increased 18 per cent between 2017 and 2023 or 2.8 per cent per year. The number of jobs (Appendix Table A2) in the sector increased even more (3.1 per cent per year), as average hours worked fell 0.4 per cent per year (Appendix Table A3). Two industries were responsible for the majority of the increase in hour worked. Trucking saw hours worked rise 2.8 per cent per year and was responsible for 34.4 per cent of the sector's overall increase in hours worked. Warehousing and storage experienced even faster growth in hours worked (and employment), up 11 per cent per year, accounting for 21.8 per cent of the sector's hours growth. Employment in warehousing nearly doubled in the five-year period from 2017 to 2023 from 50.5 thousand to 94.1 thousand (Appendix Table A1) as on-line shopping boomed. Hours worked in postal services and couriers and messengers also registered strong growth, up 4.3 per cent per year and accounted for 21.8 per cent of the sector's total hour growth. These three industries accounted for nearly 83 per cent of the transport sector's hours growth in 2017-2023.

Table 4- Absolute and Relative Change in Real Output, Measured by Real Value added, 3-digits NAICS Transportation and Warehousing Industries, Canada, 2017-2023 (compound growth rate)

3-digits Industry	Real Output (2017 billions of dollars)		Share of Output (%)		Change in Output (2017 billions of dollars)	Growth rate of Output (%)	Contribution to Growth (pp.)
	2017	2023	2017	2023			
<b>Transportation and warehousing</b>	<b>90.4</b>	<b>89.5</b>	<b>100</b>	<b>100</b>	<b>-0.9</b>	<b>-0.2</b>	<b>100</b>
Air transportation	10.3	7.1	11.4	7.9	-3.2	-6.1	355.5
Rail transportation	9.6	9.6	10.6	10.7	-0.1	-0.1	7.4
Water transportation	1.7	1.7	1.9	2.0	0.0	0.1	-1.3
Truck transportation	21.6	21.2	23.9	23.6	-0.5	-0.4	51.6
Transit, ground passenger and scenic and sightseeing transportation	9.8	7.6	10.8	8.5	-2.1	-4.0	236.2
Urban transit systems	6.2	4.0	3.2	4.4	-2.2	-7.1	243.6
Taxi and limousine service	1.2	1.3	1.2	1.5	0.1	1.7	-13.6
Other transit and ground passenger transportation and scenic and sightseeing transportation	2.4	2.1	2.0	2.3	-0.3	-2.4	37.0
Support activities for transportation	16.2	15.7	18.0	17.6	-0.5	-0.5	54.3
Pipeline transportation	9.2	10.5	10.1	11.7	1.3	2.3	-147.3
Postal service and couriers and messengers	8.4	9.0	9.2	10.1	0.7	1.3	-74.2
Postal service	4.1	4.4	4.4	5.0	0.4	1.4	-38.8
Couriers and messengers	4.3	4.6	4.8	5.1	0.3	1.2	-34.2
Warehousing and storage	3.6	6.0	4.0	6.7	2.4	8.8	-264.3

Source: Statistics Canada, Table: 36-10-04

The three-digit transportation industry with the fourth largest increase in hours worked between 2017 and 2023 was air transportation, up 2.8 per cent per year. Given that the level of output in this industry in 2023 was more than half that of 2017, this can be quite surprising. The reasons why employment in air transportation at 84.2 thousand in 2023 exceeded that of 2017 at 73.4 thousand when real output in 2023 was 68 percent of its 2017 level are a key part of the productivity story and will be explored in detail later in the report.

Table 5- Absolute and Relative Change in Total Hours Worked, 3-digits NAICS Transportation and Warehousing Industries, Canada, 2017-2023 (compound growth rate)

3-digits Industry	Hours of work (millions)		Share of hours (%)		Change in Hours of Work (millions)	Growth rate of Hours of Work (%)	Contribution to Growth (pp.)
	2017	2023	2017	2023			
<b>Transportation and warehousing</b>	<b>1,663.5</b>	<b>1,963.7</b>	<b>100</b>	<b>100</b>	<b>300.2</b>	<b>2.8</b>	<b>100</b>
Air transportation	117.8	139.2	7.1	7.1	21.4	2.8	7.1
Rail transportation	75.9	85.3	4.6	4.3	9.4	2.0	3.1
Water transportation	30.2	34.9	1.8	1.8	4.7	2.4	1.6
Truck transportation	567.5	670.7	34.1	34.2	103.2	2.8	34.4
Transit, ground passenger and scenic and sightseeing transportation	258.1	254.3	15.5	12.9	-3.8	-0.2	-1.3
Urban transit systems	115.9	124.6	7.0	6.3	8.7	1.2	2.9
Taxi and limousine service	85.5	68.5	5.1	3.5	-17.0	-3.6	-5.6
Other transit and ground passenger transportation and scenic and sightseeing transportation	56.7	61.2	3.4	3.1	4.5	1.3	1.5
Support activities for transportation	275.6	297.6	16.6	15.2	22.1	1.3	7.3
Pipeline transportation	20.2	18.1	1.2	0.9	-2.1	-1.8	-0.7
Postal service and couriers and messengers	226.9	292.4	13.6	14.9	65.5	4.3	21.8
Postal service	101.8	113.1	6.1	5.8	11.3	1.8	3.8
Couriers and messengers	125.1	179.3	7.5	9.1	54.2	6.2	18.0
Warehousing and storage	91.4	171.2	5.5	8.7	79.9	11.0	26.6

Source: Statistics Canada, Table: 36-10-0480-01

## Labour Productivity

Table 6 provides data on labour productivity, defined as real output (2017 dollars) per hour worked, in the two-digit transportation and warehousing sector and the nine three-digit industries in this sector in 2017 and 2023. Charts 9, 10 provide a more detailed picture of the evolution of the productivity growth rates of the 3-digit industries within the transportation sector over time and Chart 11 give the absolute and relative (to the transportation sector) productivity levels of these industries in 2023. As noted in the previous section, transportation and warehousing had by far the largest fall in labour productivity of any two-digit industry at 2.9 per cent per year. By far the largest fall in productivity growth in the sector was in air transport, down 41 per cent from \$87.3 dollars per hour in 2017 to \$50.8 per cent in 2023, or 8.6 per cent per year. Despite accounting for only around 7.1 per cent of hour worked in the sector, air transportation contributed 0.61 percentage points to the 2.87 per cent fall in productivity, or

around 21 per cent of the fall. The industry with the second largest fall in labour productivity between 2017-2023 was transit, ground passenger and scenic and sightseeing transportation, down 3.8 per cent per year. With around twice the hours share of air transportation, this industry contributed 20 per cent to the fall in the sector's productivity. The industry with the third largest fall in labour productivity in 2017-2023 was trucking, down 3.1 per cent per year. Since this industry had nearly one third of total hours worked in the sector, it accounted for around 37 per cent of the sector's drop in productivity despite its smaller productivity decline than the other two industries. These three industries thus accounted for nearly four fifths of the fall in labour productivity in transportation and storage industry and are thus the key to understanding productivity dynamics in the sector.

As depicted in Chart 10, four other industries in transportation and warehousing also registered falls in productivity, but much less than the three industries identified above as responsible for the majority of the sector's productivity fall. Output per hour fell 2 per cent per year in both rail transportation and warehousing and storage. Water transportation registered a larger fall in productivity at 2.3 per cent per year. Support services for transportation and postal and courier and messenger services also experienced declines in output per hour (1.8 per cent and 2.9 per cent per year respectively). As these industries mostly have relatively low shares of hours in the transportation industry (except for support activities for transportation which had 15.2 per cent of the total hours worked in the transportation industry), they collectively accounted for around 19 per cent of the sector's fall in labour productivity. The only one of the nine three-digit transportation industries to enjoy productivity growth in 2017-2023 was pipeline transportation, with output per hour growth a strong 4.2 per cent per year.

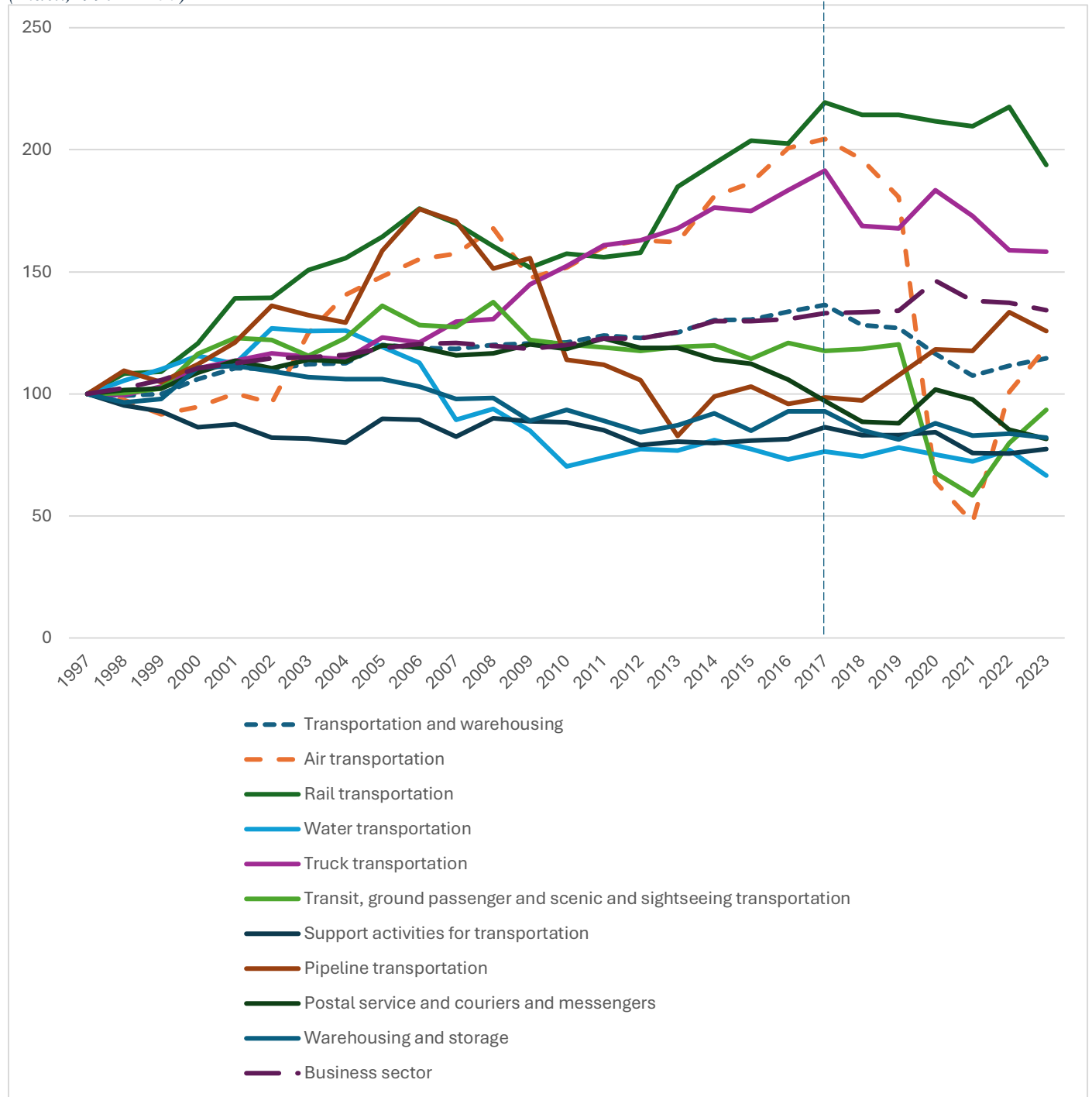
Table 6- Absolute and Relative Change in Labour Productivity, 3-digits NAICS Transportation and Warehousing Industries, Canada, 2017-2023 (compound growth rate)

3-digits Industry	Labour Productivity (2017 Dollars per hour)		Relative Labour Productivity (%)		Change in Labour Productivity (2017 Dollars per hour)	Growth rate of Labour Productivity (%)	Contribution to Growth (pp.)	Contribution to Growth (%)
	2017	2023	2017	2023				
<b>Transportation and warehousing</b>	<b>54.3</b>	<b>45.6</b>	<b>100</b>	<b>100</b>	<b>-8.7</b>	<b>-2.87</b>	<b>-2.87</b>	<b>100</b>
Air transportation	87.3	50.8	160.8	111.4	-36.5	-8.63	-0.61	21.2
Rail transportation	126.8	112.0	233.5	245.6	-14.8	-2.05	-0.09	3.3
Water transportation	57.5	50.1	105.9	109.9	-7.4	-2.27	-0.04	1.4
Truck transportation	38.1	31.5	70.2	69.1	-6.6	-3.12	-1.06	37.1
Transit and ground passenger transportation	37.9	30.1	69.8	66.0	-7.8	-3.77	-0.58	20.4
Urban transit systems	53.3	31.9	98.2	70.0	-21.4	-8.20	-0.57	19.8
Taxi and limousine service	13.8	19	25.4	41.7	5.2	5.47	0.28	-9.9
Other transit and ground passenger transportation and scenic and sightseeing transportation	42.8	34.2	78.8	75.0	-8.6	-3.67	-0.13	4.4
Support activities for transportation	58.9	52.9	108.5	116.0	-6.0	-1.77	-0.29	10.3
Pipeline transportation	454	579.3	836.1	1270.4	125.3	4.15	0.05	-1.8
Postal service and couriers and messengers	36.8	30.9	67.8	67.8	-5.9	-2.87	-0.39	13.6
Postal service	40.2	39.3	74.0	86.2	-0.9	-0.38	-0.02	0.8
Couriers and messengers	34	25.5	62.6	55.9	-8.5	-4.68	-0.35	12.3
Warehousing and storage	39.7	35.1	73.1	77.0	-4.6	-2.03	-0.11	3.9

Note: The weights used to calculate the contribution to growth were the average hours share of each 3-digit Industries between 2017-2023.

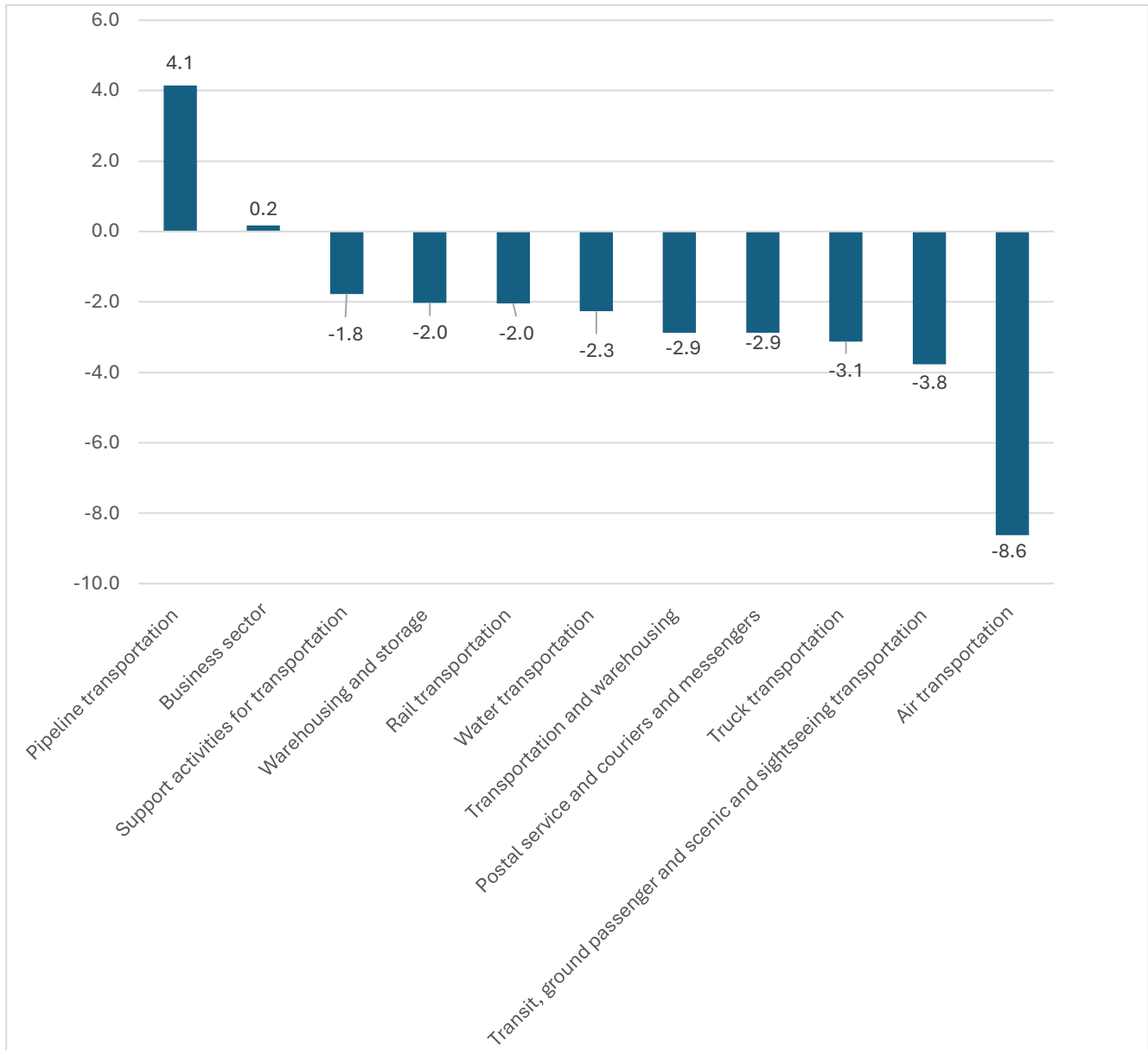
Source: CSLS Calculations

Chart 9 - Labour Productivity, within Transportation and Warehousing Sector, Canada, 1997-2023  
(Index, 1997 = 100)



Source: Statistics Canada, Table: 36-10-0480-01

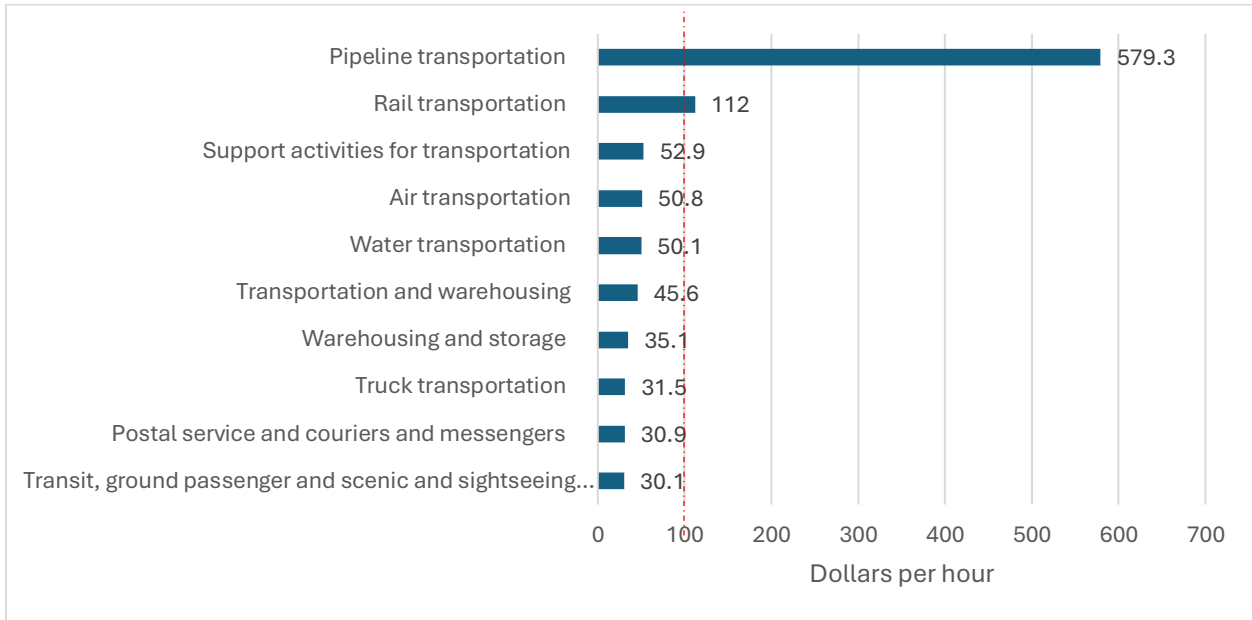
Chart 10- Labour productivity Within Transportation and Warehousing Sector, 3-digits NAICS Industries, Canada, 2017-2023, (compound growth rate)



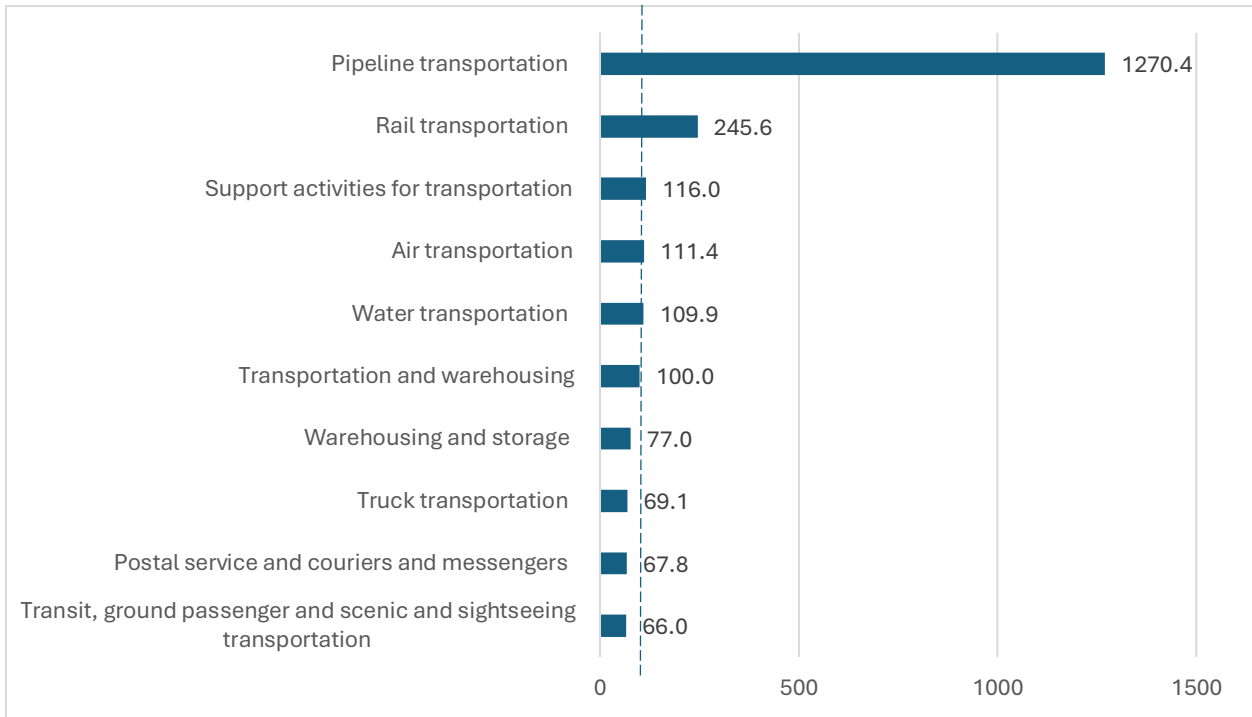
Source: Statistics Canada, Table: 36-10-0480-01

Chart 11- Labour Productivity Within Transportation and Warehousing Sector, 3-digits NAICS Industries, Canada, 2023

Panel A: Labour Productivity Levels (Chained (2017) Dollars per Hour)



Panel B: Labour Productivity Relative to the Transportation and Warehousing Sector (=100)



Note: The Transportation and warehousing, Pipeline Transportation and Business Sector are not included in Panel B.

Source: Statistics Canada, Table: 36-10-0480-01



## Output, Employment and Labour Productivity Developments in Three-Digit Transportation Industries in the United States

Table 7 provides estimates of real output (2017 dollars) in transportation and warehousing and three-digit transportation industries for 2017 and 2023 in the United States. Note that there only eight three-digit industries, down from nine in the Canadian data. Scenic and sightseeing transportation is not included with transit and ground passenger transportation but is part of support activities which appear to also include postal services and couriers and messengers. Table 8 provides the data for total hours worked and Table 9 for labour productivity, defined as real output per person employed.

*Table 7- Absolute and Relative Change in Real Value Added in Chained 2017 U.S. Dollars, 3-digits NAICS Transportation and Warehousing Industries, United States, 2017-2023 (compound growth rate)*

3-digits Industry	Real Output (2017 billions of dollars)		Share of Output (%)		Change in Output (2017 billions of dollars)	Growth Rate of Output (%)	Contribution to Growth (%)
	2017	2023	2017	2023			
<b>Transportation and warehousing</b>	<b>635.5</b>	<b>707</b>	<b>100</b>	<b>100</b>	<b>71.5</b>	<b>1.8</b>	<b>100</b>
Air transportation	128.7	151.6	20.3	21.4	22.9	2.8	24.5
Rail transportation	44.3	41	7.0	5.8	-3.3	-1.3	-3.5
Water transportation	14.0	15.9	2.2	2.2	1.9	2.1	2.0
Truck transportation	178	168.7	28.0	23.9	-9.3	-0.9	-9.9
Transit and ground passenger transportation	43.4	73	6.8	10.3	29.6	9.1	31.6
Pipeline transportation	41.0	35.1	6.5	5.0	-5.9	-2.6	-6.3
Other transportation and support activities	125	162.4	19.7	23.0	37.4	4.5	40.0
Scenic and sightseeing transportation and support activities	68.5	98.2	10.8	13.9	29.7	6.2	31.7
Couriers and messengers	56.5	64.1	8.9	9.1	7.6	2.1	8.1
Warehousing and storage	61.1	81.4	9.6	11.5	20.3	4.9	21.7

Source: U.S. Bureau of Economic Analysis, "U.Real Value Added by Industry". The contribution to growth column was calculated based on the sum total of the change in output of 3-digit industries as opposed to the change in output of the 2-digit Transportation and Warehousing industry.

At the level of the two-digit transportation and storage, the growth rate of real output between 2017 and 2023 was 1.8 per cent per year in the United States and that of labour input, measured by total hours worked, was 3.5 per cent per year. These growth rates were both around 1-2 percentage points higher than experienced in Canada (-0.2 per cent and 2.8 per cent respectively). Consequently, labour productivity growth were similar in the two countries: -1.6 per cent per year in the United States versus -2.9 per cent in Canada. But the productivity developments at the three-digit transportation industry level were markedly different.<sup>5</sup> In the United States, in contrast to Canada, transit and ground passenger transportation enjoyed very robust annual real output growth in 2017-2023, at 9.6 per cent (Chart 12, Panel A). In Canada, the corresponding annual growth rate was -3.8 per cent. In the air transport sector,

<sup>5</sup> In Appendix Table A6, we compute the labour productivity measure for Canada based on real output divided by employment. We find that the contributions for each 3-digit industry remain roughly the same and the results are robust to using this alternative definition of labour productivity for Canada.

Table 8- Absolute and Relative Change in Total Hours Worked, 3-digits NAICS Transportation and Warehousing Industries, United States, 2017-2023 (compound growth rate)

3-digits Industry	Hours Worked (Millions)		Share of Hours Worked (%)		Change in Hours Worked	Growth rate of Hours Worked (%)	Contribution to Growth (%)
	2017	2023	2017	2023			
<b>Transportation and Warehousing</b>	<b>12,159.90</b>	<b>14,937.54</b>	<b>100</b>	<b>100</b>	<b>2,777.6</b>	<b>3.5</b>	<b>100</b>
Air transportation	726.20	963.44	6.0	6.4	237.2	4.8	8.5
Rail transportation	356.29	309.39	2.9	2.1	-46.9	-2.3	-1.7
Water transportation	139.88	157.36	1.2	1.1	17.5	2.0	0.6
Truck transportation	3,717.00	3,835.50	30.6	25.7	118.5	0.5	4.3
Transit and ground passenger transportation	1,144.12	1,112.37	9.4	7.4	-31.8	-0.5	-1.1
Pipeline transportation	106.60	120.36	0.9	0.8	13.8	2.0	0.5
Scenic and sightseeing transportation and support activities	1,445.34	1,713.24	11.9	11.5	267.9	2.9	9.6
Postal service	1,163.91	1,153.68	9.6	7.7	-10.2	-0.1	-0.4
Couriers and messengers	1,250.39	2,033.06	10.3	13.6	782.7	8.4	28.2
Warehousing and storage	2,110.17	3,539.13	17.4	23.7	1,429.0	9.0	51.4

Source: U.S. Bureau of Labour Statistics, "Hours Worked and Employment Measures".

with a growth rate of -8.6 per cent, Canada's labour productivity performance was much worse than the United States that fell by -2 per cent annually in 2017-2023.

Clearly, the responses to the pandemic in these industries differed between the two countries, with the United States apparently recovering much quicker than Canada.

The increase in working hours in transportation and storage of 3.5 per cent per year in the United States between 2017 and 2023 was largely accounted for by only two industries. Warehousing and storage, with 9 per cent average annual growth rate accounted for 51.4 per cent of the total hours worked increase while couriers and messengers grew by an annual growth rate of 84 per cent and accounted for 28.2 per cent of the sector's increase in total hours worked. The industry with the third largest increase in hours was air transportation, up 4.8 per cent per year. The greatest fall in hours was recorded in rail transportation, down 2.3 per cent per year.

Table 9- Absolute and Relative Change in Output per Hour, 3-digits NAICS Transportation and Warehousing Industries, United States, 2017-2023 (compound growth rate)

3-digits Industry	Labour Productivity (dollars per hour)		Relative Labour Prod. (%)		Change in Labour Prod. (dollars per hour)	Growth rate of Labour Prod. (%)	Contribution to Growth (pp.)	Contribution to Growth (%)
	2017	2023	2017	2023				
<b>Transportation and Warehousing</b>	<b>52.3</b>	<b>47.3</b>	<b>100</b>	<b>100</b>	<b>-4.9</b>	<b>-1.64</b>	<b>-1.64</b>	<b>100</b>
Air transportation	177.2	157.4	339.1	332.5	-19.9	-1.96	-0.13	7.7
Rail transportation	124.3	132.5	237.9	280.0	8.2	1.07	0.02	-1.3
Water transportation	100.1	101.0	191.5	213.5	1.0	0.16	0.00	-0.1
Truck transportation	47.9	44.0	91.6	92.9	-3.9	-1.41	-0.36	22.1
Transit and ground passenger transportation	37.9	65.6	72.6	138.7	27.7	9.57	0.71	-43.5
Pipeline transportation	384.6	291.6	735.9	616.1	-93.0	-4.51	-0.04	2.2
Scenic and sightseeing transportation and support activities	86.5	94.8	165.5	200.3	8.3	1.54	0.18	-10.8
Postal service	58.9	85.1	112.6	179.8	26.3	6.34	0.49	-29.9
Couriers and messengers	45.2	31.5	86.5	66.6	-13.7	-5.82	-0.79	48.4
Warehousing and storage	29.0	23.0	55.4	48.6	-6.0	-3.76	-0.89	54.4

Note: The weights used to calculate the contribution to Growth were the employment share of each 3-digit industries in 2023.

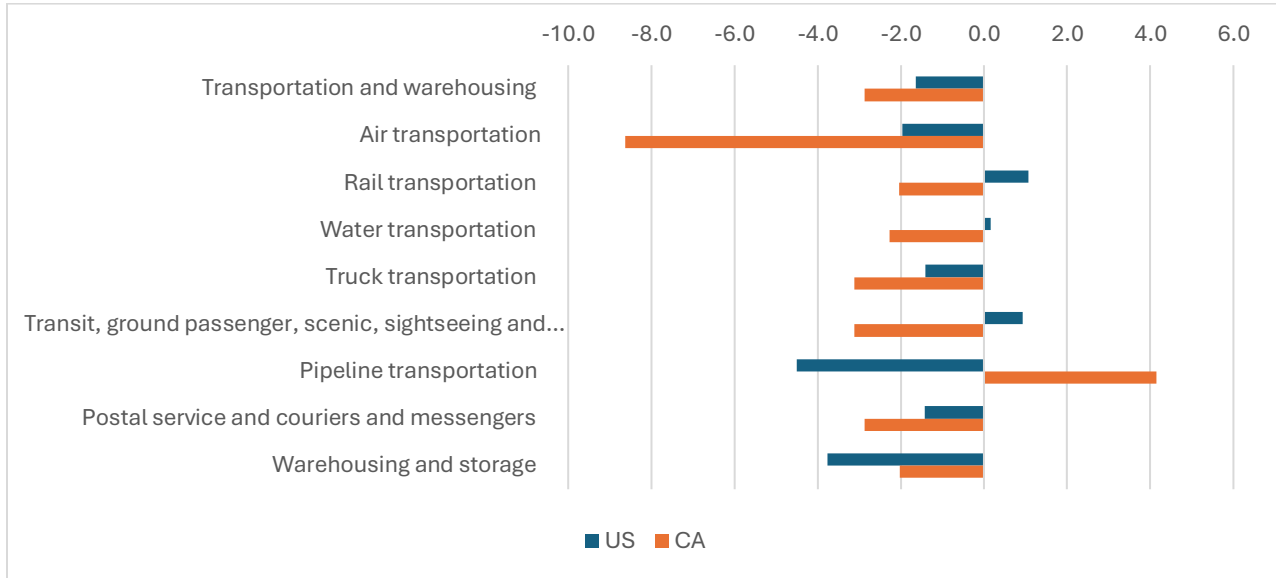
Source: CCLS calculations

To provide more context for the transportation productivity comparison between Canada and the United States, Chart 12, Panel B shows the labour productivity performance of various transportation sub-industries in both countries between 2000 and 2017. Transportation productivity grew at almost the same rate in both countries (1.5 per cent per year in Canada and 1.4 per cent per year in the United States). In both Canada and United States, air, rail and truck transportation experienced strong labour productivity growth rates. Specifically, air transportation labour productivity grew by 4.9 per cent per year in the United States and by 4.6 per cent per year in Canada; rail transportation labour productivity grew by 3.5 per cent per year in Canada and by 2.5 per cent per year in United States and truck transportation labour productivity grew by 3.3 per cent per year in Canada and by 1.1 per cent per year in United States. Postal service and couriers and messengers' industry experienced a decline in labour productivity at a rate of -0.7 per cent per year and -0.5 per cent per year in Canada and the United States respectively.

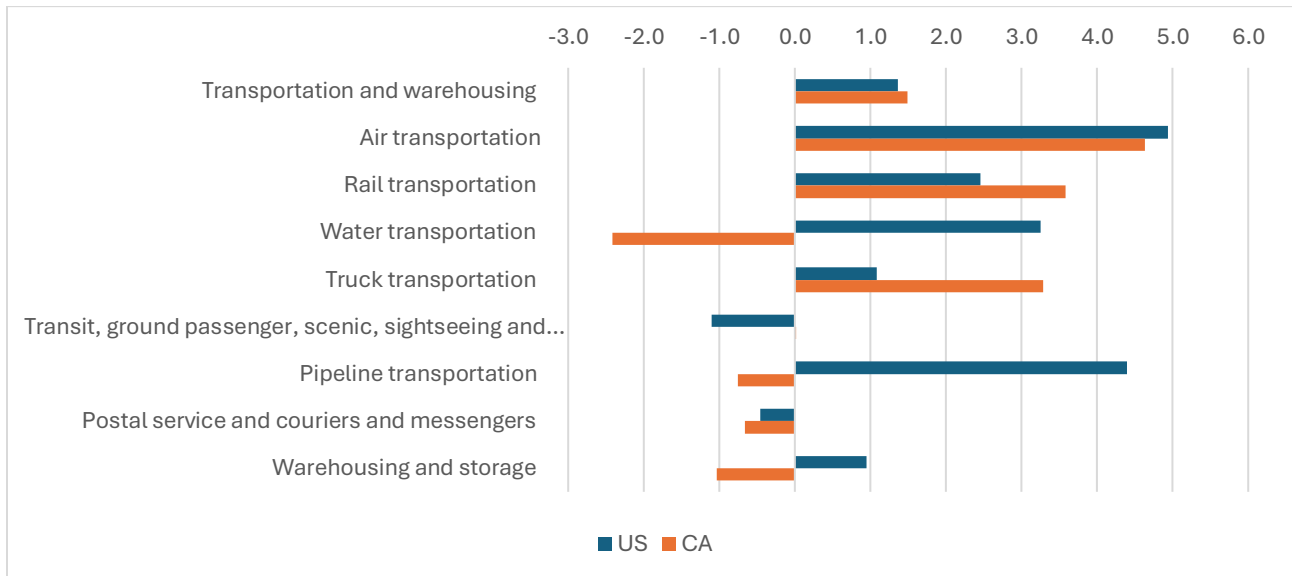
The trends in labour productivity growth across other transportation sub-industries was significantly different for each jurisdiction. Water transportation labour productivity grew by 3.3 per cent per year in the United States while it declined by -2.4 per cent per year in Canada. In the United States, pipeline transportation and warehousing and storage posted robust labour productivity growth between 2000 and 2017 at 4.4 and 0.9 per cent per year respectively, but the same sub-industries in Canada experienced productivity declines of -0.8 and -1 per cent per year.

*Chart 12-Comparison of the Productivity Growth 3-digit Industries within Transportation and Warehousing between Canada and United States*

*Panel A: 2017-2023*



*Panel B: 2000-2017*



*Note: To make the comparison across the two countries possible, the labour productivity data for transit, ground passenger, scenic, sightseeing and support activities industries were accounted for together using hours worked shares of these industries in 2023. Postal service and couriers and messengers were also merged together for consistency across Canada and United States labour productivity data.*

*Source: CSLS calculations*

The industry with largest decline in labour productivity in the transportation and storage sector in the United States between 2017 and 2023 was couriers and messengers, down 5.8 per cent per year and accounting for 48.4 per cent of the aggregate decline. The second largest fall in productivity was in the pipeline transportation industry with productivity down 4.5 per cent per year. The trucking industry also experienced a fall in productivity in the United States, down 1.4 per cent per year between 2017

and 2023. This was a milder decline to that experienced in Canada in the same period (-3.1 per cent per year).

### **Transportation Productivity in G-7 Countries**

This section discusses the labour productivity and TFP<sup>6</sup> growth rates in the transportation sector in G-7 countries from 1995 to 2020 (the latest year data was available for G-7 Countries). Table 10, Panel A describes the labour productivity situation in transportation in G-7 countries between 1995 and 2020. The data for Canada are from Statistics Canada while the data for the other countries are from the recently released EUKLEMS INTRAPROD database.

Taking a long-term perspective from 1995 to 2020, one can observe that the fastest growth in labour productivity was experienced by Germany (1.13 per cent per year), followed by France (0.92 per cent) and Canada (0.72 per cent). Meanwhile, within the same period, Japan (-0.57 per cent) and United Kingdom (-0.47 per cent) have had a decline in labour productivity in their transportation and storage sectors.<sup>7</sup>

One can argue that including 2020 as the end year can be problematic because of the pandemic effects on this sector (which were quite remarkable). For that reason, we also investigate the period 1995-2017. In this time frame, the highest labour productivity growth in transportation was that of Germany (1.60 per cent per year). France (1.54 per cent) and Canada (1.26 per cent) posted the second and third highest growth rates respectively.

More recently from 2017 to 2020, the labour productivity in the transportation sector in all G-7 countries has been on the decline. Japan (-8.2 per cent per year) had the sharpest decline among all G-7 countries, followed by United Kingdom (-7.56 per cent) and France (-3.99 per cent). It is worth mentioning that Canada was not far from France (in terms of the decline in labour productivity) at -3.59 per cent.

Again, if one is interested in the pre-pandemic labour productivity performance of these countries, it would be more appropriate to exclude 2020 from the analysis. Doing so and focusing on 2017-2019 we find that Canada had the worst transportation sector labour productivity growth among all G-7 countries (-3.36 per cent per year). United States (-2.06 per cent) and France (-1.72 per cent) were trailing Canada on the path of labour productivity decline in the transportation sector. Interestingly, Germany (0.67 per cent per year) and Japan (0.66 per cent) posted modest labour productivity growth rates in the same period. However, the fact that these two latter countries had negative labour productivity growth between 2017 to 2020 shows that their transportation sector productivity growth in 2020 must have more than offset this growth between 2017 to 2019.

To investigate this point further and also to obtain a better picture of the immediate effects of the pandemic on the transportation sector in G-7 countries we confine our attention to the year 2020. Virtually all G-7 countries suffered from significant productivity decline in their transportation industries. Japan posted a staggering -23.64 per cent growth rate in 2020. United Kingdom also experienced a massive decline in transportation sector labour productivity at -18.56 per cent. It is

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<sup>6</sup> Throughout this report the terms TFP (Total Factor Productivity) and MFP (Multifactor Productivity) are used interchangeably.

<sup>7</sup> We note that all per cent figure reported in this section are compound annual growth rates.

notable that while Canada was also down by 3.83 per cent, its productivity decline was much less compared to most other G-7 countries (except for the United States).

*Table 10- Productivity Growth Rates in Transportation and Warehousing Industry, G-7 Countries, 1995-2020 (Compound Growth rates)*

*Panel A: Labour Productivity Growth*

Country	Germany	France	Italy	Japan	United Kingdom	United States	Canada
Period	Annual Compound Growth Rate						
1995-2020	1.13	0.92	0.42	-0.57	-0.47	0.05	0.72
1995-2017	1.60	1.54	0.76	0.49	0.52	0.40	1.26
2017-2020	-2.78	-3.99	-2.24	-8.20	-7.56	-2.63	-3.52
2017-2019	0.67	-1.72	-0.34	0.66	-1.52	-2.06	-3.36
2020	-9.34	-8.38	-5.95	-23.64	-18.56	-3.77	-3.83

*Panel B: Total Factor Productivity Growth*

Country	France	Germany	Italy	UK	United States	Canada
Period	Annual Compound Growth Rate					
1995-2020	-0.26	0.31	-0.35	-1.16	-0.01	-1.33
1995-2017	0.47	0.82	0.19	-0.22	0.29	-0.29
2017-2020	-5.57	-3.56	-4.27	-7.70	-2.30	-8.54
2017-2019	-2.12	0.58	-0.24	-1.17	-1.53	-3.63
2020	-12.10	-11.33	-11.85	-19.48	-3.80	-17.60

*Note: In Panel B data from Japan were not available.*

*Source: Euklems & INTANProd database, 2023 release. Statistics Canada, Table: 36-10-0208-01*

Table 10, Panel B gives the total factor productivity growth rates in the transportation sector in G-7 countries (excluding Japan) for the period 1995-2020 and its subperiods. Chart 13 plots the path of labour productivity in transportation in G-7 countries from 1995 to 2020 and Chart 14 depicts the corresponding path for TFP.

Between 1995 and 2020 Germany had the highest TFP growth rate in transportation at 0.31 per cent. All other G-7 countries were down in the same period with the largest decline being that of Canada (-1.33 per cent) followed by United Kingdom (-1.16 per cent).

From 1995 to 2017, Germany enjoyed the fastest TFP growth in transportation, with an increase of 0.82 per cent, followed by France (0.47 per cent), the United States (0.29 per cent) and Italy (0.19 per cent). Canada had the poorest TFP growth performance (-0.29 per cent) followed by the United Kingdom (-0.22 per cent) that also posted a decline in productivity within this time period.

From 2017 to 2020, the most recent year for which data are available for G-7 countries, all countries have seen falls in TFP in transportation. The largest fall was in Canada, with TFP down 8.54 per cent. This was followed by the United Kingdom (-7.70 per cent), France (-5.57 per cent), Italy (-4.27 per cent), Germany (-3.56 per cent) and the United States (-2.30 per cent). This sharp contrast in Canada's long-term transportation sector's TFP growth between 1995-2017 and after 2017 is quite remarkable.

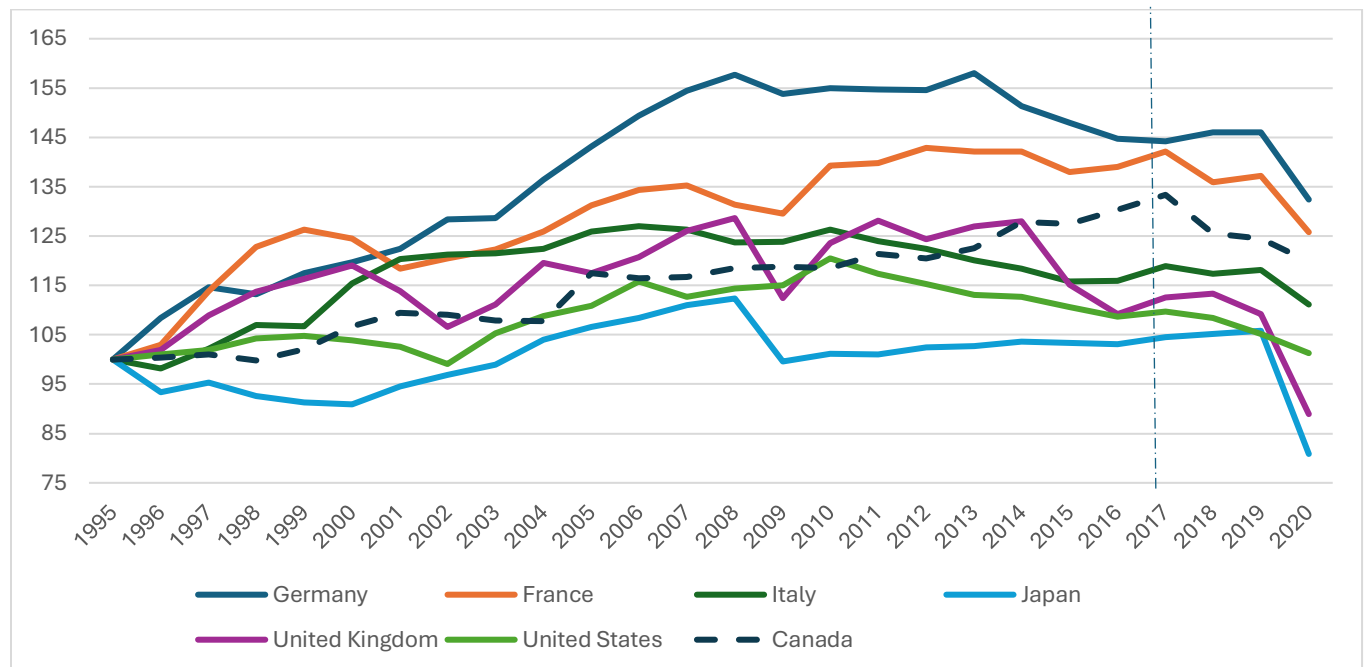
The post-2017 period can be divided into pre-pandemic (2018 and 2019) and pandemic (2020) sub-periods. There was a fall in TFP in both periods in all countries (except for Germany between 2018 and 2019), but the decline was much greater in 2020 than in 2018 and 2019. The unweighted average fall in TFP in transportation for the six countries was 12.69 per cent in 2020, compared to 1.35 per cent per year from 2017 to 2019.

Between 2017 and 2019 five of the six countries saw a fall in TFP in transportation. The exception was Germany, with TFP up 0.58 per cent. The largest fall was in Canada down 3.63 per cent, followed by France (-2.12 per cent), United States (-1.53 per cent), United Kingdom (-1.17 per cent) and Italy (-0.24 per cent). The decline in TFP in these countries partly reflects the rapid increase in the capital stock in the transportation industry that was not accompanied by an equal increase in output.

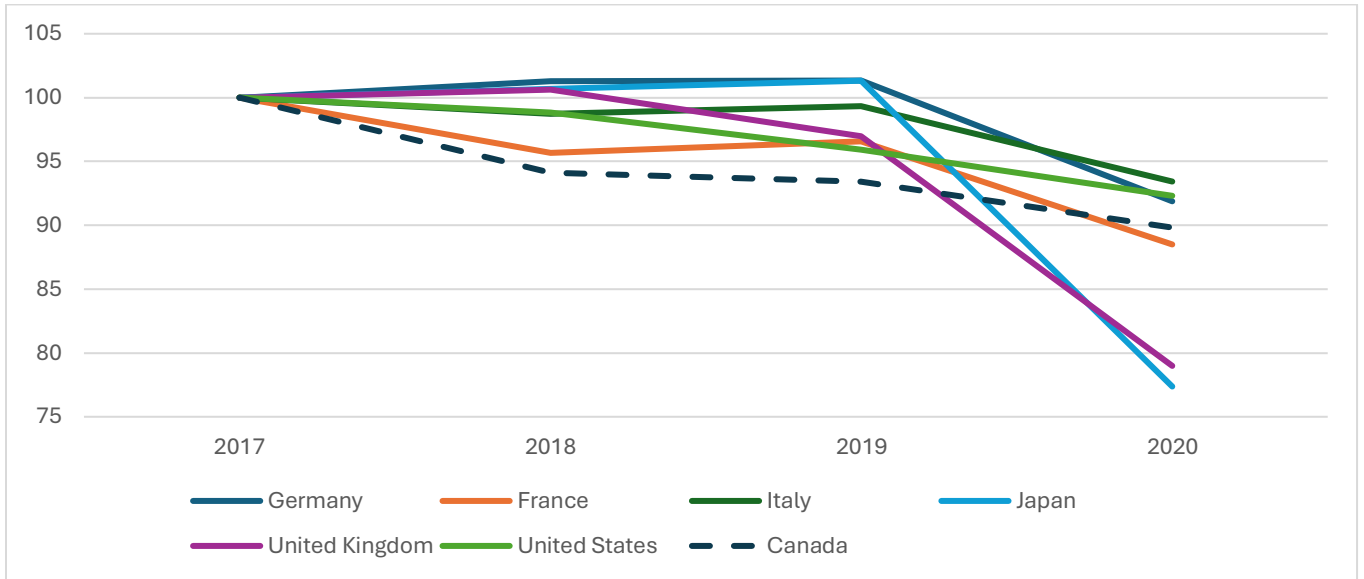
The largest fall in TFP in transportation in 2020 was in the United Kingdom, down 19.5 per cent, followed by the Canada (-17.60 per cent), France (-12.10), Italy (-11.9 per cent), Germany (-11.3 per cent), and the United States, with only a 3.8 per cent fall.

*Chart 13: Labour Factor Productivity, Transportation and Warehousing Industry, G-7 Countries, 1995-2020*

*Panel A: 1995-2020 (Index, 1995=100)*



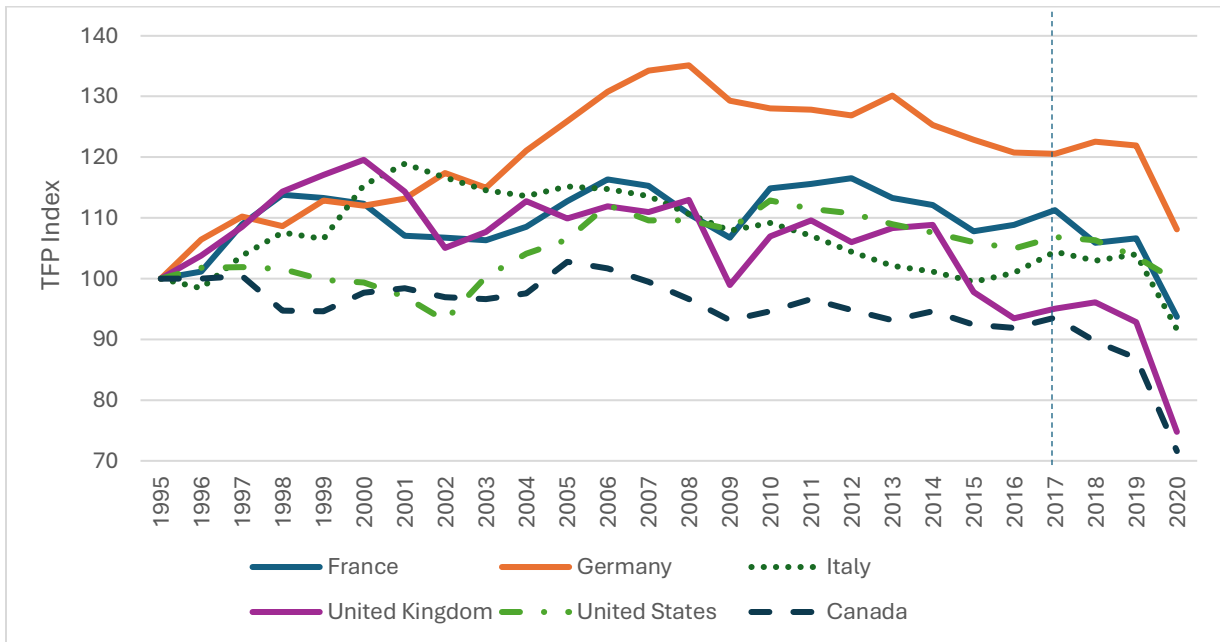
Panel B: 2017-2020 (Index, 2017=100)



Source: Euklems & INTANProd database, 2023 release. Statistics Canada, Table: 36-10-0208-01

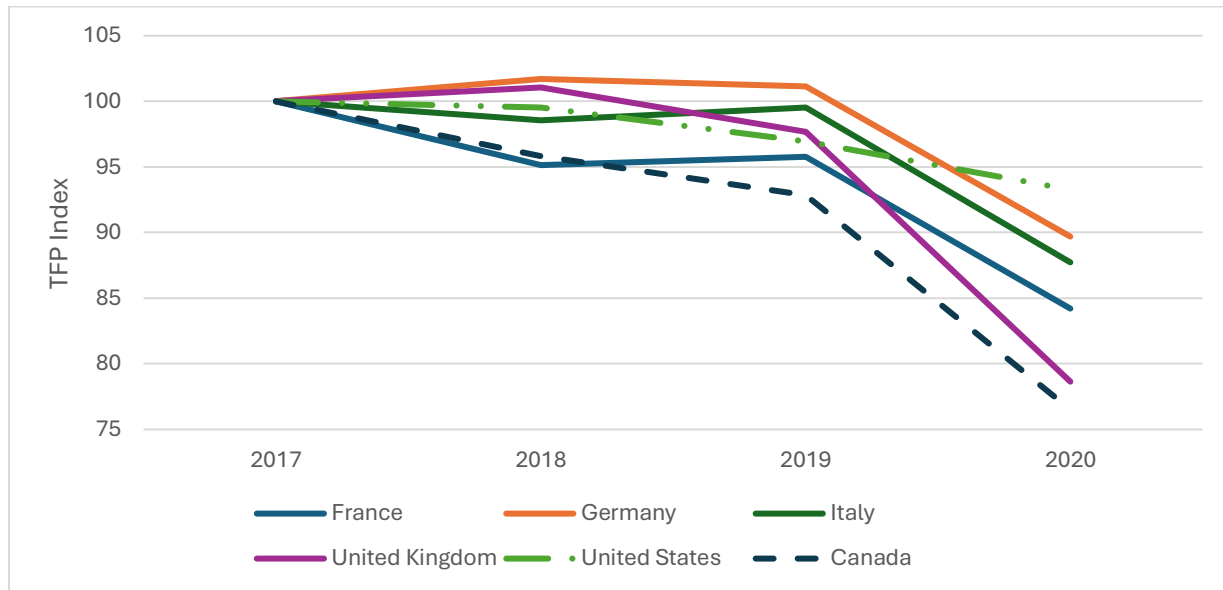
Chart 14: Total Factor Productivity, Transportation and Warehousing Industry, G-7 Countries, 1995-2020

Panel A: 1995-2020 (Index, 1995=100)





Panel B: 2017-2020 (Index, 2017=100)



Source: Euklems & INTANProd database, 2023 release. Statistics Canada, Table: 36-10-0208-01

Several takeaways related to G-7 countries and specifically to Canada come out of the developments highlighted above. Regarding the G-7 countries in general:

- The year 2017 seems to be a breakpoint on both TFP and labour productivity growth in transportation, with slower growth in 2018 and 2019 than in the pre-2017 period even before the pandemic hit. The only exceptions in this regard are Germany (positive TFP and labour productivity growth) and Japan (positive labour productivity growth).
- Because of lags in the adjustment of labour, and especially capital, to changes in output, the pandemic year of 2020 saw very large falls in TFP and labour productivity in transportation. This dramatic drop affected all G-7 nations but by far the largest impacts were felt in Japan and United Kingdom (in terms of Labour productivity) and United Kingdom and Canada (in terms of TFP).
- The ability of countries to adjust inputs to changes in output in transportation appears to vary considerably among G-7 countries during the pandemic, as shown by the wide range of falls in TFP. The United States in particular appears to have adjusted inputs to the fall in transportation output in 2020 as it had by far the smallest decline in TFP and labour productivity.
- While until 2017 Canada enjoyed positive growth rates of labour productivity in transportation, it suffered a remarkable decline post-2017 and even prior to the pandemic.
- Canada had by far the worst TFP performance among all G-7 countries up to the pandemic (1995-2019) and the second worst TFP growth in 2020.

- Interestingly, in terms of labour productivity performance, the pandemic's effects on Canada's transportation sector were not as severe as other G-7 countries. In fact, the drop in labour productivity in transportation in Canada was almost the same as the average compound labour productivity decline between 2017-2019.
- The TFP growth picture in Canada post-2017 has been particularly bleak. Canada had the sharpest decline in TFP in 2017-2019 between all G-7 nations and the second sharpest decline in 2020. In fact, Canada has the largest divergence between its TFP and labour productivity performance. This signals that the Canadian transportation sector found capital adjustments particularly difficult (more so than labour adjustments) post-2017.

## **Part Two: Accounting for the Fall in Productivity in Transportation and Storage using Different Methodologies**

This part of the report sheds light on the fall in productivity in transportation and storage in Canada since 2017 from three methodologies or perspectives. The first subsection employs a growth accounting methodology to decompose the fall in labour productivity growth between 2000-2017 and 2017-2023 into changes in labour composition, capital intensity and multifactor productivity growth. The second subsection uses a decomposition formula to decompose labour growth in 2017-2002 for two-digit industries in the business sector and three-digit transportation industries into within-sector effects, re-allocation level effects, and re-allocation growth effects. The third section looks at how the fall productivity in the transportation and storage has affected the share of wages in total income and the actual evolution of real wages.

### **Sources of Labour Productivity Growth in Transportation and Storage in Canada from Growth Accounts**

Growth accounting is the workhorse methodology used by productivity analysts to identify the sources of labour productivity growth. Labour productivity growth is decomposed into three components, changes in the labour composition, changes in capital intensity or capital services per hour worked and changes in multifactor or total factor productivity.

Statistics Canada produces growth accounts for two-digit NAICS industries for the 1961-2022 period (Table 36-10-0208-01). Unfortunately, because of limitations on the availability of capital services below the two-digit industry level, growth accounts are not available for the three-digit transportation industries. The growth account estimates are currently only available until 2022.

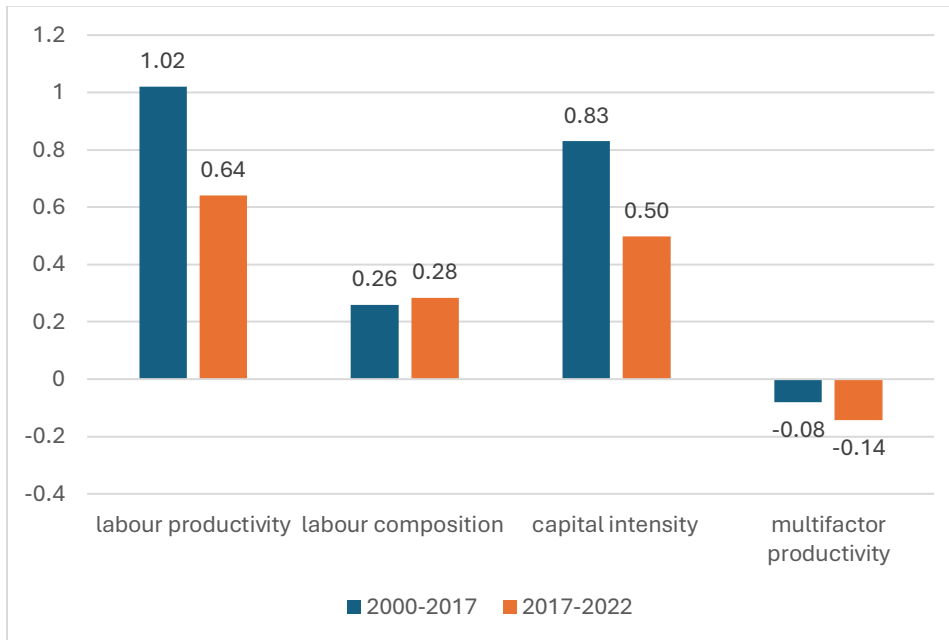
Table 10 gives the sources of labour productivity growth for selected periods from 1961 to 2022 for the business sector and for transportation and storage. The labour productivity and multifactor productivity growth rates were discussed earlier in the report.

Chart 15 provides the contributions of the three sources of labour productivity growth in the 2000-2017 and 2017-2022 period for the business sector and for transportation and storage, between 2017 and 2022, labour productivity growth in the business sector in Canada has advanced 0.6 per cent per year, down from 1.0 per cent in 2000-2017. This fall can be accounted for partly by an increase in the negative contribution MFP is making (up to -0.14 per cent from 0 per cent in 2000-2017). Labour composition contribution is roughly the same in the two periods (0.26 per cent in 2000-2017 vs 0.28 per cent in 2017-2022). The major contribution however is that of capital intensity was about 0.8 per cent in 2000-2017 and declined to 0.5 per cent in 2017-2022. Table 11 provides a longer-term picture of the sources of labour productivity growth in Canada for both the business sector and the transportation industry.

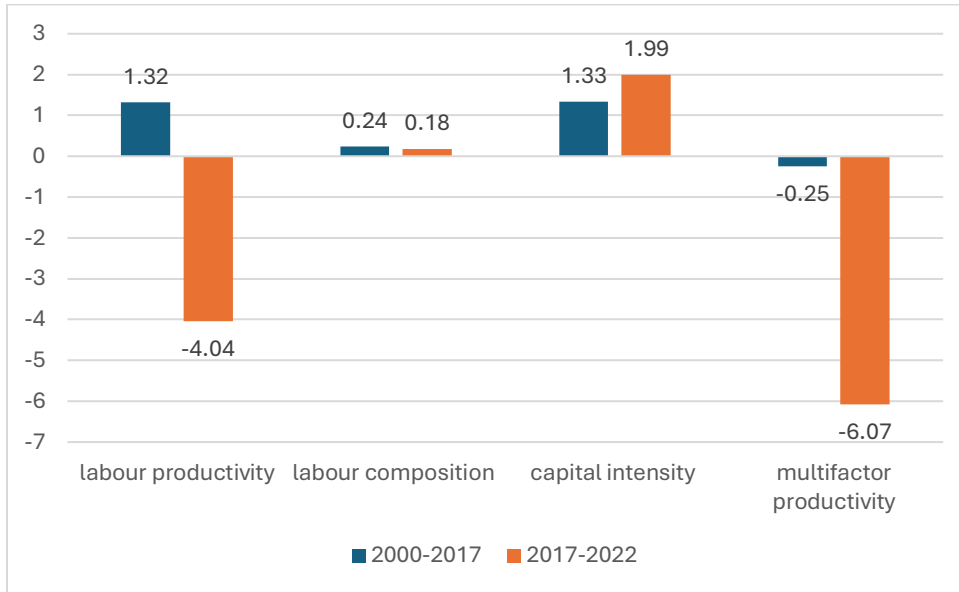
In contrast to the relative stability of labour productivity growth and the sources of labour productivity growth in the Canadian business sector between the 2000-2017 and 2017-2022 periods, developments in transportation in these two periods have been dramatically different, both in terms of labour productivity growth and the sources of this labour productivity growth as shown in Chart 15.

*Chart 15: Sources of Labour Productivity Growth, Canada*

*Panel A: Business Sector*



Panel B: Transportation and Warehousing Sector



Source: Statistics Canada. Table 36-10-0208-01

As has been noted earlier, output per hour in transportation and storage fell 4 per cent a year from 2017 to 2022, compared to a 1.3 per cent annual labour productivity growth rate from 2000 to 2017. The fall-off in labour productivity growth was not just due to the pandemic as output per hour fell 3.2 per cent per year between 2017 and 2019, compared to 4.3 per cent between 2019 and 2022. From a growth accounting perspective, it was the massive deterioration in MFP growth that accounted for all the fall in labour productivity. MFP contributed -0.3 percentage points per year to labour productivity growth in 2000-2017, but -6.1 percentage points in 2017-2022. The contribution of labour composition, while still positive after 2017, was down slightly from 0.3 points to 0.2 points.

The likely explanation for this decline in MFP was the expansion of capital stock in the transportation sector (especially urban transit) brought about by increased public investment in infrastructure.<sup>8</sup> Data from Statistics Canada (Table: 36-10-0096-01) show that total non-residential investment in the transportation industry increased from 32.0 billion dollars (2017 chained dollars) in 2017 to 44.2 billion dollars in 2022 (an increase of 38.3 per cent over this period).<sup>9</sup> Of particular interest is the sharp increase in engineering construction capital stock which was up from 15.7 billion dollars to 26.1 billion dollars (66.2 per cent) While we do not have information on the change in capital stock at the 3-digit level industries in the Statistics Canada's data, it is likely to attribute most of the increase in engineering construction investment to the expansion of the public transit system (e.g. LRT in Ottawa). Meanwhile as mentioned earlier, real output in transportation industry fell between 2017 and 2022. This is why MFP which is defined as the ratio of an index real output over an index of combined inputs of capital and labour has decreased significantly.

<sup>8</sup> Through the Investing in Canada Plan, launched in 2016, the Government of Canada committed over \$180 billion over 12 years for infrastructure. Provincial and municipal levels of government have also invested substantial amounts in upgrading and expanding transportation system across the country.

<sup>9</sup> Data for 2023 has not yet been released at the time of writing this report.

In contrast, the contribution of capital intensity increased from 1.3 points per year in 2000-2017 to 2 points in 2017-2022. However, this increased contribution took place after 2019 as in 2017-2019 there was very insignificant contribution from capital intensity to labour productivity growth (0.3 per cent) compared to 2019-2022 (6 per cent).

*Table 11- Sources of Labour Productivity Growth, Business Sector and Transportation and Warehousing Sector, 1961-2022*

Period	Business sector				Transportation and warehousing			
	Labour productivity	Contribution of labour composition to labour productivity growth	Contribution of capital intensity to labour productivity growth	Multifactor productivity	Labour productivity	Contribution of labour composition to labour productivity growth	Contribution of capital intensity to labour productivity growth	Multifactor productivity
1961-1973	3.6	0.7	1.3	1.5	5.1	0.4	0.9	3.8
Per cent Contribution	100.0	19.7	36.3	42.8	100.0	7.2	16.7	75.1
1981-1989	1.5	0.4	0.8	0.4	2.1	0.3	0.0	1.8
Per cent Contribution	100.0	23.9	49.7	25.9	100.0	15.2	-0.8	85.4
1989-2000	1.8	0.4	0.9	0.5	1.1	0.2	1.0	-0.1
Per cent Contribution	100.0	21.4	51.1	27.0	100.0	17.1	96.6	-13.7
2000-2008	0.9	0.3	1.1	-0.5	1.3	0.3	1.2	-0.1
Per cent Contribution	100.0	32.3	131.5	-63.3	100.0	22.5	87.2	-9.8
2008-2015	1.1	0.3	0.7	0.2	1.0	0.2	1.5	-0.6
Per cent Contribution	100.0	22.7	60.9	16.1	100.0	15.7	146.9	-61.8
2008-2019	1.0	0.2	0.5	0.2	0.5	0.2	1.3	-1.0
Per cent Contribution	100.0	23.8	52.2	23.7	100.0	35.0	280.6	-213.0
2015-2019	0.9	0.2	0.3	0.4	-0.6	0.2	0.8	-1.5
Per cent Contribution	100.0	26.1	33.8	39.8	100.0	-26.5	-144.1	268.2
2017-2022	0.6	0.3	0.5	-0.1	-4.0	0.2	1.99	-6.1
Per cent Contribution	100.0	50.0	83.0	-16.6	100.0	-5.0	-50.0	152.5
2019-2022	0.77	0.33	0.6	-0.1	-4.31	0.3	6.0	-7.6
Per cent Contribution	100.0	42.8	78.0	-13.0	100.0	-7.0	-139.2	176.3
2000-2017	1.02	0.26	0.83	-0.08	1.32	0.24	1.33	-0.25
Per cent Contribution	100.0	25.5	81.4	-7.8	100.0	18.2	100.8	-18.9
2017-2019	0.49	0.22	0.45	-0.17	-3.36	-0.01	0.30	-3.63
Per cent Contribution	100.0	44.9	91.8	-34.7	100.0	0.3	-8.9	108.0

Source: Statistics Canada, Table: 36-10-0208-0

The much greater pace and contribution of capital intensity growth after 2019 was a cyclical phenomenon and did not reflect increased investment. Rather the fall in employment and hours worked combined with the relative fixity of the capital stock resulted in a rise in the capital/labour ratio reflecting the underutilized capital. This illustrates the perils of growth accounting for short periods when there is not a full adjustment of inputs to changes in output.

## Decomposition of Labour Productivity Growth in Canada into Within-sector and Re-allocation Effects

The contributions to labour productivity growth for each 2-digit and 3-digit industry were reported in Table 3 (for contributions of 2-digit industries to business sector productivity) and Table 6 (for contributions of 3-digit industries to transport sector productivity). Those calculations were made with the simplifying assumption that the contribution of each industry to the aggregate productivity (business sector or transport sector) would be proportional to the share of hours worked in that industry. The limitation of this approach is that it does not account for the productivity levels of each industry. For example, a 1 per cent drop of labour productivity in a highly productive industry (i.e. high level of productivity) reduces aggregate output per hour by a larger margin than a per cent drop in productivity in a low productivity industry.

As a result, to identify the sources of the productivity growth more accurately in the business sector and within the transportation industry between 2017 to 2023, we use the decomposition method developed by Sharpe (2010) which breaks down aggregate productivity growth into within-sector effects and re-allocation effects. This method effectively weighs the contributions of each industry to aggregate productivity growth both based on their hours shares and productivity levels and growth rates. We modify the decomposition slightly and apply it once to the business sector as the aggregate sector, and then to the transportation industry as the aggregate sector to obtain the within-industry and re-allocation effects. Mathematically, the decomposition can be expressed as follows:

$$\Delta P = \sum_i h_i^0 \Delta P_i + \sum_i (P_i^0 - \bar{P}^0) \Delta h_i + \sum_i \Delta h_i (\Delta P_i - \Delta \bar{P}_i) \quad (1)$$

Where  $P$  is the overall business sector (transportation industry) labour productivity level<sup>10</sup>,  $P_i$  is the labour productivity level in 2-digit (3-digits transportation industry)  $i$ ,  $h$  is the share of total sector-wide labour hours which is employed in the 2-digits (3-digit industry)  $i$ , the subscript 0 indicates a variable in time 0 (the beginning of the period) as opposed to time 1 (the end of the period),  $\Delta$  indicates change over the period, and  $\Delta P$  is the average change in business sector (transportation sector) productivity levels. The first term in the decomposition captures the “Within-sector” effects which reflect the productivity growth within each 2-digit industry (3-digit industry) that contributes to the overall productivity growth in the business sector (transportation industry). The second term in equation (1) is the “re-allocation level” effect which is the ceteris paribus effect of net labour influx into 3-digit industries with higher-than-average productivity (relative to the average of the business sector or transportation industry depending on the level of aggregation). The last term in the same equation represents what we refer to as the “Re-allocation growth” effect that demonstrates the sector-wide (industry-wide) productivity growth implications of the net movement of workers into 2-digit (3-digit industries) that have higher than average productivity growth rates (relative to the average of the business sector or transportation industry depending on the level of aggregation).

The next section applies this decomposition framework to the 2017-2023 period to identify the contributions of these effects to the declining productivity growth in the business sector and also specifically within the transportation industry.

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<sup>10</sup> Labour productivity is the ratio between real value added and hours worked. Real value added for each industry and each aggregate is constructed from a Fisher chain index.

### **Two-digit industries**

Table 12 and Appendix Table A4 decompose output per hour growth in two-digit industries in Canada over the 2017-2023 period into the within-sector effect, the re-allocation level effect, and the re-allocation growth effect. For the business sector there was a very significant positive re-allocation level effect of 0.22 percentage points. In other words, more than all the business sector productivity growth of 0.17 per cent per year could be explained by the net re-allocation of labour between industries. The main drivers of this re-allocation effect were the falling share of hours worked in three sectors with average productivity levels around half the business sector average, namely retail trade, accommodation and food services, and other private services and the increase in the share of hours worked in a high productivity sector of mining and oil and gas extraction.

In the transportation sector, all three components of productivity growth contributed to the 2.87 per cent average annual rate of decline in output per hour.

Falling productivity within the transport sector contributed -0.19 percentage points to productivity growth. This accounts for -111.7 per cent growth of the business sector output per hour.

There was a negative re-allocation level effect of 0.008 percentage points, accounting for -4.5 per cent of the business sector output per hour growth. This is explained by the increased hour worked share in the transport sector which has a below average productivity level.

There was also a negative re-allocation growth rate effect of -0.017 percentage points, accounting for -9.9 per cent of the business sector output per hour growth. This is explained by the increased hour worked share in the transport sector which has a well below average productivity growth rate. Adding the three effects together gives -0.19 points, which is -111.7 per cent of business sector productivity growth of 0.17 per cent. One notes that this -111.7 per cent contribution is consistent with the contribution of the transport sector to business sector (-112.3 per cent) obtained by weighting the productivity growth rate in transport (-2.87 per cent) by its 2017 hours share (7 per cent) as done in Table 3.

### **Three-digit industries**

To carry out the decomposition specified in Equation 1, we need to have the breakdown of the change in productivity levels and shares of hours at the at 3-digit industry level. Column 3 of Table 13 provides the change in productivity levels from 2017-2023 for the transportation industry as a whole and the 3-digits industries within that that industry. While the transportation industry experienced an 8.70 dollars per hour fall in its productivity level, there is substantial heterogeneity in terms of the productivity changes among various 3-digit industries. Among these, air transportation had the sharpest decline in productivity levels (-36.50 dollars per hour) followed by rail transportation (-14.80 dollars per hour). By far the best performance from the standpoint of productivity level change was that of pipeline transportation (125.30 dollars per hour). Column (7) of Table 13 contains the calculated change in the share of hours in each industry. Warehousing and storage along with postal service and couriers and messengers saw the largest increase in their share of hours (3.2 per cent and 1.3 per cent increase, respectively) while Transit transportation and support activities for transportation had the most relative decline in their share of hours worked between 2017 to 2023 (-2.6 per cent and -1.4 per cent, respectively).

Table 12- Summary Results of the Decomposition of the Decline in the Productivity Growth Rate, Business Sector, Canada, 2017-2023

2-Digit Industry	Observed change in prod. growth (1)	Within-sector effect		Re-allocation level effect		Re-allocation growth effect		Total effect	
		pp. (2)	Contribution (%) (3) = (2)/ 0.17	pp. (4)	Contribution (%) (5) = (4)/ 0.17	pp. (6)	Contribution (%) (7) = (6)/ 0.17	pp. (6)	Contribution (%) (7) = (6)/ 0.17
<b>Business sector industries</b>	<b>0.17</b>	<b>0.001</b>	<b>3.8</b>	<b>0.22</b>	<b>129.4</b>	<b>-0.03</b>	<b>-17.6</b>	<b>0.17</b>	<b>100.0</b>
Agriculture, forestry, fishing, and hunting	1.66	0.047	27.4	0.008	4.5	-0.007	-4.0	0.05	23.5
Mining and oil and gas extraction	-0.98	-0.068	-40.0	0.048	28.1	-0.004	-2.3	-0.02	-12.0
Utilities	-1.08	-0.029	-17.1	0.005	2.7	0.000	-0.2	-0.03	-12.4
Construction	-1.86	-0.183	-107.7	-0.017	-10.1	-0.027	-15.8	-0.23	-112.7
Manufacturing	-0.22	-0.031	-18.3	-0.011	-6.4	0.002	1.0	-0.04	-20.0
Wholesale trade	1.00	0.074	43.5	-0.002	-1.1	-0.001	-0.4	0.07	35.4
Retail trade	1.95	0.143	83.9	0.072	42.3	-0.009	-5.2	0.21	102.0
<b>Transportation and warehousing</b>	<b>-2.87</b>	<b>-0.164</b>	<b>-96.6</b>	<b>-0.008</b>	<b>-4.5</b>	<b>-0.017</b>	<b>-9.9</b>	<b>-0.19</b>	<b>-111.7</b>
Information and cultural industries	0.93	0.038	22.5	0.014	8.0	0.002	1.0	0.05	26.6
Finance and insurance	1.46	0.137	80.4	-0.005	-3.0	-0.001	-0.9	0.13	64.5
Real estate, rental and leasing	0.80	0.052	30.5	-0.037	-21.5	-0.003	-1.6	0.01	6.3
Professional, scientific and technical services	0.26	0.021	12.5	-0.006	-3.4	0.001	0.8	0.02	8.4
Holding companies	-13.91	-0.061	-35.8	0.009	5.2	0.040	23.7	-0.01	-5.8
Administrative and support, waste management and remediation services	-0.36	-0.014	-8.1	0.023	13.3	0.001	0.9	0.01	5.2
Educational services	4.49	0.014	8.2	-0.002	-1.4	0.001	0.3	0.01	6.0
Health care and social assistance	-0.73	-0.028	-16.5	-0.008	-4.5	-0.003	-1.7	-0.04	-19.1
Arts, entertainment and recreation	0.73	0.007	3.9	0.005	2.8	0.000	-0.1	0.01	5.6
Accommodation and food services	0.67	0.021	12.5	0.104	60.8	-0.001	-0.7	0.12	61.2
Other private services	1.50	0.032	18.7	0.033	19.3	-0.002	-1.2	0.06	31.0

Source: CSLs calculations

It is important to situate the relative size and economic performance of the nine three-digit industries in transportation and warehousing to identify which of these industries accounted for the poor performance of the sector.



Table 13- Absolute and Relative Change in Labour Productivity, 3-digits NAICS Transportation and Warehousing Industries, Canada, 2017-2023 (compound growth rate)

3-Digit Industry	Prod. Level (\$/hour)		Change in Prod. Level (3) = (2) – (1)	Prod. Growth (%) (5)	Share of hours (%)		Change in Hours Share (%) = (7)-(6)
	2017 (1)	2023 (2)			2017 (6)	2023 (7)	
<b>Transportation and warehousing</b>	<b>54.30</b>	<b>45.60</b>	<b>-8.70</b>	<b>-2.87</b>	<b>100</b>	<b>100</b>	<b>0</b>
Air transportation	87.30	50.80	-36.50	-8.63	7.1	7.1	0.01
Rail transportation	126.80	112.00	-14.80	-2.05	4.6	4.3	-0.22
Water transportation	57.50	50.10	-7.40	-2.27	1.8	1.8	-0.04
Truck transportation	38.10	31.50	-6.60	-3.12	34.1	34.2	0.04
Transit, ground passenger and scenic and sightseeing transportation	37.90	30.10	-7.80	-3.77	15.5	12.9	-2.56
Support activities for transportation	58.90	52.90	-6.00	-1.77	16.6	15.2	-1.41
Pipeline transportation	454.00	579.30	125.30	4.15	1.2	0.9	-0.29
Postal service and couriers and messengers	36.80	30.90	-5.90	-2.87	13.6	14.9	1.25
Warehousing and storage	39.70	35.10	-4.60	-2.03	5.5	8.7	3.23

Source: CSLs calculations based on Statistics Canada, Table: 36-10-0480-01

Table 14 provides estimates of real output (2017 chained dollars) for transportation and warehousing and the 9 three-digit NAICs industries in the sector in 2017 and 2023. By far the most important transport industry is trucking, which in 2023 accounted for slightly less than one quarter of the real value added in the sector.

The second most important industry was support activities for transportation at 17.6 per cent, followed by pipeline transportation (11.7 per cent), rail transportation (10.7 per cent), postal service and couriers and messengers (10.1 per cent), transit, ground passenger and scenic and sightseeing transportation (8.5 per cent), air transportation (7.9 per cent), warehousing and storage (6.7 per cent), and water transportation (2.1 per cent).

The relative importance of the transportation sector fell in Canada from 5.9 per cent of business sector real value added in 2017 (\$90.4 billion) to 5.4 per cent in 2023 (\$89.5 billion), the largest fall experienced by any of the major two-digit industries. This decline in turn was driven by the fall on output of 0.2 per cent per year compared to business sector output growth of 1.4 per cent. Only one industry experienced a larger fall in output, accommodation, and food services down 0.6 per cent per year. The transportation sector contributed -0.7 per cent to the growth in business sector output between 2017 and 2023.

Having the relevant changes in productivity levels and shares of hours we now can turn to conducting the decomposition outlined in equation (1). The detailed results of the decomposition exercise are provided in Appendix Table A5. Overall, of the -9.90 dollars per hour decline in the productivity level in the transportation industry, -7.39 dollars per hour or 74.70 per cent can be attributed to the within-sector effects. Most notable 3-digit industries in this regard are air transportation (accounting for 31.8

Table 14- Absolute and Relative Change in Real Output, Measured by Real Value added, 3-digits NAICS Transportation and Warehousing Industries, Canada, 2017-2023 (compound growth rate)

3-digits Industry	Real Output (2017 billions of dollars)		Share of Output (%)		Change in Output (2017 billions of dollars)	Growth rate of Output (%)	Contribution to Growth (pp.)
	2017	2023	2017	2023			
<b>Transportation and warehousing</b>	<b>90.4</b>	<b>89.5</b>	<b>100</b>	<b>100</b>	<b>-0.9</b>	<b>-0.2</b>	<b>100</b>
Air transportation	10.3	7.1	11.4	7.9	-3.2	-6.1	355.5
Rail transportation	9.6	9.6	10.6	10.7	-0.1	-0.1	7.4
Water transportation	1.7	1.7	1.9	2.0	0.0	0.1	-1.3
Truck transportation	21.6	21.2	23.9	23.6	-0.5	-0.4	51.6
Transit, ground passenger and scenic and sightseeing transportation	9.8	7.6	10.8	8.5	-2.1	-4.0	236.2
Urban transit systems	6.2	4.0	3.2	4.4	-2.2	-7.1	243.6
Taxi and limousine service	1.2	1.3	1.2	1.5	0.1	1.7	-13.6
Other transit and ground passenger transportation and scenic and sightseeing transportation	2.4	2.1	2.0	2.3	-0.3	-2.4	37.0
Support activities for transportation	16.2	15.7	18.0	17.6	-0.5	-0.5	54.3
Pipeline transportation	9.2	10.5	10.1	11.7	1.3	2.3	-147.3
Postal service and couriers and messengers	8.4	9.0	9.2	10.1	0.7	1.3	-74.2
Postal service	4.1	4.4	4.4	5.0	0.4	1.4	-38.8
Couriers and messengers	4.3	4.6	4.8	5.1	0.3	1.2	-34.2
Warehousing and storage	3.6	6.0	4.0	6.7	2.4	8.8	-264.3

Source: Statistics Canada, Table: 36-10-04

per cent of the within-sector effect), truck transportation (22.4 per cent of the within-sector effect) and transit transportation (19.1 per cent of the within-sector effect).

In terms of productivity growth in the transportation industry and as demonstrated by Table 15, the observed decrease in productivity growth rate was -2.87 percentage points between 2017 and 2023. Of this decrease in the productivity growth rate, -0.16 percentage points can be explained by the within-sector effects (in this regard the most notable are the contributions of air transportation at -0.85 percentage points, truck transportation at -0.74 percentage points and transit transportation at -0.40 percentage points), -0.55 percentage points can be attributed to the re-allocation level effect (-0.38 percentage points of which solely due to the pipeline transportation industry) and merely -0.09 percentage points is due to the re-allocation growth effect.<sup>11</sup> Table 15 provides the three-digit industry contributions to these effects at the total sector level and to the industry's aggregate contribution (the sum of the three effects).

<sup>11</sup> Interestingly, the re-allocation growth effect's contribution to the declining productivity growth rates is somewhat made smaller due to the increase in the re-allocation growth effect in the transit industry.

The most important development to explain is the -2.44-percentage point contribution to the transportation and warehousing sector's labour productivity growth from the within-sector effect. Three industries account for the large negative contributions. The first is air transportation at -0.85 points. The second is warehousing and storage with a -0.74-percentage points contribution. The third is truck transportation with -0.40 per centage points. On the other hand, the within-sector effect was positive for one industry, namely pipeline transportation (0.50 percentage points).

*Table 15- Relative Change and Growth Rate of Labour Productivity and Share of Hours 3-digits NAICS Transportation and Warehousing Industries, Canada, 2017-2023*

3-Digit Industry	Observed change in productivity growth (1)	Within-sector effect		Re-allocation level effect		Re-allocation growth effect		Total Effect	
		pp. (2)	Contribution (%) (3) = (2) / -2.87	pp. (4)	Contribution (%) (5) = (4) / -2.87	pp. (6)	Contribution (%) (7) = (6) / -2.87	pp. (8)	Contribution (%) (9) = (3) + (5) + (7)
<b>Transportation and warehousing</b>	<b>-2.87</b>	<b>-2.44</b>	<b>84.9</b>	<b>-0.55</b>	<b>19.1</b>	<b>-0.09</b>	<b>3.13</b>	<b>-3.07</b>	<b>107.1</b>
Air transportation	-8.63	-0.85	29.7	0.00	0.0	0.00	0.03	-0.85	29.7
Rail transportation	-2.05	-0.22	7.8	-0.05	1.8	0.00	-0.15	-0.27	9.4
Water transportation	-2.27	-0.04	1.5	0.00	0.0	0.00	0.01	-0.04	1.6
Truck transportation	-3.12	-0.74	25.9	0.00	0.1	0.00	-0.01	-0.74	25.9
Transit, ground passenger and scenic and sightseeing transportation	-3.77	-0.40	13.9	0.14	-4.8	-0.01	0.27	-0.27	9.3
Support activities for transportation	-1.77	-0.33	11.4	-0.02	0.7	-0.01	0.44	-0.36	12.6
Pipeline transportation	4.15	0.50	-17.5	-0.38	13.4	-0.13	4.48	-0.01	0.4
Postal service and couriers and messengers	-2.87	-0.27	9.3	-0.07	2.5	0.01	-0.40	-0.33	11.4
Warehousing and storage	-2.03	-0.08	2.9	-0.16	5.4	0.04	-1.52	-0.20	6.8

Source: CSLS calculations based on Statistics Canada, Table 36-10-0480-01

### Distribution of Productivity Gains in Transportation Industries

As has been seen, the fall in productivity in the transportation and warehousing sector is largely accounted for by three of the transportation sub-industries: air transportation, transit, ground passenger and scenic and sightseeing transportation and trucking. This section of the report examines the distributional implications of the declines in productivity in these industries. It is widely recognized that productivity growth is the determinant of real wage growth. What happened to real wages in these sectors when productivity fell?

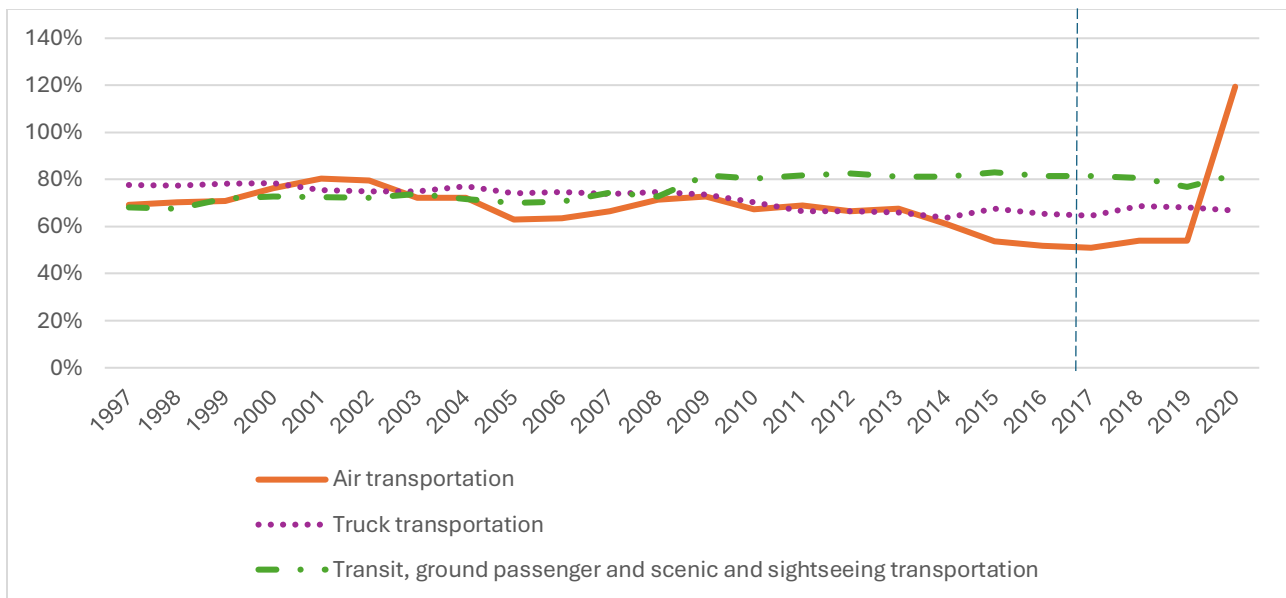
The share of nominal labour compensation in nominal value added or GDP shows what proportion of output goes to labour.<sup>12</sup> This ratio will vary depending on the capital intensity of the industry. Industries which are capital intensive will have a low share of labour compensation in nominal GDP, with the opposite for low capital intensity sectors. For this discussion, we are more interested in changes in the labour compensation share after the 2017 fall in labour productivity.

Chart 16 shows the share of nominal labour compensation in nominal GDP for the nine three-digit transportation industries. Panel A gives the trends for the three industries that experienced the largest falls in productivity while Panel B covers the remaining six industries.<sup>13</sup> Changes in the labour compensation shares reflect the relative growth rates of compensation and GDP. When compensation growth exceeds that of GDP, the share rises, and vice versa.

We are particularly interested in developments since 2017 when transportation productivity fell. The nominal labour compensation share was relatively stable between 2017 and 2020 in all nine transportation industries except air transportation. Here the share jumped massively from 55 per cent in 2019 to 120 per cent in 2020. This was caused by the massive shutdown in air travel in 2020 because of the pandemic. Nominal value added plummeted 80 per cent while labour compensation only fell 40 per cent.

*Chart 16: Labour Compensation Share of Total Nominal Output, 3-digits NAICS Transportation and Warehousing Industries, Canada, 1997-2020*

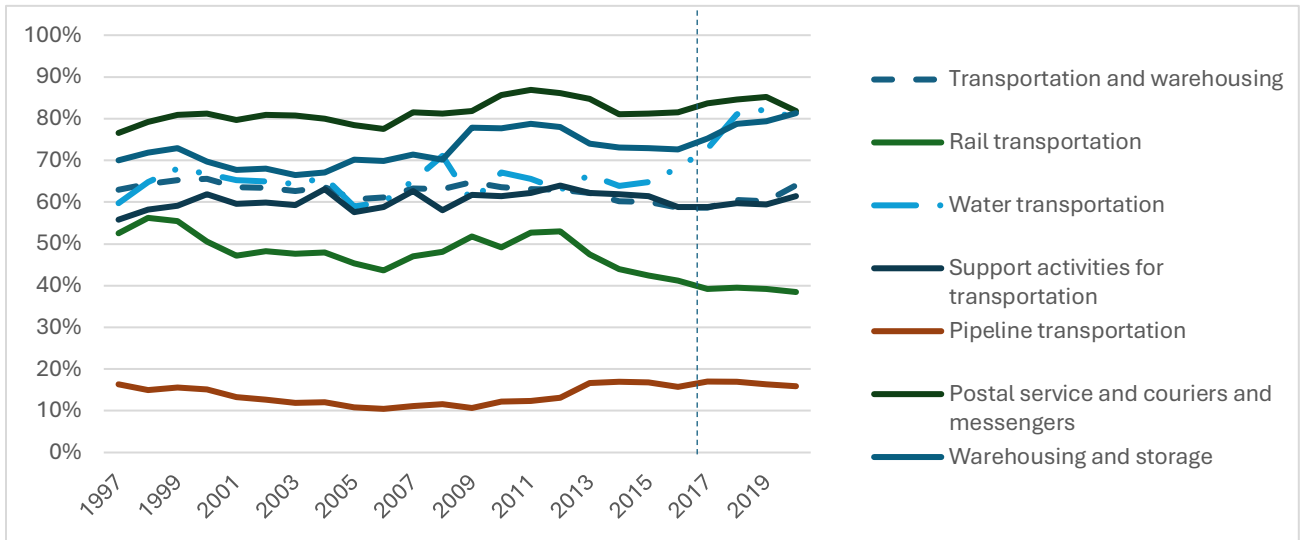
*Panel A: Select 3-digits Industries.*



<sup>12</sup> Naturally, the capital share of output = 1 - labour share of output. One can interpret this relationship as the division of total output between employees (labour) and employers (owners of capital).

<sup>13</sup> Unfortunately, Statistics Canada provides estimates for nominal value added only to 2020.

Panel B: All other 3-digits industries

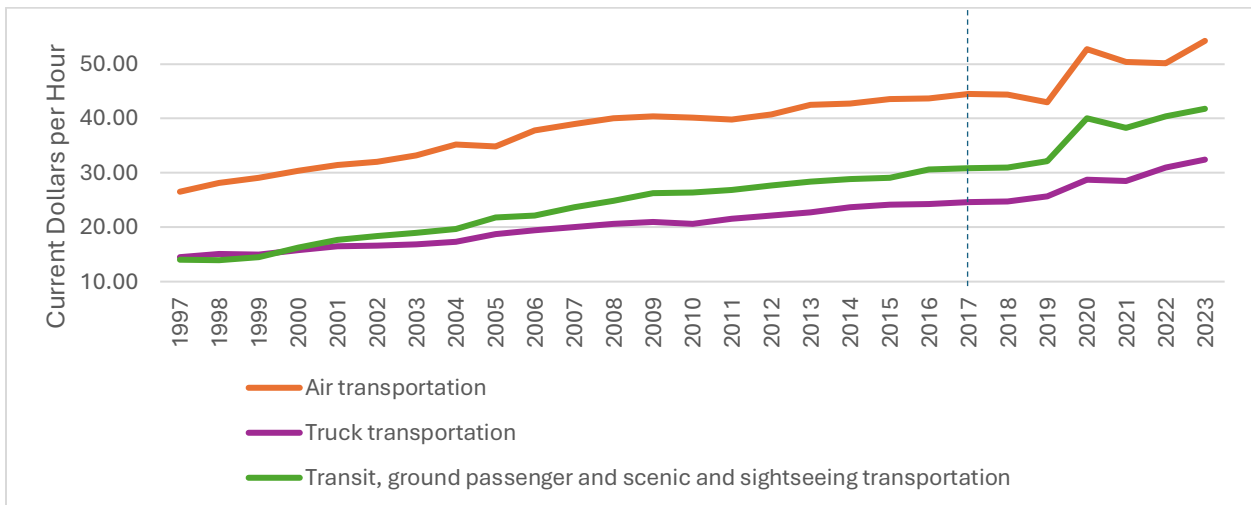


Source: Statistics Canada, Table 36-10-0480-01

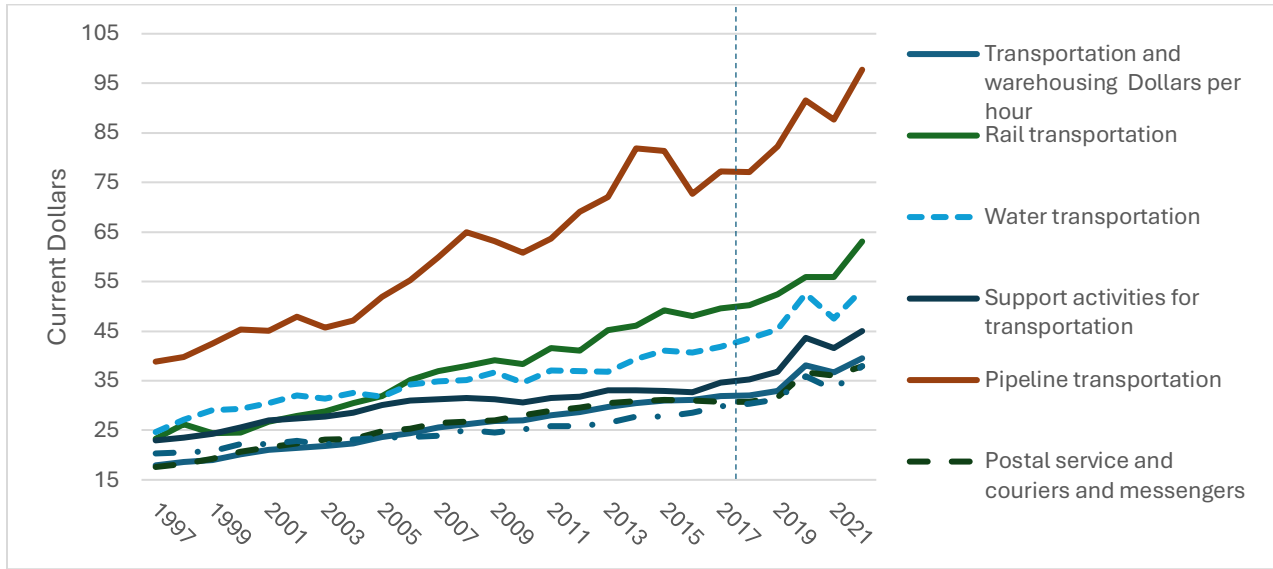
In addition to the labour share of output, a second distributional metric is the relationship between wages and productivity at the industry level. Chart 17 shows the nominal hourly labour compensation, or wages, for the nine three-digit transportation industries. Panel A gives the trends for the three industries that experienced the largest falls in productivity while Panel B covers the remaining six industries. There is wide variation in wages across transportation industries. There have been large increases in nominal wages since 1997, since 2017, and even since 2019 in all transportation industries.

Chart 17: Nominal Labour Compensation per Hour (Nominal Hourly Wage), 3-digits NAICS Transportation and Warehousing Industries, Canada, 1997-2023

Panel A: Select 3-digits Industries



Panel B: All other 3-digits industries

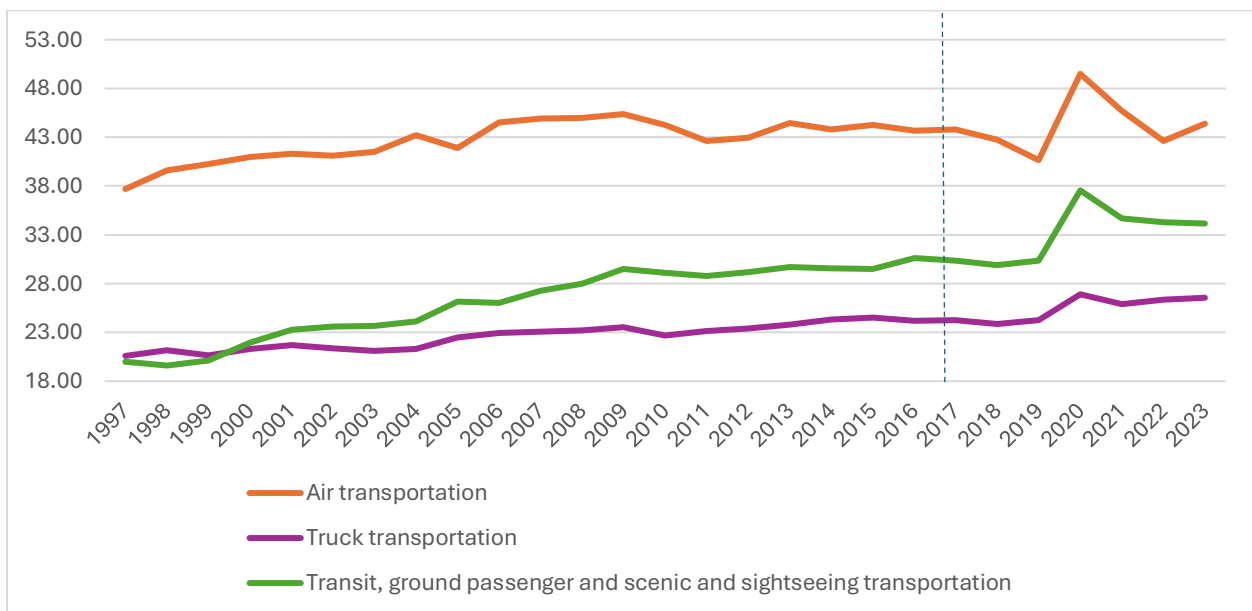


Source: Statistics Canada, Table 36-10-0480-01

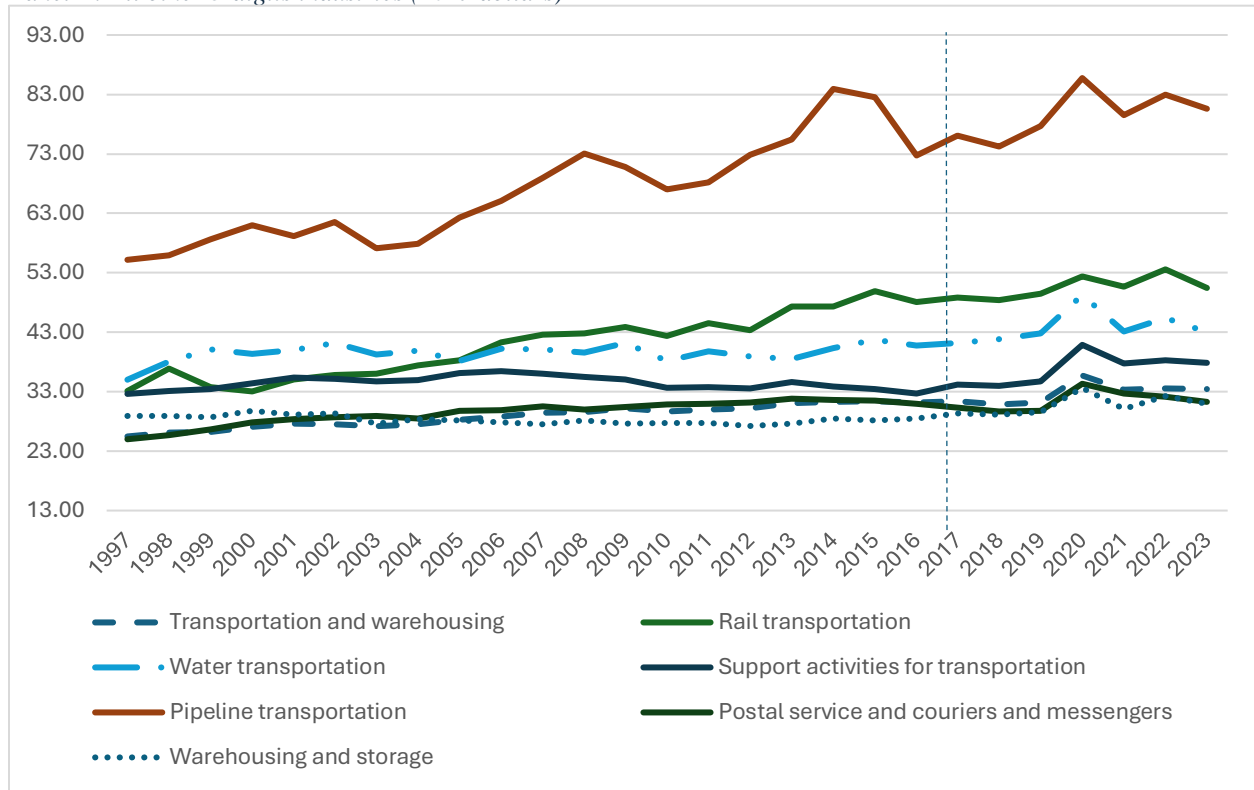
Progress in real wages has of course been much less than in nominal wages because of inflation. Chart 18 shows the real hourly labour compensation, or real wages, adjusting for the CPI, for the nine three-digit transportation industries. Panel A gives the trends for the three industries that experienced the largest falls in productivity while Panel B covers the remaining six industries. Since 2017, real wages are up in nine transportation industries despite the falls in labour productivity in almost all these industries.

Chart 18: Real Labour Compensation per Hour (Real Hourly Wage), 3-digits NAICS Transportation and Warehousing Industries, Canada, 1997-2023

Panel A: Select 3-digits Industries (2017 dollars)



Panel B: All other 3-digits industries (2017 dollars)

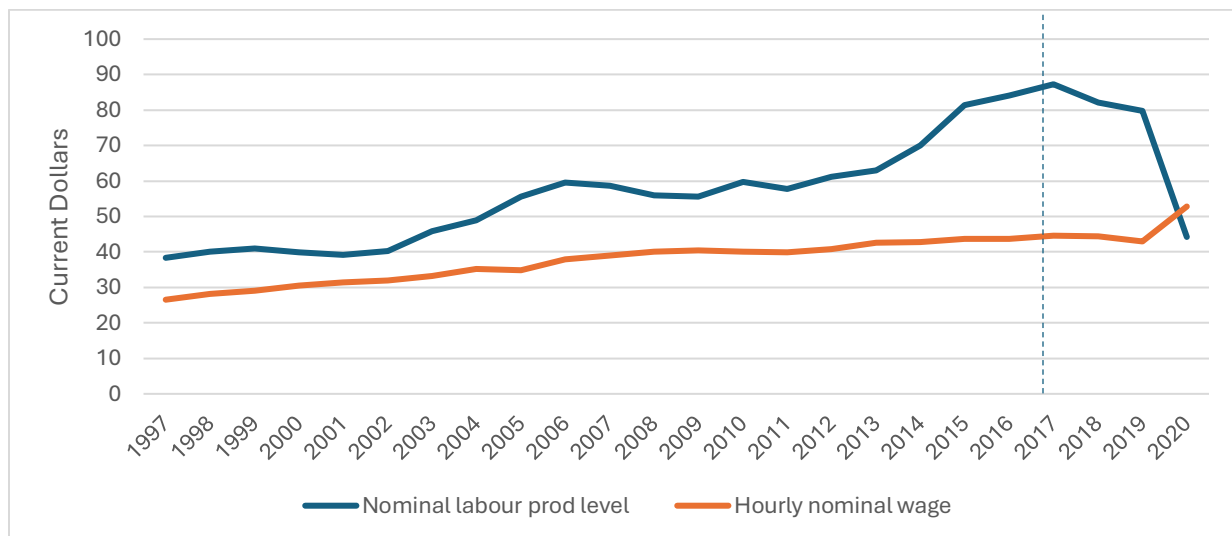


Source: Statistics Canada tables 36-10-0480-01 and 18-10-0005-01

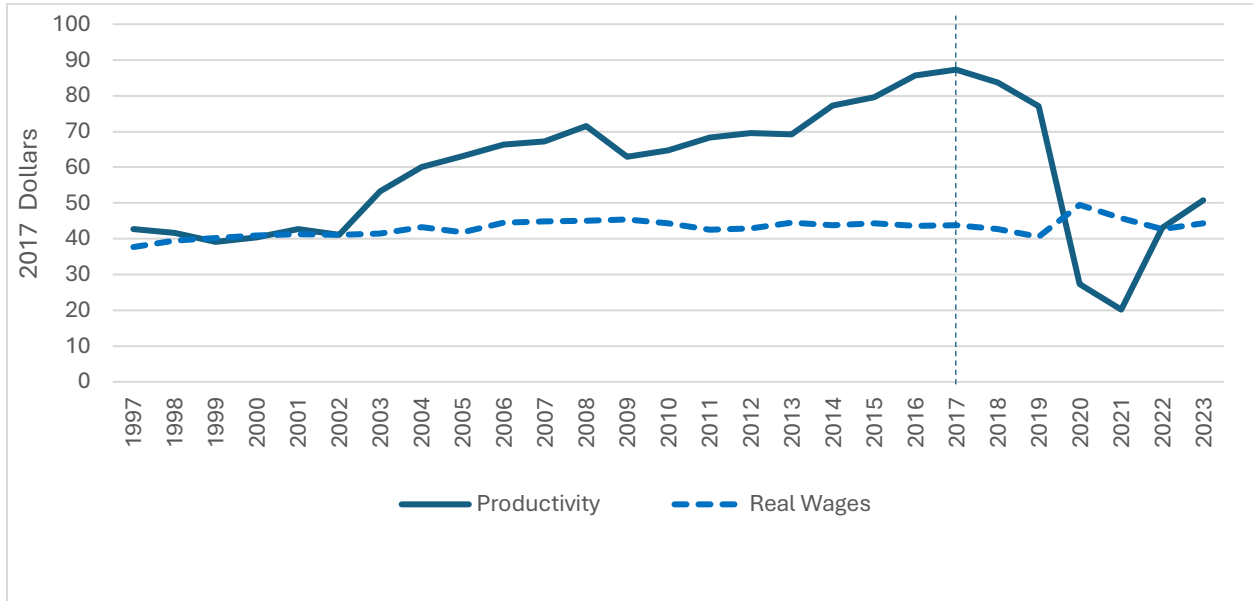
It is illustrative to look at the relationship between wages and productivity in the three industries that experienced the largest falls in productivity. Chart 19 shows trends in the air transportation for nominal value added per hour worked or nominal or money wages and nominal hourly labour compensation (Panel A) and for real output per hour and real hourly labour compensation or real wages (Panel B). Chart 20 does the same for trucking and Chart 21 for transit, ground transportation and scenic and sightseeing transportation.

Chart 19: Labour Productivity Index and Wages Comparison in Air Transportation, Canada

Panel A: Nominal Wages and Nominal Labour Productivity, 1997-2020



Panel B: Real Wages and Productivity, 1997-2023



Source: Statistics Canada tables 36-10-0480-01 and 18-10-0005-01

Chart 20: Labour Productivity Index and Wages Comparison in Truck Transportation, Canada, (Base year = 2017)

Panel A: Nominal Wages, 1997-2020





Panel B: Real Wages (base year = 2017), 1997-2023

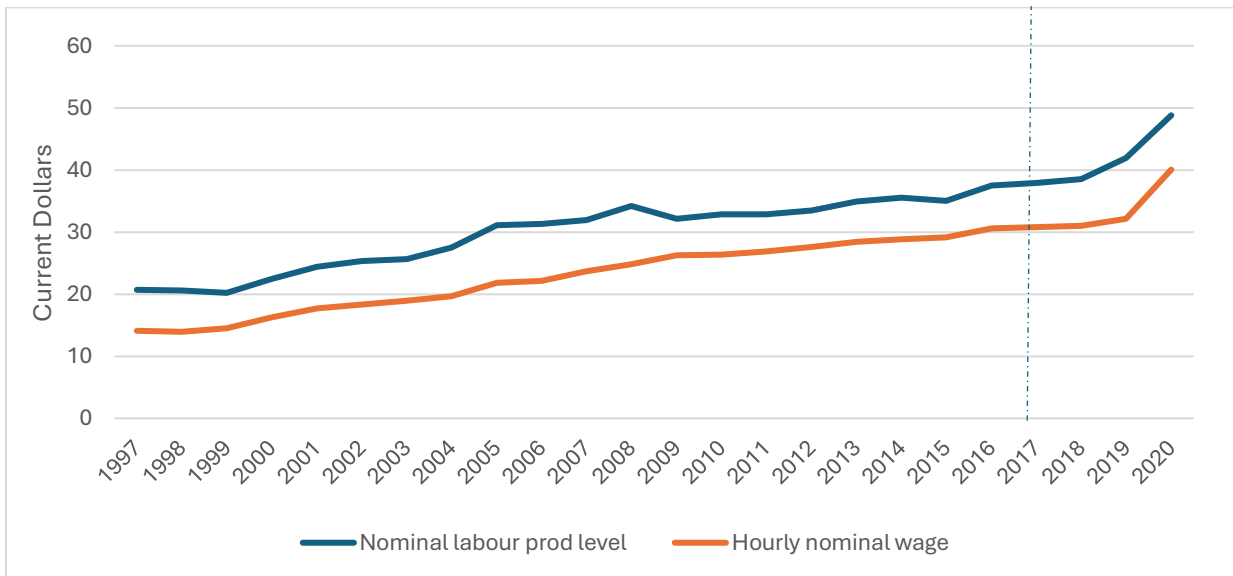


Source: Statistics Canada tables 36-10-0480-01 and 18-10-0005-01

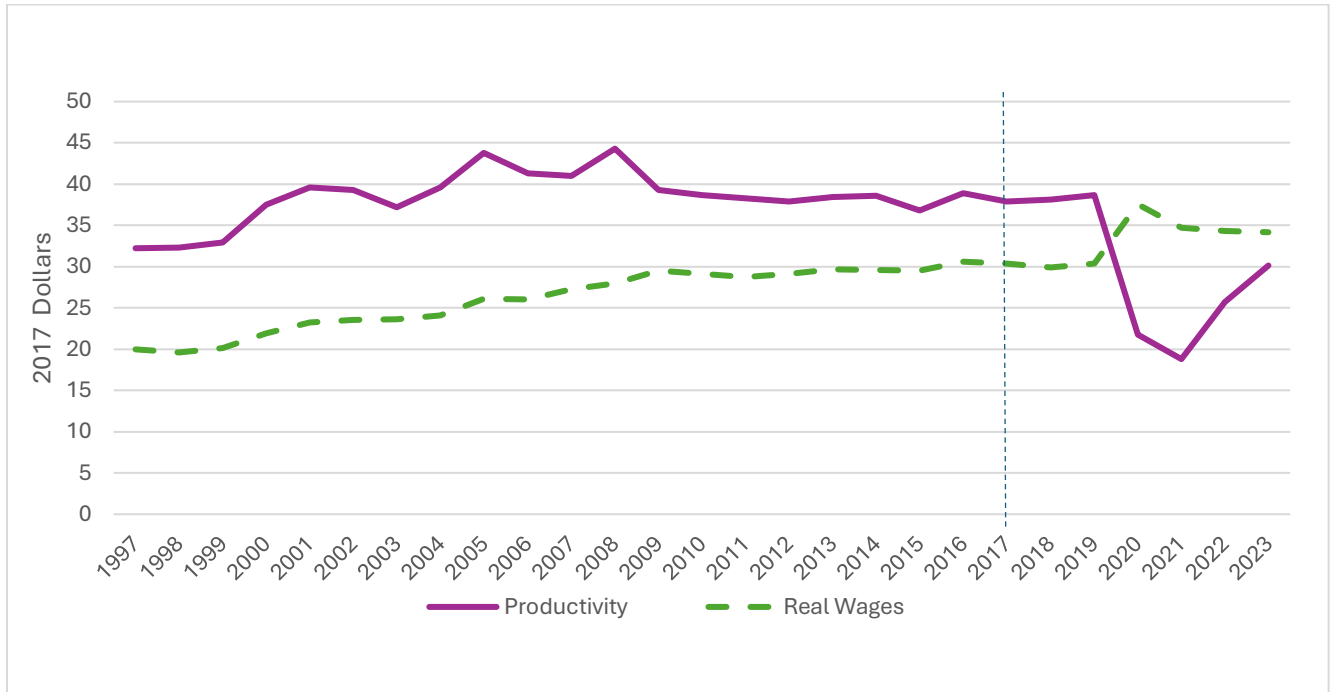
There are large divergences between real wages and productivity growth in all three industries. This does not however mean that workers are not receiving their fair share. Because of wage competition across industries, workers with similar qualifications should receive the same wage.

Chart 21: Labour Productivity Index and Wages Comparison in Public Transit Transportation, Canada, 1997-2022 (Base year = 2017)

Panel A: Nominal Wages



Panel B: Real Wages (base year = 2017)



Source: Statistics Canada tables 36-10-0480-01 and 18-10-0005-01

However, because of differences in the pace of technological advance across industries, some industries can experience much faster productivity growth than others. Because of labour market competition, these industries are only required to pay the market wage. Under competitive conditions, the greater productivity gains in these industries translate into lower input prices, not higher wages for the workers in these industries. It is the aggregate rate of growth of labour productivity that sets the limits for the growth of real wages.

In air transportation, the rate of growth of nominal value added per hour worked or current dollar productivity exceeded that of nominal hour compensation from 1997 to 2019. This is consistent with the fall in the labour share observed in Chart 16. In 2020 nominal value added per hour worked plummeted because of the pandemic, but nominal hourly compensation rose significantly, mostly due to a composition effect of low wage workers being laid off more than high wage workers. The level of output per hour worked in 2017 dollars was the same as real wages from 1997 to 2002. However, from 2002 to 2019 labour productivity in air transportation more than doubled while real wages stagnated. This divergence went to both lower air ticket prices and greater profits. Labour productivity plummeted 44 per cent between 2019 and 2022. At the industry level, large fluctuations in productivity do not translate into comparable fluctuations in real wages. In trucking, productivity growth greatly exceeded real wage from 1997 to 2017, consistent with the falling labour compensation share. Since then, productivity has fallen while real wages have picked up substantially. In transit, ground passenger and scenic and sightseeing transportation, since 2017 real wages have risen while productivity has fallen.

## **Part Three: Explaining the Fall in Transport Sector Productivity in Canada since 2017**

The previous two parts of the report have provided detailed analysis of productivity developments of the two-digit transportation and storage sector and of three-digit transportation industries in Canada since 2017. Output per hour in transportation and storage fell 2.9 per cent per year from 2017 to 2023, the largest fall of any two-digit industry. At the three-digit level, three industries accounted for over three quarters of the fall in productivity, namely air transportation, urban transit systems, and trucking. Explaining the fall in transport sector productivity thus means focusing on what happened to productivity in these three industries.

### **Context**

Canada has experienced weak productivity growth since 2000. Total economy output per hour from 2000 to 2022 rose at only a 0.8 per cent average annual rate, below the OECD average of 1.3 per cent and the United States at 1.3 per cent. Canada ranked 27<sup>th</sup> out of 33 OECD countries in terms of productivity growth (Sargent and Hahn, 2023). The factors that are responsible for this weak aggregate productivity growth affect all industries so it should not be surprising that productivity growth in the Canadian transportation and storage sector has lagged that in other countries. As mentioned earlier, Canada had the worse performance in terms of total factor productivity growth in transportation among G-7 countries from 1995 to 2020.

The factors that have been put forward as the culprits for Canada's abysmal long-term productivity growth are numerous, but no consensus has emerged of which explanations have the most validity. Plausible explanations include lackluster innovation, both creation through R&D of new production processes and products and adoption of best practice technologies; low rate of investment, particularly in machinery and equipment and software; lack of competition in certain sectors due to entry barriers; regulation regimes inimical to productivity growth; inadequate workforce skills and labour shortages; a global slowdown in the underlying pace of technical advance; and finally measurement problems. These factors will be referenced where appropriate in the discussion of the reasons for the fall in productivity in the three key industries.

It is long-run productivity trends that matter for sustainable increases in living standards, so the focus of productivity researchers is generally on the explanation of long-run productivity developments, or at least trends over a complete business cycle. But productivity also exhibits short-to-medium fluctuations determined by the demand-side business cycle conditions and by exogenous supply-side shocks to the economy such as the pandemic. Indeed, the pandemic led to a shutdown in many industries with important consequences for productivity in these industries.

As will be seen, the pandemic and its aftermath had massive negative productivity effects on certain sectors. But the post-2017 fall in productivity in transportation industries started before 2020. Productivity growth in 2018 and 2019 was negative in many industries.

## **Air Transportation**

Chart 22, Panel A shows the evolution index of real output, hours worked, and labour productivity in air transportation from 2017 to 2023. Output was relatively stable from 2017 to 2019, but hours worked surged 19 per cent reducing labour productivity by 12 per cent. A plausible reason behind the surge in hours worked in this industry was the increase in the profitability and productivity gains of airlines between 2000 to 2017. This provided a positive outlook for future growth and prompted airlines to increase their hiring and be less likely to adjust their labour inputs (i.e. laying off staff) even though output gains were very modest. In fact, output plummeted 76 per cent in 2020 as air service largely shut down because of travel restrictions related to the pandemic. Output fell an additional 30 per cent in 2021 before rebounding significantly in 2022 and 2023, but it was still only 65.2 per cent of the 2019 pre-pandemic level. Had hours worked evolved with the same annual changes as real output, productivity would be unchanged. But for many reasons firms do not have the ability to adjust hour worked to changes in demand and output. This results in short-term changes, sometimes very large changes, in productivity. While output fell 83 per cent from 2019 to 2021 hours only declined only fell 37 per cent. This resulted in labour productivity plummeting 74 per cent. The greater rebound in output than hours in 2022 and 2023 boosted productivity 151 per cent from the very low 2021 level, but in 2023 it was still only 66 per cent of the 2019 pre-pandemic level.

From 2000 to 2017 output per hour in air transport in Canada more than doubled, growing 10 per cent per year. This reflected a 107 per cent increase in real output combined with a 3 per cent fall in hours worked. Larger planes, higher load factors, more efficient scheduling, more effective use of staff brought about by new technologies<sup>14</sup>, among other factors, likely contributed to this productivity bonanza.

The post-2017 collapse of labour productivity in air transportation in Canada is unique and largely explained by the pandemic. In the pandemic years of 2020 and 2021, most airlines continued to maintain operations despite very limited traffic and high fixed labour costs. It is not surprising that productivity plummeted. The airlines were only able to continue operations with government subsidies. As real output rebounds and surpasses the pre-pandemic peak, productivity will revive. This happened in 2022 and 2023.

Real output in air transportation in the United States rebounded from the pandemic much faster in than in Canada, by 2022, both output and labour productivity south of the border had surpassed the 2019 levels (Tables 7 and 9). This is mainly driven by the fact that the travel restrictions and lockdowns in Canada lasted longer and were more significant compared to the United States.

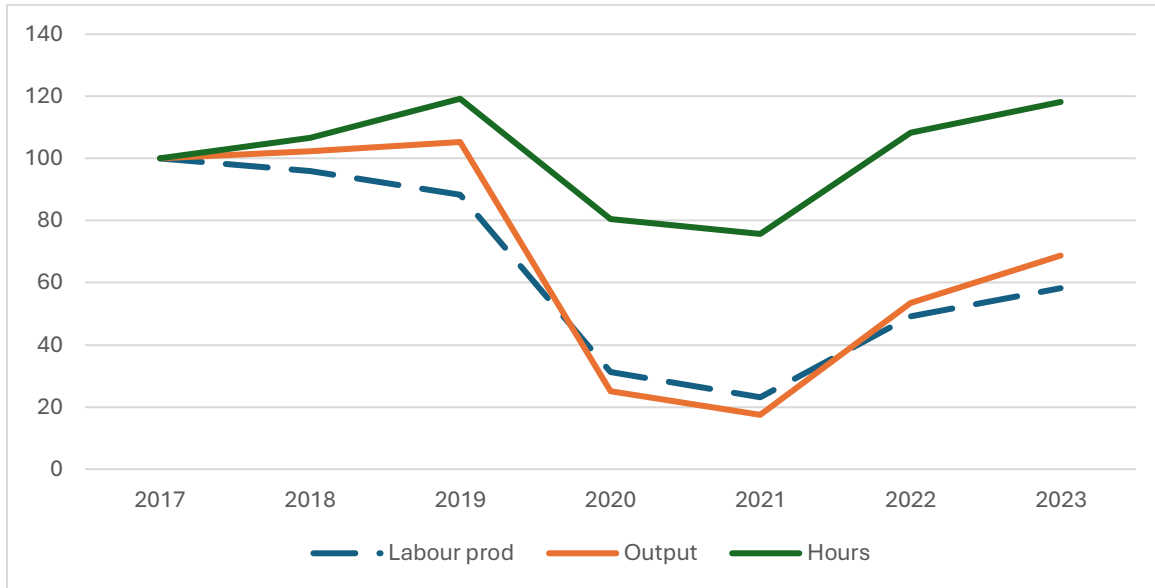
There are also long-term structural factors affecting productivity in air transportation. The 10 per cent annual increase in labour productivity from 2000 to 2017 was not sustainable. This was seen in 2018 and 2019 when productivity fell even though output levels were high because of large increases in employment, it is likely that the high profits led to over-hiring in these years. Going forward, it is unlikely that advances in aviation technology will result in the large productivity gains experienced in air transportation in Canada from 2000 to 2017.

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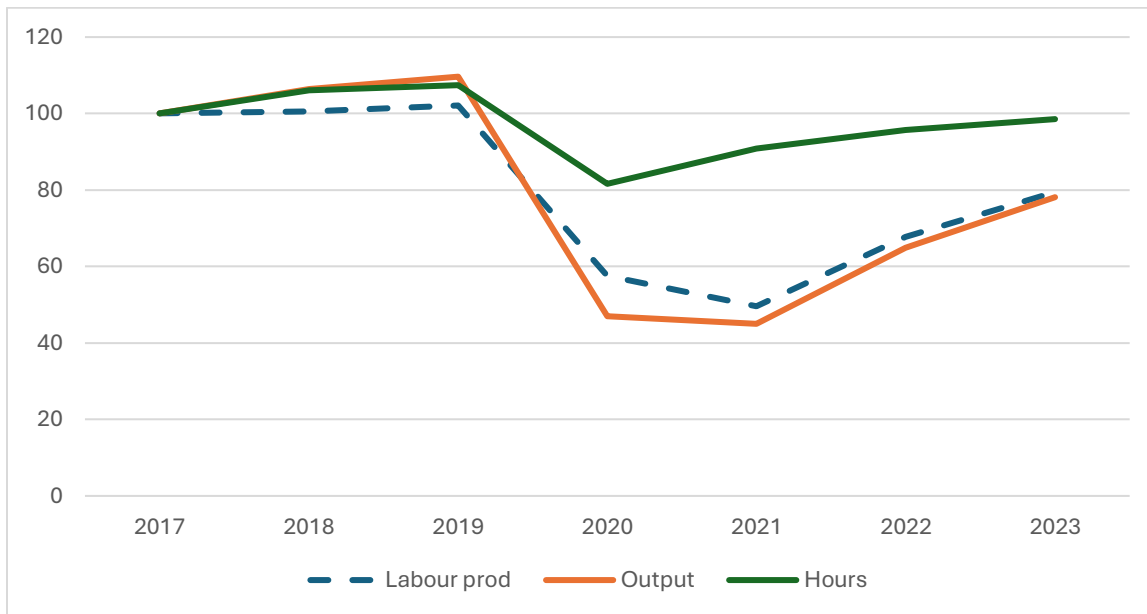
<sup>14</sup> Examples include online check-in systems and Self-Service Check-in kiosks that reduced the labour utilization of airlines.

Chart 22: Changes in Output, Hours and Labour Productivity, Select 3-digit Industries within Transportation and Warehousing, Canada 2017-2022 (index = 2017)

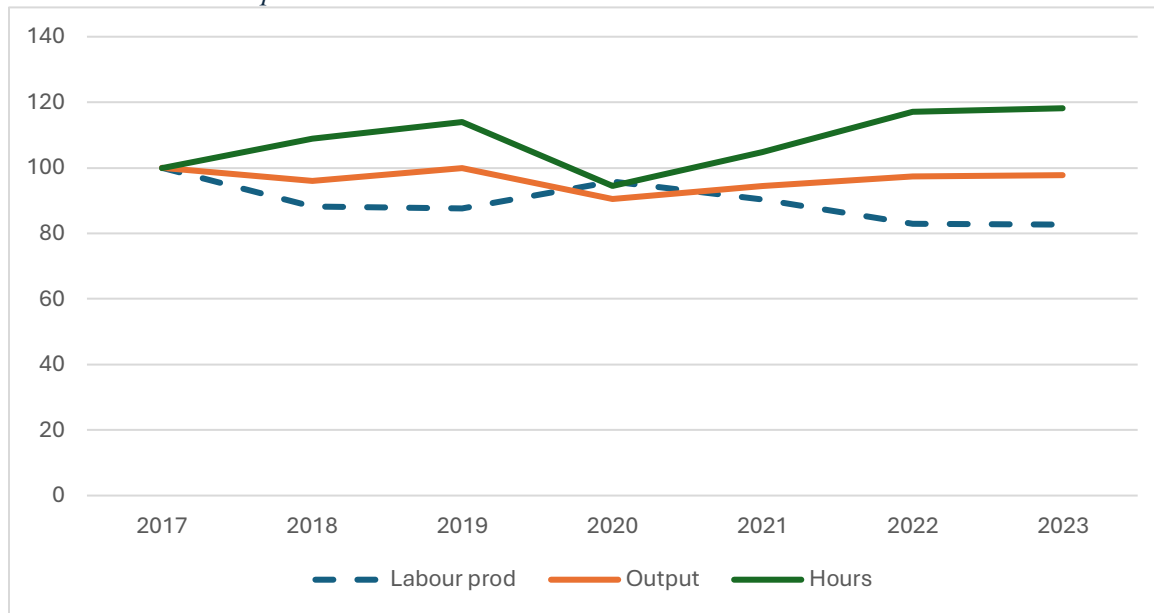
Panel A: Air Transportation



Panel B: Transit Transportation



Panel C: Truck Transportation



Source: Statistics Canada. Table 36-10-0480-01

### **Urban Transit Systems**

Like air transportation, urban transport systems were severely affected by the pandemic. Chart 21, Panel B shows the evolution of indexes of real output, hours worked, and labour productivity in urban transit systems from 2017 to 2023. Output and hour worked progressed at roughly the same rate from 2017 to 2019, so labour productivity was relatively stable. Output plummeted 68 per cent in 2020 as work from home because of the closing of workplaces due to the pandemic meant fewer people were using public transit. Output fell an additional 9 per cent in 2021 but it has experienced significant gains in 2022 and 2023 rebounding 73 per cent from the low in 2021, but it was still only 71 per cent of the 2019 pre-pandemic level.

For many reasons public transit authorities cannot adjust hour worked to changes in falls in demand for transit services. Routes must be maintained even though ridership is down significantly. This results in very large changes in productivity. While output fell 71 per cent from 2019 to 2021, hours only declined 7 per cent. This resulted in labour productivity plummeting 69 per cent. The strong rebound in output in 2022 and 2023 (71 per cent from a low base) raised productivity 59 per cent as the transit system was able to handle the increased number of riders without additional staff. However, in 2023 output per hour in urban transit systems was still only 76 per cent of the 2019 pre-pandemic level.

From 2000 to 2017 output per hour in urban transit systems in Canada fell 37 per cent. This reflected a 44 per cent increase in output combined with an even larger 96 per cent increase in hours worked, more riders used urban transit systems, but many more workers were needed to staff the systems. Unlike air transportation, there was no productivity bonanza in urban transit systems. This indicates that the labour-saving technologies and innovations that boosted the productivity of the air transportation industry were not available to the urban transit system.

The post-2017 collapse of labour productivity in urban transit is explained by the pandemic. Output per hour did not fall between 2017 and 2019. In the pandemic years of 2020 and 2021, urban transit systems continued to maintain operations despite very limited traffic and high fixed labour costs. It is not surprising that productivity plummeted. Transit systems were able to continue full operations with increased government subsidies. As ridership rebounds, productivity will revive. This happened in 2022 and 2023. However, the permanent shift to hybrid models where office workers stay home and work remotely 2 to 3 days per week means that there has been a structural fall in the demand for urban transit services. This makes it unlikely that the number of daily riders will return to pre-pandemic levels. With the fixed costs of the systems, the lower load factors may prevent a return to the pre-pandemic productivity level.

Real output in urban transit systems in the United States rebounded from the pandemic much faster than in Canada. By 2022, both output and labour productivity south of the border had surpassed the 2019 levels (Tables 7 and 9). One can attribute this difference to fewer and shorter pandemic-related travel restrictions in the U.S. compared to Canada and the faster return of the demand for public transportation.

### **Trucking**

Truck transportation was not as affected by the pandemic as air transportation and urban transit systems. Even in a pandemic, the modern economy still needs to transport goods for consumption and production. The fall in output per hour in trucking of 3.1 per cent per year between 2017 and 2023 was much less than in air transportation (8.6 per cent) and urban transit systems (3.8 per cent). However, because trucking employs so many workers, around one third of all workers in the transportation and storage sector, productivity development in this industry has a major effect on the overall evolution of production in the sector. Indeed, around one third of the fall in labour productivity in transportation and storage is accounted for by trucking. Chart 22, Panel C shows the evolution index of real output, hours worked, and labour productivity in trucking from 2017 to 2023.

Trucking enjoyed strong productivity gains from 2000 to 2017 with output per hour up 73 per cent or 4 per cent per year from \$22.0 (2017 dollars) to \$38.1. This reflects real output growth of 71 per cent combined with a 1 per cent fall in hours worked. In other words, the trucking industry was able to transport many more goods without hiring additional workers. An impressive feat made possible by double trailers, more efficient load scheduling through computerization, and better highways.

The productivity level in trucking peaked in 2017, with productivity falling 12 per cent by 2019 based on a 14 per cent increase in hours worked and unchanged output. In 2020 output per hour in trucking actually increased 9 per cent as the fall in hour work of 17 per cent exceeded that of real output (11 per cent). In 2021 and 2022 productivity fell in both years as hour growth exceeded output growth. Output per hour was fairly stable in 2023. The overall fall in productivity in trucking between 2019 and 2023 at 5 per cent was less than the fall of 12 per cent between 2017 and 2019. Clearly, the pandemic cannot account for most of the post-2017 fall in labour productivity in trucking. Border restrictions and labour shortages (Trucking HC Canada, 2021 and PwC, 2022) may also have played a role in reducing productivity growth in trucking. Potential reasons for the long-standing labour shortages in this industry are the low wages and challenging working conditions (e.g. long hours, long time away from family and health risks) in trucking.

A key issue is whether labour productivity in trucking can ever regain its impressive pre-2017 growth rate. The introduction of double trailers (Longer Combination Vehicle or LCVs) boosted productivity substantially in the pre-2017 period (Deveau, 2012). It is unlikely this innovation will be repeated. An additional factor that is having a negative impact on trucking productivity is increased traffic congestion, particularly in major metropolitan centres such as the Greater Toronto Area. With strong population growth in these centres, this congestion may become worse, increasing delivery times and lowering labour productivity.

## **Conclusion**

After enjoying above average productivity growth in the first decade and one half of the 21<sup>st</sup> century, productivity in the transportation and warehouse sector in Canada collapsed after 2017. The objective of this report has been to shed light on this development through a “deep dive” into the statistics on output, labour input and productivity in the nine three-digit transportation industries.

The report has identified air transportation, urban transit systems and trucking as accounting for most of the fall in labour productivity in transportation and warehousing after 2017.

The effects of the pandemic were found to be the primary cause of the fall in productivity growth in air transportation and urban transit systems as the fall in output greatly exceeded the fall in employment and hours worked due to the fixity of capital and the labour needed to operate it.

When demand for air travel returns to the pre-pandemic level in Canada, which will be driven more by personal than business travel, the industry will also regain most if not all of its output and productivity losses, as it has done in the United States. Because of the permanency of the hybrid work where workers are only at the office part of the week, demand for transit services may never regain pre-pandemic levels so it may be difficult for urban transit system to regain the load factors needed for high productivity levels.

The pandemic was not the primary cause of the fall in labour productivity in trucking after 2017 as operations in the industry were much less affected than in air transportation and urban transit. Rather the fall in productivity in trucking appears related to increased traffic congestion in recent years and to the end of the productivity boom arising from the introduction of the double trailers in the first decade and half of this century.

In contrast to Canada, the United States experienced no fall in productivity in either air transportation or urban transit system after 2017. The effect of the pandemic on these two industries appears to have been weaker and the recovery quicker south of the border than in Canada. On the other hand, trucking did experience a fall in productivity, as it did in Canada.

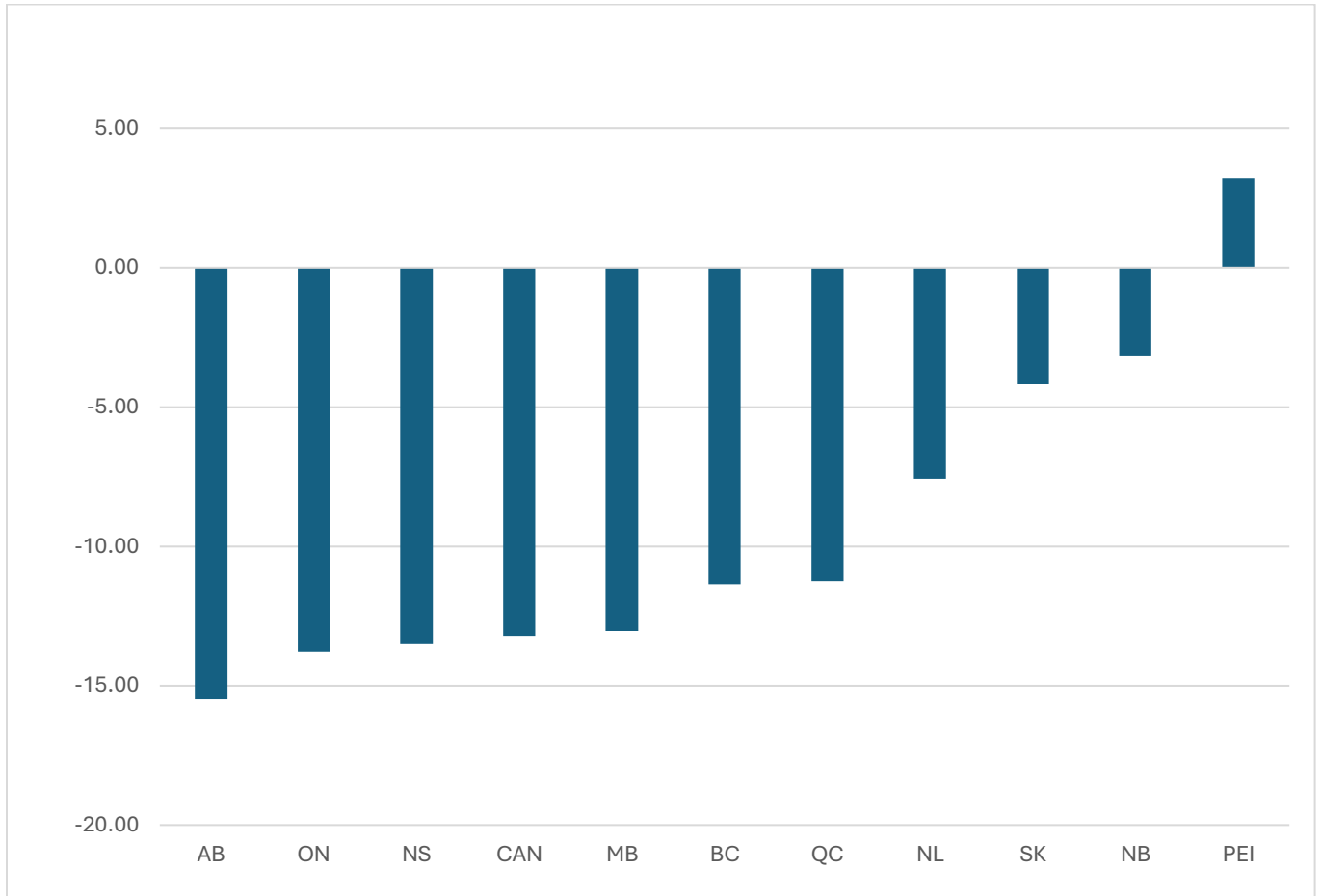


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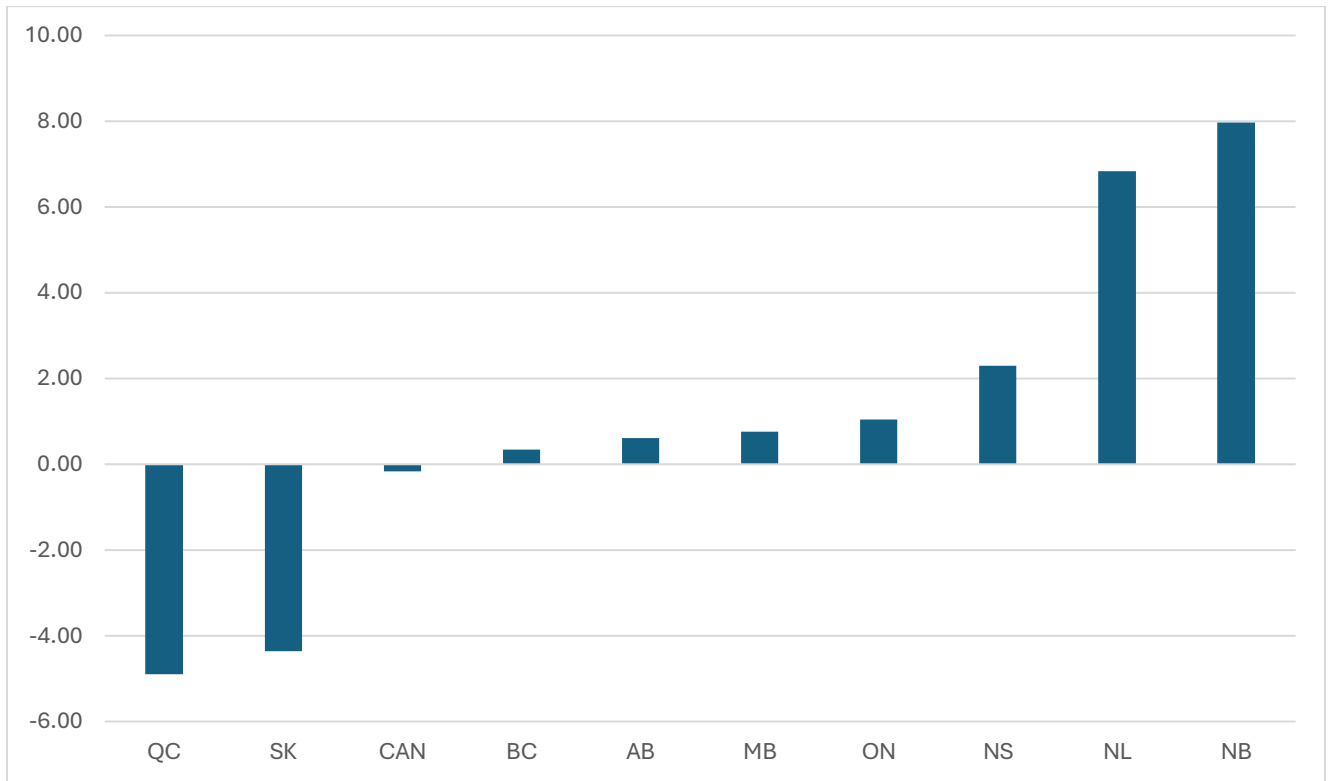
## Appendix

Chart A1- Labour Productivity Growth in Air Transportation Industry by Province, 2017-2022 (average annual compound growth rate in output per hour)



Source: Statistics Canada, Table 36-10-0480-01

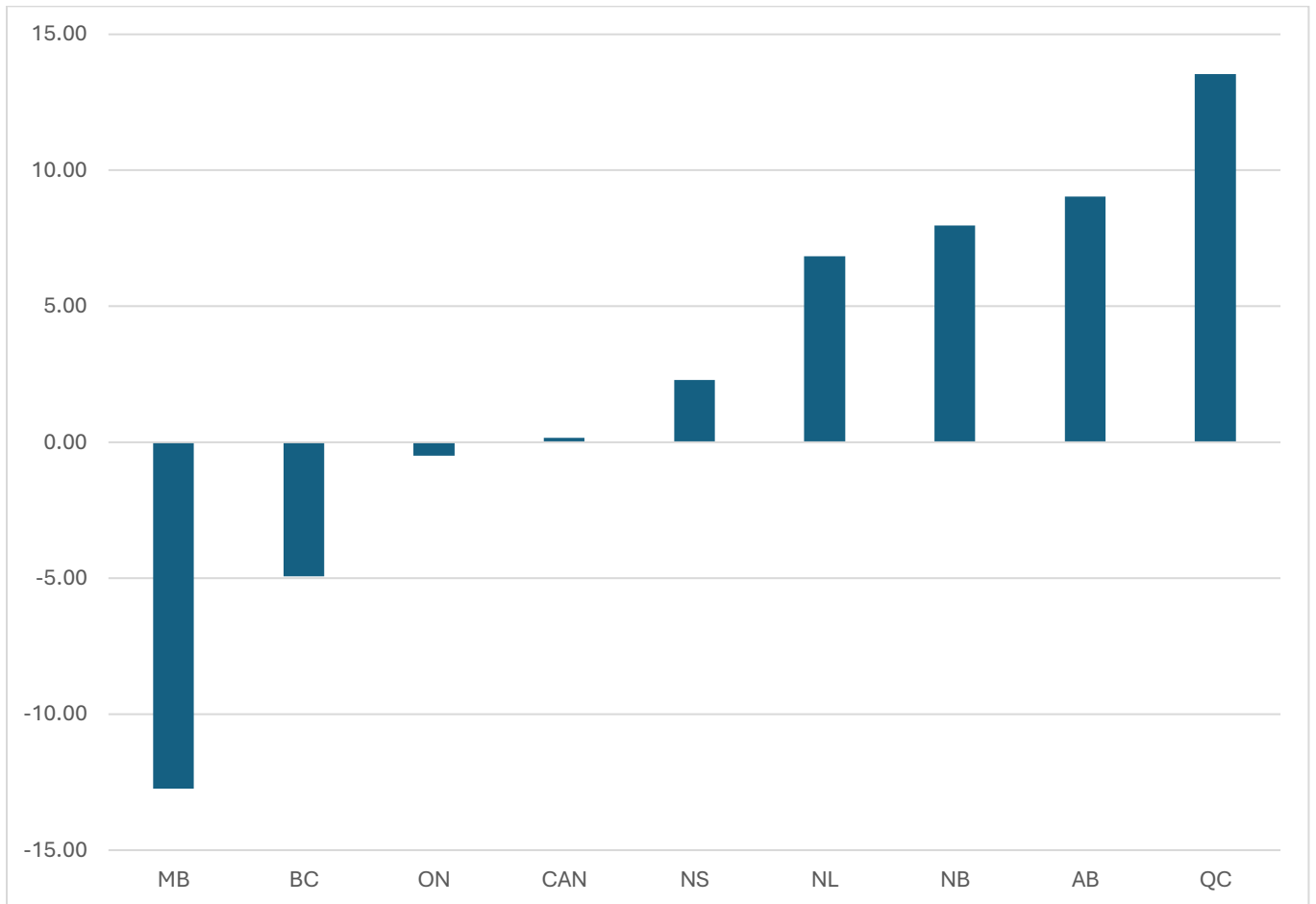
*Chart A2- Labour Productivity Growth in Rail Transportation Industry by Province, 2017-2022 (average annual compound growth rate in output per hour)*



*Note: Data for PEI were not available.*

*Source: Statistics Canada, Table 36-10-0480-01*

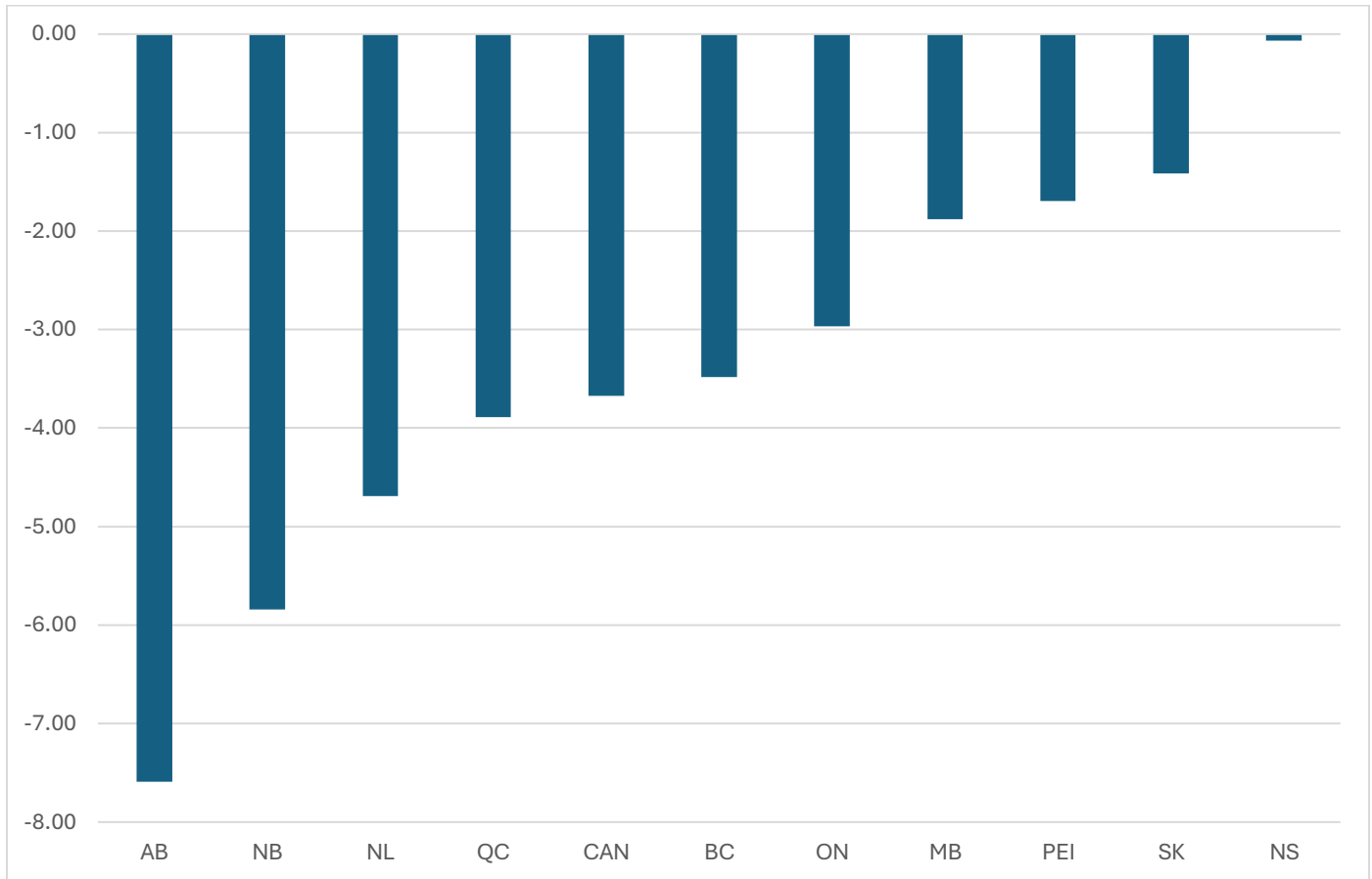
*Chart A3- Labour Productivity Growth in Water Transportation Industry by Province, 2017-2022 (average annual compound growth rate in output per hour)*



*Note: Data for PEI and Saskatchewan were not available.*

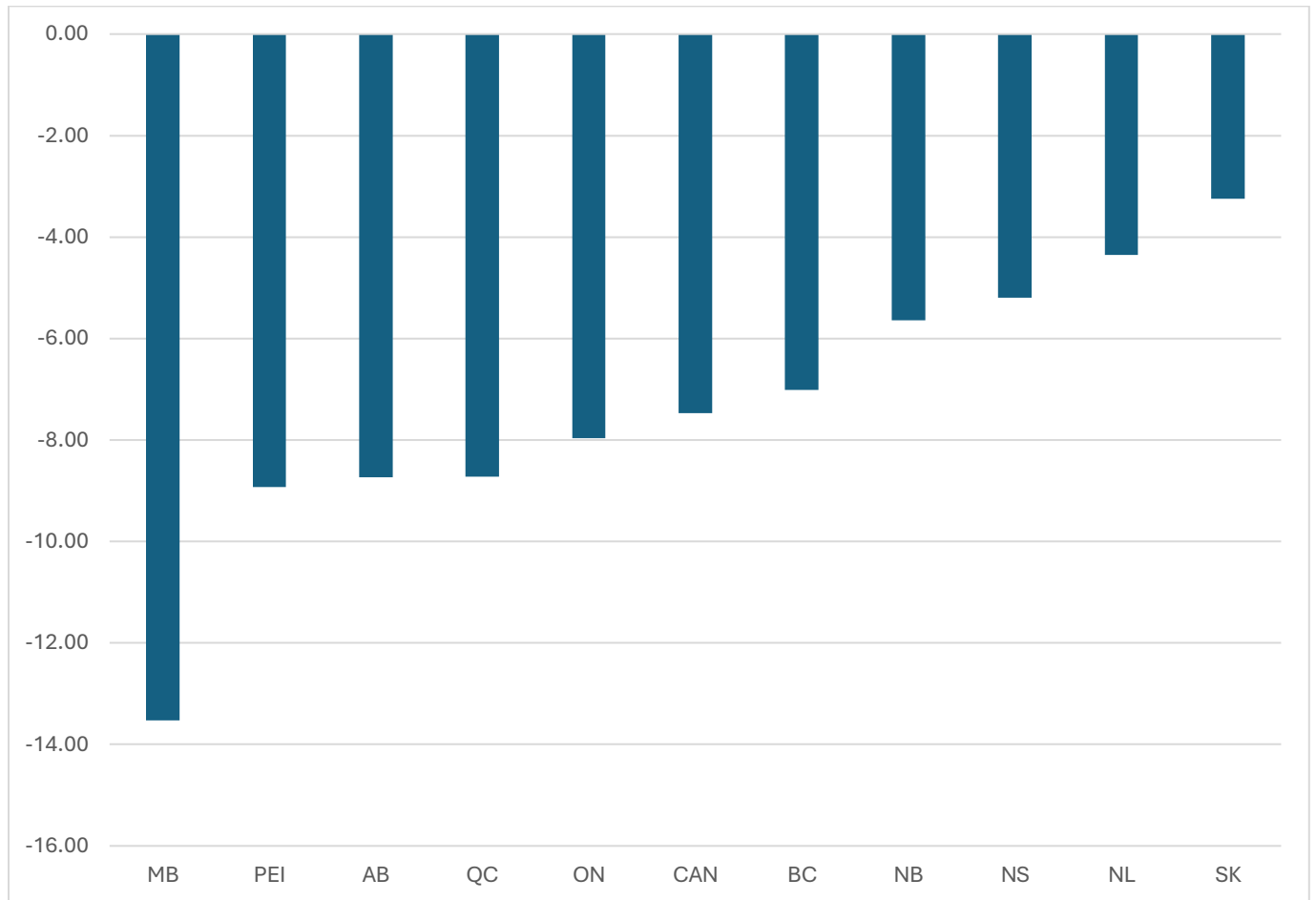
*Source: Statistics Canada, Table 36-10-0480-01*

Chart A4- Labour Productivity Growth in Truck Transportation Industry by Province, 2017-2022 (average annual compound growth rate in output per hour)



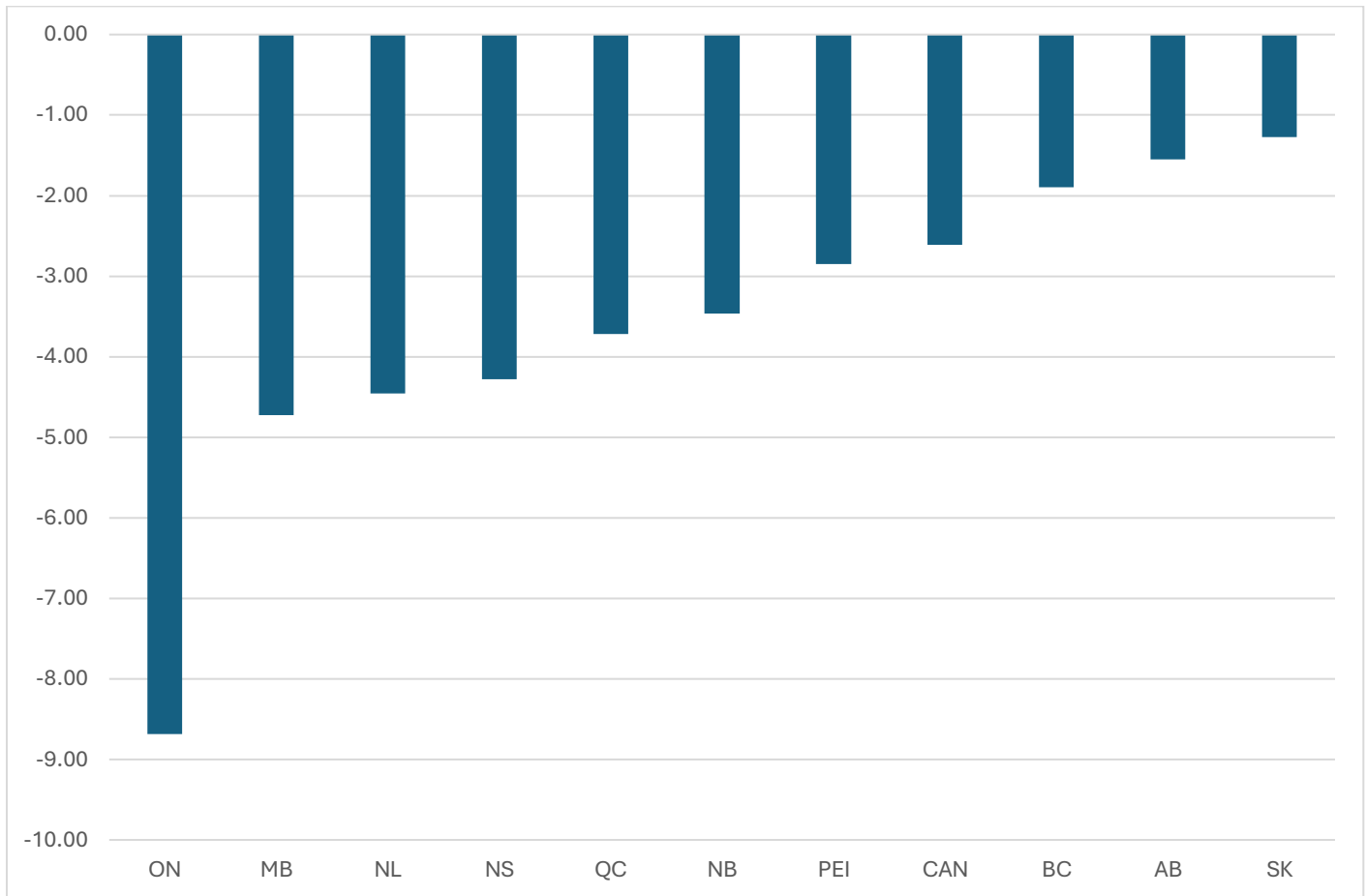
Source: Statistics Canada, Table 36-10-0480-01

*Chart A5- Labour Productivity Growth in Transit, Ground Passenger and Scenic and Sightseeing Transportation Industry by Province, 2017-2022 (average annual compound growth rate in output per hour)*



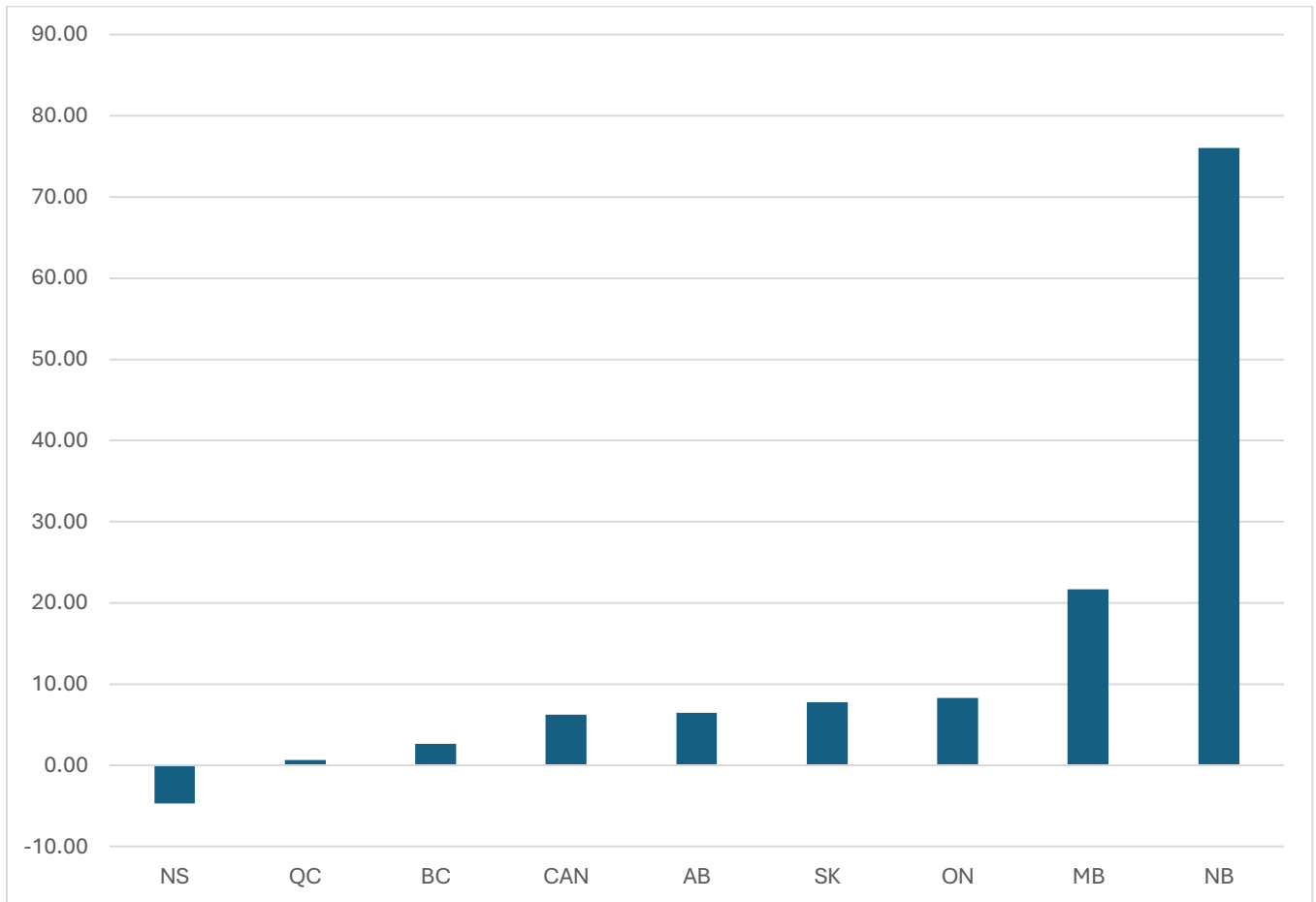
Source: Statistics Canada, Table 36-10-0480-01

*Chart A6- Labour Productivity Growth in Support Activities for Transportation Industry by Province, 2017-2022 (average annual compound growth rate in output per hour)*



Source: Statistics Canada, Table 36-10-0480-01

*Chart A7- Labour Productivity Growth in Pipeline Transportation Industry by Province, 2017-2022 (average annual compound growth rate in output per hour)*

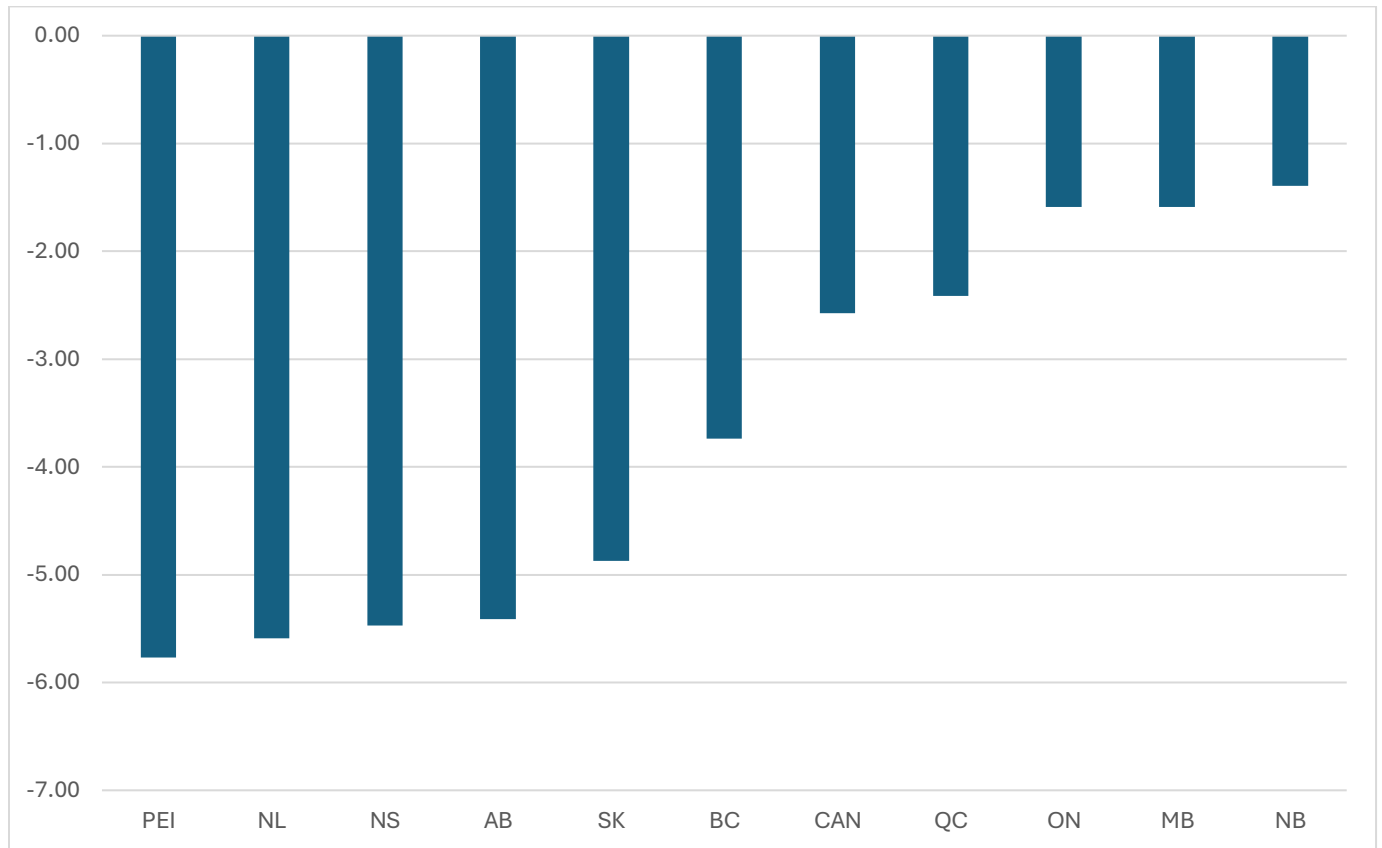


*Note: Data for PEI and New Found land were not available.*

*Source: Statistics Canada, Table 36-10-0480-01*

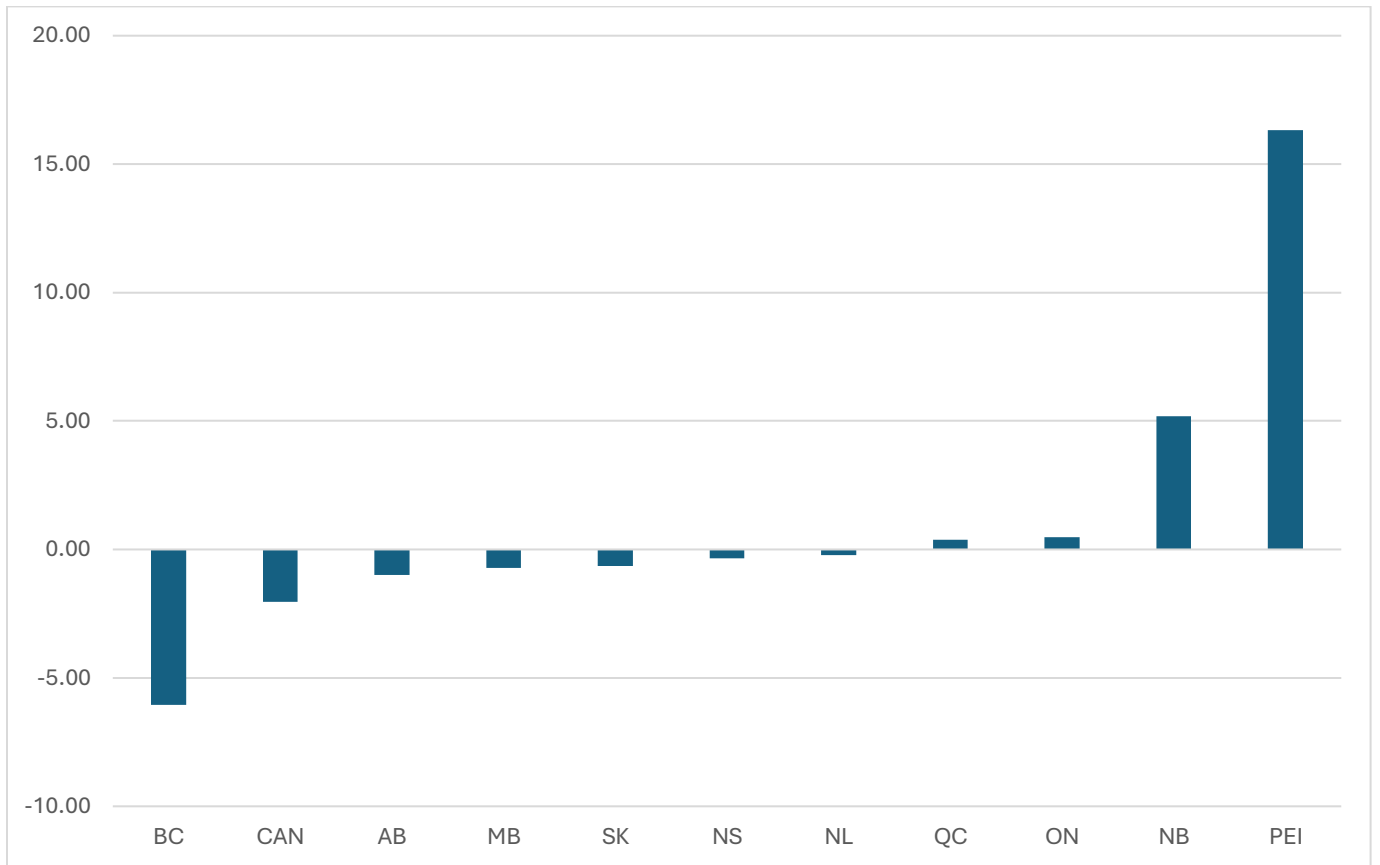


Chart A8- Labour Productivity Growth in Postal Service and Couriers and Messengers Industry by Province, 2017-2022 (average annual compound growth rate in output per hour)



Source: Statistics Canada, Table 36-10-0480-01

*Chart A9- Labour Productivity Growth in Warehousing and Storage Industry by Province, 2017-2022  
(average annual compound growth rate in output per hour)*



Source: Statistics Canada, Table 36-10-0480-01

Table A1: Absolute and Relative Change in Employment, Measured by Total Number of Jobs, 2-digits NAICS Industries, Canada, 2017-2023 (compound growth rate)

2-digit Industry	Employment (thousands)		Share of Employment (%)		Change in Employment (thousands)	Growth rate of Employment (%)	Contribution to Growth (pp.)
	2017	2023	2017	2023			
Business sector	14,505	15,680.1	100	100	1,175	1.3	100.0
Agriculture, forestry, fishing and hunting	376	353.6	2.6	2.3	-23	-1.0	-1.9
Mining and oil and gas extraction	227	261.3	1.6	1.7	35	2.4	3.0
Utilities	105	115.6	0.7	0.7	11	1.7	0.9
Construction	1,427	1741.5	9.8	11.1	315	3.4	26.8
Manufacturing	1,593	1674.2	11.0	10.7	81	0.8	6.9
Wholesale trade	816	872.6	5.6	5.6	56	1.1	4.8
Retail trade	2,125	2159.2	14.7	13.8	34	0.3	2.9
<b>Transportation and warehousing</b>	<b>864</b>	<b>1045.9</b>	<b>6.0</b>	<b>6.7</b>	<b>182</b>	<b>3.2</b>	<b>15.5</b>
Information and cultural industries	353	400.0	2.4	2.6	47	2.1	4.0
Finance and insurance	912	967.0	6.3	6.2	55	1.0	4.7
Real estate, rental and leasing	358	364.1	2.5	2.3	6	0.3	0.5
Professional, scientific and technical services	1,176	1528.0	8.1	9.7	352	4.5	30.0
Administrative and support, waste management and remediation services	954	945.4	6.6	6.0	-8	-0.1	-0.7
Educational services	131	147.0	0.9	0.9	16	1.9	1.3
Health care and social assistance	696	811.5	4.8	5.2	116	2.6	9.8
Arts, entertainment, and recreation	293	307.7	2.0	2.0	15	0.8	1.2
Accommodation and food services	1,332	1275.8	9.2	8.1	-56	-0.7	-4.8
Other private services	673	673.4	4.6	4.3	0	0.0	0.0

Source: Statistics Canada, Table 36-10-0480-01

Table A2- Absolute and Relative Change in Employment, Measured by Total Number of Jobs, 3-digits NAICS Transportation and Warehousing Industries, Canada, 2017-2023 (compound growth rate)

3-digits Industry	Employment (thousands)		Share of Employment (%)		Change in Employment (thousands)	Growth rate of Employment (%)	Contribution to Growth (pp.)
	2017	2023	2017	2023			
<b>Transportation and warehousing</b>	<b>863.7</b>	<b>1045.9</b>	<b>100</b>	<b>100</b>	<b>182.3</b>	<b>3.2</b>	<b>100.0</b>
Air transportation	73.4	83.2	8.5	8.0	9.8	2.1	5.4
Rail transportation	37.1	40.4	4.3	3.9	3.3	1.4	1.8
Water transportation	15.3	17.0	1.8	1.6	1.7	1.8	0.9
Truck transportation	259.3	315.6	30.0	30.2	56.4	3.3	30.9
Transit and ground passenger transportation	139.8	146.9	16.2	14.0	7.0	0.8	3.9
Support activities for transportation	145.4	158.5	16.8	15.2	13.1	1.4	7.2
Pipeline Transportation	10.5	9.4	1.2	0.9	-1.1	-1.8	-0.6
Postal service and couriers and messengers	132.3	180.8	15.3	17.3	48.5	5.3	26.6
Warehousing and storage	50.5	94.1	5.9	9.0	43.5	10.9	23.9

Source: Statistics Canada, Table: 36-10-0480-01

Table A3- Average Hours of Work, 3-digit industries within Transportation and Warehousing Sector, Canada, 2017-2023

3-digits Industry	Average Hours of Work		Relative Hours (%)		Change in Average Hours of Work	Growth rate of the Average Hours of Work (%)
	2017	2023	2017	2023		
<b>Transportation and warehousing</b>	<b>1,926</b>	<b>1,878</b>	<b>100.0</b>	<b>100.0</b>	<b>-48</b>	<b>-0.4</b>
Air transportation	1,604	1,673	83.3	89.1	69	0.7
Rail transportation	2,045	2,111	106.2	112.4	66	0.5
Water transportation	1,972	2,051	102.4	109.2	79	0.7
Truck transportation	2,189	2,125	113.7	113.2	-64	-0.5
Transit, ground passenger and scenic and sightseeing transportation	1,846	1,731	95.8	92.2	-115	-1.1
Urban transit systems	1,844	1,859	95.7	99.0	15	0.1
Taxi and limousine service	2,106	1,824	109.3	97.1	-282	-2.4
Other transit and ground passenger transportation and scenic and sightseeing transportation	1,558	1,447	80.9	77.1	-111	-1.2
Support activities for transportation	1,895	1,878	98.4	100.0	-17	-0.2
Pipeline transportation	1,921	1,922	99.7	102.3	1	0.0
Postal service and couriers and messengers	1,716	1,617	89.1	86.1	-99	-1.0
Postal service	1,633	1,586	84.8	84.5	-47	-0.5
Couriers and messengers	1,789	1,638	92.9	87.2	-151	-1.5
Warehousing and storage	1,808	1,820	93.9	96.9	12	0.1

Source: Statistics Canada, Table 36-10-0480-01

Table A4- Absolute and Relative Change in Labour Productivity (Real output over Employment), 3-digits NAICS Transportation and Warehousing Industries, Canada, 2017-2023 (compound growth rate)

<b>2-Digit Industries</b>	<b>Business sector productivity level change (\$/Hours)</b>	<b>Within-sector effect (levels) (\$/Hours)</b>	<b>Re-allocation level effect (on Prod. levels) (\$/Hours)</b>	<b>Re-allocation growth effect (on Prod. levels) (\$/Hours)</b>
Business sector industries	0.60	0.02	0.79	-0.10
Agriculture, forestry, fishing and hunting	5.50	0.16	0.03	-0.02
Mining and oil and gas extraction	-11.90	-0.24	0.17	-0.01
Utilities	-13.20	-0.10	0.02	0.00
Construction	-5.80	-0.65	-0.06	-0.10
Manufacturing	-0.90	-0.11	-0.04	0.01
Wholesale trade	4.20	0.26	-0.01	0.00
Retail trade	3.90	0.50	0.25	-0.03
<b>Transportation and warehousing</b>	<b>-8.70</b>	<b>-0.58</b>	<b>-0.03</b>	<b>-0.06</b>
Information and cultural industries	5.50	0.14	0.05	0.01
Finance and insurance	7.50	0.48	-0.02	-0.01
Real estate, rental and leasing	7.40	0.18	-0.13	-0.01
Professional, scientific and technical services	0.90	0.07	-0.02	0.01
Holding companies	-30.60	-0.21	0.03	0.14
Administrative and support, waste management and remediation services	-0.80	-0.05	0.08	0.01
Educational services	7.80	0.05	-0.01	0.00
Health care and social assistance	-2.20	-0.10	-0.03	-0.01
Arts, entertainment and recreation	1.50	0.02	0.02	0.00
Accommodation and food services	1.00	0.08	0.36	0.00
Other private services	2.50	0.11	0.12	-0.01

Source: Statistics Canada, Table 36-10-0480-01

Table A5- Absolute and Relative Change in Labour Productivity (Real output over Employment), 3-digits NAICS Transportation and Warehousing Industries, Canada, 2017-2023 (compound growth rate)

3-Digit Industries	Prod. Level Change (\$/hour) (1)	Within-sector effect		Re-allocation level effect		Re-allocation growth effect	
		Effect on Prod levels (\$/Hour) (2)	Per cent Contribution (3) = (2)/-9.9	Effect on Prod levels (\$/Hour) (4)	Per cent Contribution (5) = (4)/-9.9	Effect on Prod levels (\$/Hour) (7)	Per cent Contribution (8) = (7)/-9.9
<b>Transportation and warehousing</b>	<b>-8.70</b>	<b>-7.39</b>	<b>84.9</b>	<b>-1.66</b>	<b>19.1</b>	<b>-0.27</b>	<b>3.13</b>
Air transportation	-36.50	-2.58	29.7	0.00	0.0	0.00	0.03
Rail transportation	-14.80	-0.68	7.8	-0.16	1.8	0.01	-0.15
Water transportation	-7.40	-0.13	1.5	0.00	0.0	0.00	0.01
Truck transportation	-6.60	-2.25	25.9	-0.01	0.1	0.00	-0.01
Transit, ground passenger	-7.80	-1.21	13.9	0.42	-4.8	-0.02	0.27
Support activities for transportation	-6.00	-0.99	11.4	-0.06	0.7	-0.04	0.44
Pipeline transportation	125.30	1.52	-17.5	-1.16	13.4	-0.39	4.48
Postal service and couriers and messengers	-5.90	-0.80	9.3	-0.22	2.5	0.03	-0.40
Warehousing and storage	-4.60	-0.25	2.9	-0.47	5.4	0.13	-1.52

Source: Statistics Canada, Table 36-10-0480-01

Table A6- Absolute and Relative Change in Labour Productivity (Real output over Employment), 3-digits NAICS Transportation and Warehousing Industries, Canada, 2017-2023 (compound growth rate)

3-digits Industry	Labour prod. (thousand dollars per worker)		Relative Prod. (%)		Change in prod. (thousand dollars per worker)	Growth rate of prod. (%)	Contribution to Growth (p.p)	Contribution to Growth (%)
	2017	2023	2017	2023				
<b>Transportation and warehousing</b>	<b>104.7</b>	<b>83.8</b>	<b>100</b>	<b>100</b>	<b>-20.9</b>	<b>-4.36</b>	<b>-4.36</b>	<b>100.0</b>
Air transportation	140.2	74.3	134.0	88.7	-65.9	-11.93	-0.82	18.9
Rail transportation	258.7	256.9	247.2	306.6	-1.9	-0.14	-0.01	0.1
Water transportation	111.0	111.0	106.0	132.5	0.0	-0.01	0.00	0.0
Truck transportation	83.3	68.2	79.6	81.5	-15.1	-3.92	-1.35	31.0
Transit, ground passenger and scenic and sightseeing transportation	70.1	45.6	67.0	54.4	-24.5	-8.25	-1.17	27.0
Urban transit systems	98.6	104.6	94.2	124.9	6.0	1.19	0.08	-1.8
Taxi and limousine service	29.6	35.4	28.3	42.2	5.8	3.64	0.16	-3.7
Other transit and ground passenger transportation and scenic and sightseeing transportation	65.9	69.8	63.0	83.3	3.9	1.14	0.04	-0.8
Support activities for transportation	111.4	97.5	106.4	116.4	-13.9	-2.63	-0.42	9.6
Pipeline transportation	876.2	1156.8	837.1	1381.0	280.7	5.71	0.06	-1.4
Postal service and couriers and messengers	63.5	51.6	60.7	61.6	-11.9	-4.06	-0.58	13.3
Postal service	65.8	62.9	62.8	75.1	-2.9	-0.89	-0.05	1.2
Couriers and messengers	61.5	44.1	58.7	52.6	-17.4	-6.44	-0.54	12.4
Warehousing and storage	71.2	63.7	68.1	76.0	-7.6	-2.22	-0.16	3.6

Source: Statistics Canada, Table 36-10-0480-01