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Understanding Developments in Individuals' Earnings Dispersion in Canada Using Matched Employer-Employee Data

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Abstract

This paper presents developments in the dispersion of individuals' earnings in Canada and examines the potential of firm characteristics to account for this dispersion and changes in this dispersion. This paper uses the Canadian Employer–Employee Dynamics Database from 2001 to 2013 and shows that the overall earnings dispersion declined slightly over this time period, as the increasing dispersion in the top half of the distribution was offset by convergence in the bottom half. The increasing dispersion in the top half of the distribution is mostly attributable to the earnings of individuals in firms with 500 or more employees, while the decreasing dispersion in the bottom half occurred for workers in firms of all sizes. Evidence suggests that the rise in the minimum wage played a role in the decline in dispersion. Lastly, while both changes in earnings between industries and changes in the dispersion of productivity have an impact on the dispersion of individuals' earnings, it has been found that the earnings dispersion within firms accounts for most of the dispersion in any given year and for all of the change across time.

Keywords: earnings, productivity, dispersion, inequality, matched employer–employee data

Executive summary

The dispersion of earnings among workers may come from multiple sources. It may reflect differences in workers' characteristics, such as education and experience. It may also be because workers are employed at different firms that pay differently. Recent studies from other countries have found that firms play an important role in explaining earnings disparities among workers, often through the link between productivity and pay. However, there has been no Canadian evidence on the link between the earnings dispersion and firm differences because of a lack of matched employer–employee data.

This paper presents developments in the dispersion of individuals' earnings in Canada and examines the potential of firm characteristics to account for this dispersion and changes in this dispersion in the post-2000 period using the Canadian Employer–Employee Dynamics Database. The main findings can be summarized as follows.

First, consistent with other previous Canadian studies, this paper finds that the overall earnings dispersion in Canada has slightly declined over the 2001-to-2013 period. This was primarily because the earnings gain at the bottom of the earnings distribution outpaced the gain at the top. Specifically, while the upper half of the distribution (between the 90th and 50th percentiles) became more divergent throughout this period, the distribution in the bottom half (between the 50th and 10th percentiles) converged considerably faster. This decline in dispersion in the bottom half of the distribution was attributable to workers in firms of all sizes, while the increase in dispersion in the top half was mostly attributable to workers in large firms.

Second, the overall earnings dispersion declined within the provinces and territories, except for those most reliant on natural resources (i.e., Newfoundland and Labrador, Saskatchewan, Alberta, and British Columbia). Almost all provinces and territories experienced a decline in dispersion in the bottom half of the earnings distribution. All industrial sectors experienced decreases in the overall earnings dispersion and in the dispersion at the lower end of the distribution between 2001 and 2013. All sectors except utilities experienced an increase in the dispersion at the upper end.

Third, the evolving trends of the earnings distribution are quite different between male and female workers. Male workers experienced a large increase in the dispersion at the upper end of the distribution and a large decrease at the lower end, while female workers experienced a slight increase at the upper end and a slight decrease at the lower end. This is because male workers experienced a more pronounced polarization in earnings—both earnings at the top and the bottom of the distribution increased much faster than the median. For both men and women, evidence suggests that the increase in the minimum wage played a role in the decline of the dispersion in the bottom half of the distribution.

Fourth, decomposing the variance of earnings into within-firm and between-firm components shows that earnings differences within firms accounted for more than 60% of the overall dispersion in Canada, and that the decline in the within-firm dispersion accounted for the decline in the overall dispersion.

Firm characteristics have an impact on the earnings dispersion. Changes in the between-firm component of the earnings dispersion are the result of changes in between-firm earnings across industries, rather than within industries. The dispersion in firm productivity is positively related to the between-firm earnings dispersion at both the industry and firm levels. Moreover, larger or more productive firms experienced larger within-firm earnings dispersions.

1 Introduction

Inequality, no matter how it is measured, has generally increased since the late 1970s in Canada and in many other countries (see, for example, Katz and Murphy 1992; Katz and Autor 1999; Fortin et al. 2012; Heisz 2015; Card, Heining and Kline 2013; Song et al. 2019; Barth et al. 2016). Most previous studies have attributed this increase in inequality to (a) higher demand for skilled workers performing "abstract tasks" (requiring cognitive and interpersonal skills) induced by skill-biased technological change, which increases returns for more skilled workers (Autor, Levy and Murnane 2003; Autor, Katz and Kearney 2008; Autor and Acemoglu 2011); (b) a shortfall of investments in human capital and a failure to supply a sufficient number of high-skilled workers in response to skill-biased technological change (Murphy and Topel 2016); and (c) globalization and outsourcing that depress wages for middle- and low-skilled workers resulting from more competition with low-skilled, low-paid workers from developing countries (Autor, Dorn and Hanson 2013).

Recently, a new set of studies has attempted to assess the role of firms in explaining inequality.[1] To that end, many studies have decomposed overall inequality into within-firm and between-firm components. Most of these studies used administrative data that link employers and workers and found that the increase in income disparity between firms has contributed significantly to the rise in overall inequality. For example, Song et al. (2019) looked at U.S. Social Security data and found that rising disparity in between-firm earnings accounted for more than two-thirds of the increase in the overall earnings inequality in the United States from 1981 to 2013. Similarly, Card, Heining and Kline (2013) looked at German social security data and found that increased differences in earnings among employers accounted for about one-third of the overall rise in inequality in Germany between 1985 and 2009. Lastly, Barth et al. (2016) looked at U.S. matched employer–employee data (the Longitudinal Employer-Household Dynamics database) and found that the widening distribution of earnings among establishments explained most of the increase in inequality.

The changing dispersion in average earnings between firms may reflect—in part—the change in worker composition between firms because of a sorting process that moves workers with similar skills into the same firms. It may also reflect the changing dispersion in productivity between firms that results from new technology, globalization or a change in market power, as productivity is often related to pay. Identifying trends in inequality and understanding the role firms play is important, as this can provide empirical evidence to inform public debate and guide policy. However, there has been no Canadian evidence on the link between earnings inequality and firm differences because of a lack of matched employer–employee data.[2] Consequently, this paper provides empirical evidence on recent developments in Canadian earnings inequality after 2000, as well as their link to firm-level differences, particularly firm-level productivity. This analysis uses a newly developed matched employer–employee database: the Canadian Employer–Employee Dynamics Database (CEEDD). The CEEDD is particularly suitable for this study, as it covers all workers in Canada and their employers, and it also contains information on between-firm differences, including different measures of productivity.[3] Therefore, this paper facilitates comparisons with other countries to determine whether Canada follows trends seen elsewhere or diverges from them.

1. See Card et al. (2018) for a review of the literature.
2. A new Statistics Canada study (Grekou, Gu and Yan [2020]) uses firm-level data and different measures of dispersion to examine the link between average earnings per worker between firms and differences in firm characteristics.
3. A matched employer–employee survey, the Workplace and Employee Survey, is also available in Canada for 1999 to 2006. However, only a random sample of up to 24 employees was drawn for each selected workplace, which could create bias when calculating within-firm wage variance.

Although inequality has been rising in Canada since the late 1970s, it has been stable and has even slightly declined since 2000 (Fortin and Lemieux 2015, and Heisz 2015).[4] Consistent with these previous studies, this paper finds that the overall earnings dispersion (measured by the ratio of the 90th percentile of the earnings distribution to the 10th percentile) in Canada slightly declined between 2001 and 2013. This decline was mostly attributable to the earnings gain at the bottom of the earnings distribution outpacing that at the top, and this was closely related to the rise in minimum wages in Canada.

Decomposing the overall earnings dispersion into within-firm and between-firm components shows that the decline in the overall earnings dispersion was the result of a narrowing of the earnings differences within firms. The between-firm earnings dispersion increased slightly, driven solely by greater between-firm differences across industries, rather than within the same industry.

This study also finds that the dispersion in between-firm productivity increased between 2001 and 2013 and was positively related to the between-firm earnings dispersion at both the industry and firm levels. The findings on the relationship between differences in firm characteristics and the between-firm earnings dispersion are consistent with another Statistics Canada study (Grekou, Gu and Yan 2020), which also found that productivity and industrial differences played important roles.

The Canadian evidence presented in this study is generally consistent with that from other countries, such as the United States and other member countries of the Organisation for Economic Co-operation and Development (OECD): both dispersions in between-firm earnings and firm-level productivity increased in the post-2000 period and were positively correlated. However, the divergence of the between-firm earnings dispersion and the link between the productivity dispersion and the between-firm earnings dispersion were not as strong in Canada as they were in other countries.

This paper is organized as follows. Section 2 introduces the CEEDD and outlines the variables and methodology used to compute earnings, productivity and their dispersions. Section 3 presents the overall earnings dispersion in Canada, and the results on the within-firm and between-firm earnings dispersions are presented in Section 4. Section 5 examines the trend of firm-level productivity distribution over time, and its correlation to the earnings dispersion is examined in Section 6.

2 Data and methodology

The data source is the CEEDD, which is a Canadian matched employer–employee database. It is created by linking administrative data files, including individual tax files (T1 General – Income Tax and Benefit Return), individual employment remuneration files (T4 Statement of Remuneration Paid), incorporated (T2 Corporation Income Tax Return) and unincorporated business (T1 business declaration) tax files, and the Longitudinal Immigration Database (IMDB). The version of the CEEDD used in this study covers the annual universe of individual tax filers, as well as that of incorporated and unincorporated business tax filers in Canada from 2001 to 2013. The CEEDD is ideal for studying between-firm and within-firm earnings dispersions because it contains detailed information for all individual employees at a given firm, such as age, gender, marital status, immigrant status and job earnings. It is also ideal for studying the link between differences in earnings and productivity across firms because it contains information that can be used to calculate firm-level productivity, such as industry classification, number of employees, payroll, tangible assets, revenues, expenses and profits.

4. Fortin and Lemieux (2015) and Heisz (2015) found a slightly declining trend for the post-2000 period using hourly wage and adult-equivalent-adjusted household income, respectively.

Several key concepts and variables are defined below in preparation for subsequent analysis. Earnings (y) reflect workers' total employment income from their main job in a given calendar year, as reported on their T4 slip.[5] This means that, if a worker is employed by multiple firms in the same year, only the highest-paying firm (the main job) is used.[6] It is important to note that this concept of earnings reflects total annual employment income rather than hourly wage. Therefore, patterns in the earnings dispersion could capture variations in both hourly wages and labour supply, such as the number of hours or weeks worked.[7] The minimum earnings threshold is introduced later to reduce the impact of variation in hours worked.

Firm-level productivity is based on value added, which is measured as the sum of labour income and capital income. In the CEEDD, labour income is approximated by employment payroll and employee benefits, while capital income is approximated by total net income before tax.[8]

Furthermore, two measures of firm-level productivity are used in this study: labour productivity (LP) and multifactor productivity (MFP). LP, in a logarithm, is calculated as

$$ln\left(LP_{ft}\right) = \ln\left(VA_{ft}\right) - \ln\left(L_{ft}\right),$$

where VA_{ft} is firm f's real value added in year t, and L_{ft} is f's employment as measured by f's average monthly employment. MFP is calculated as the Solow residual, which, in a logarithm, is calculated as

$$ln\left(MFP_{fit}\right) = \ln\left(VA_{fit}\right) - \beta_i^L \ln\left(L_{fit}\right) - \left(1 - \beta_i^L\right)\ln\left(K_{fit}\right),$$

where i reflects f's industry (classified using three-digit North American Industry Classification System [NAICS] code), K_{fit} is f's real capital stock as per its book value of total tangible assets[9] and β_i^L is industry i's labour income share as measured by the median ratio of firm-level labour income to value added over the study period. Calculating MFP is straightforward, but it relies on the important assumption that production is characterized by a Cobb–Douglas function with constant returns to scale. Berlingieri, Blanchenay and Criscuolo (2017) found that the dispersion was fairly consistent across different measures of MFP, including the Solow residual. However, the correlation between the earnings dispersion and the MFP dispersion tends to be weaker when MFP is calculated using the Solow residual rather than with other measures.

Variance is used to measure dispersion in either earnings or firm-level productivity. Furthermore, the ratio between key percentiles in the distribution is used. The benefit of the latter measure is that it can show how different parts of a distribution behave. For example, while the ratio between the 90th and 10th percentiles (i.e., p90/p10) reflects overall dispersion, the ratios between the

5. Self-employment income and other sources of income are also available in the CEEDD. However, these income sources are not associated with a particular firm, so they are not relevant in studying the link between inequality and firms.
6. In 2013, 54% of workers aged between 20 and 60 had only one job and 44% had between two and five jobs. Among those who held multiple jobs, the earnings from their main job accounted for 78% of the earnings from all jobs on average (at the median).
7. It would be interesting to study the variations of hourly wages and working hours separately. However, it is beyond the scope of this paper. This paper instead uses total remuneration to measure inequality. Many people who are willing to work more cannot get enough working hours. Therefore, underemployment is also a source of inequality.
8. In particular, employment payroll is based on the PD7A payroll (PD7A Statement of account for current source deductions), which is the sum of the monthly payroll remitted by employers to the Canada Revenue Agency. Employee benefits paid by firms include group insurance, employment insurance, the Canada Pension Plan and Quebec Pension Plan, workers' compensation, registered pension plans, and profit-sharing plans, among others.
9. Value added and capital stock are deflated to 2007 prices using a KLEMS (capital, labour, energy, materials, and services) price index at the three-digit NAICS level.

90th and 50th (i.e., p90/p50) and the 50th and 10th (i.e., p50/p10) percentiles capture the dispersions in the upper and lower halves of the distribution, respectively.[10] Following convention, earnings and productivity are often expressed as a logarithm. Therefore, the log of the ratio—or log differential (e.g., logp90-logp10)—is also used in the paper.

To construct the baseline sample for the analysis, several restrictions were applied. First, firm-level productivity was calculated only for incorporated firms in the business sector.[11] In addition, productivity was measured only for firms that employed at least one worker on average throughout the year.

Second, restrictions were also applied to calculate the dispersion in earnings. The dispersion was based on the earnings of workers aged 20 to 60 to minimize the impacts of transitioning from school to work and from work to retirement.[12] Moreover, workers in the baseline sample needed to earn at least the equivalent of 13 weeks of full-time work at the minimum wage of their province of residence.[13] This restriction was imposed to reduce the effects of fluctuations in labour supply and the effects of workers who are weakly attached to the labour market. An alternative minimum earnings threshold (assuming full-time, full-year employment at minimum wage) was also used, and the impacts on the overall earnings dispersion remained qualitatively similar (see Chart A.1 in Appendix A). Lastly, a firm had to have at least five workers who satisfied the previous two conditions[14] to compute meaningful within-firm earnings variance.

In the end, the baseline sample accounts for one-third of all employers, but for a majority of total employment in the full sample that includes all workers who have positive earnings from any business (main jobs only) during a given year (Table B.1 in Appendix B). The full sample includes 661,500 to 916,900 firms that issued at least one T4 slip from 2001 to 2013 (Column 1). Each year, these firms employed about 12 million to 14 million individual workers (Column 2) and represented 9.7 million to 12 million in total employment as measured by PD7A average monthly employment (Column 3). The baseline sample consists of about 230,000 to 255,500 employers and about 8 million to 8.8 million individual workers each year (Columns 4 and 5), which respectively accounted for 32% of all employers and 62% of all workers in the full sample on average. However, the total employment associated with those employer firms in the baseline sample still ranged from about 8.4 million to 10 million, accounting for 85% of total employment in the full sample on average.

The earnings dispersions based on the baseline sample were qualitatively similar to those based on the full sample. This will be discussed in the next section.

10. The percentile ratios—especially the 90th/10th percentile ratio—have been widely used in the literature as a measure of inequality. See, for example, Card, Heining and Kline (2013); Song et al. (2019); and Abowd, Mckinney and Zhao (2018).
11. The business sector excludes the following NAICS-based industries: 521 (monetary authorities), 6111 to 6113 (elementary and secondary schools, colleges and universities), 622 (hospitals), 813 (religious, grant-making, civic, and professional and similar organizations), 814 (private households) and 91 (public administration). These sectors are not-for-profits and likely behave differently from the business sector.
12. The age restriction is similar to that used by Card, Heining and Kline (2013) and Song et al. (2019).
13. The minimum threshold restriction is similar to that used by Song et al. (2019). The earnings threshold was calculated using the provincial average of usual hours worked per week by full-time employees (Statistics Canada, Table 14-10-0043-01) and provincial minimum wages (Employment and Social Development Canada 2014).
14. The minimum firm size used was much smaller than that studied in Song et al. (2019) (minimum 20 employees). This is because firms in Canada are much smaller than those in the United States.

3 Earnings dispersion in the post-2000 period

This section describes the earnings dispersion in Canada from 2001 to 2013 at the national level and by province, sector, firm size and gender.

3.1 National earnings dispersion

Chart 1 illustrates the trend in the various measures of the earnings dispersion in Canada from 2001 to 2013. More specifically, it shows how these measures have changed in year *t* from their respective values in 2001.

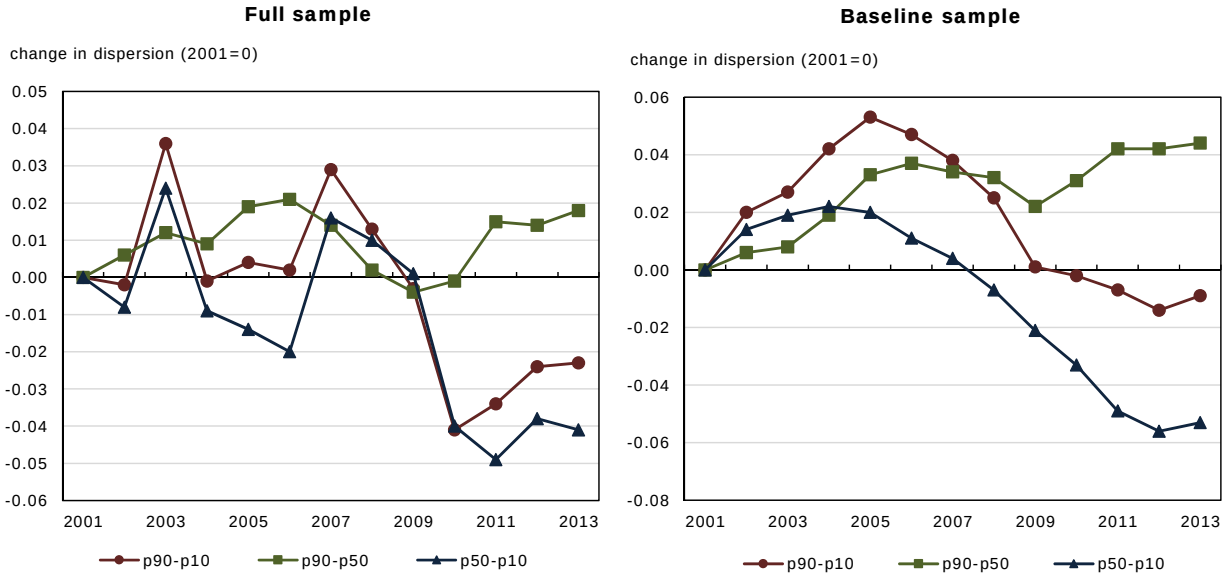
For the baseline sample, Chart 1 shows that the overall earnings dispersion—labelled "p90-p10"—increased until 2009 relative to its value in 2001. Specifically, overall inequality increased compared with its 2001 level and peaked in 2005. By this point, prior to the Great Recession, overall inequality was about 5% greater than in 2001.[15] After 2005, the increase in overall inequality shrank until it was about 1% lower in 2013 than in 2001.

The overall decline in inequality occurred despite widening earnings gaps in the upper half of the distribution. Based on the baseline sample, the ratio between the 90th and 50th percentiles—labelled "p90-p50"—increased steadily and, by 2013, it was about 4% greater than in 2001. Overall inequality fell because declines in the dispersion in the lower half of the earnings distribution more than offset the increases in the top half. After rising moderately until 2004, the ratio between the 50th and 10th percentiles—labelled "p50-p10"—fell by about 5% by 2013.

It is important to emphasize that the sample restrictions imposed on the baseline sample do not seem to drive the observed trends in inequality. Chart 1 shows qualitatively similar results among a broader sample of workers (i.e., the full sample): overall inequality declined because the increase in the dispersion in the top half of the distribution was not large enough to offset the decrease in the dispersion in the lower half. However, one exception where restrictions do matter is with respect to the magnitudes of the decline in inequality: the full sample of workers yielded a larger decrease in inequality than the baseline sample. This is because the increase in dispersion in the top half of the earnings distribution was more modest in the full sample than in the baseline sample, while decreases in the lower half in both samples were of more similar magnitudes.

15. This number was calculated by taking the exponent of the log of the ratio shown in Chart 1, which yielded the percentage difference.

Chart 1
Changes in the earnings dispersion in Canada from 2001 to 2013



Notes: p90-p10 refers to the difference between the 90th and 10th percentiles of the log earnings distribution; p90-p50 refers to the difference between the 90th and 50th percentiles of the log earnings distribution; p50-p10 refers to the difference between the 50th and 10th percentiles of the log earnings distribution.
Source: Statistics Canada, Canadian Employer–Employee Dynamics Database.

As suggested by Fortin and Lemieux (2015), the decline in overall inequality and in the lower tail of the earnings distribution may be the result of increases in provincial minimum wages. Since 2005, minimum wage hikes could have made it possible for earnings at the bottom of the distribution to grow faster than those at the top or middle.[16] Following Fortin and Lemieux (2015), the relationship between rising minimum wages and rising earnings at the bottom was examined. Estimation details are included in Appendix C. The results show that increases in the minimum wage led to increases in earnings at the bottom of the distribution. Moreover, the effect was more significant for female workers than male workers. This may be partly because there were proportionally more female workers who earned minimum wage or below (Fortin and Lemieux 2015), or because female workers who earned minimum wage wanted to work more hours, as increases in the minimum wage lead to an increase in the opportunity cost of leisure. Overall, this suggests that the rise in the minimum wage played a role in the decline of the dispersion at the bottom of the earnings distribution and, as a result, in the decline in the overall dispersion.

The slight decline—or relatively stable trend—in the overall earnings dispersion after 2000 is generally consistent with what has been found in other Canadian studies, such as those by Heisz (2015), who studied market income and after-tax income, and by Fortin and Lemieux (2015), who looked at hourly wages from the Labour Force Survey. This finding was also largely consistent with the overall earnings inequality trend in the United States after 2000, except that inequality in the United States increased again after the Great Recession (Song et al. 2019).[17]

16. The earnings at the 10th percentile increased by 17% from 2005 to 2013, while the median earnings and earnings at the 90th percentile increased by 9% and 10%, respectively.
17. A recent OECD report found an increase in log wage variance in Canada over time (OECD 2019). However, this increase occurred between 1991 and 2016. The underlying Canadian data source used in the OECD report was the Longitudinal Worker File.

3.2 Other aspects of earnings dispersion

Are the trends observed at the national level widespread across geographic regions and sectors or are they specific to only a few provinces, territories or industries? Table 1 reports the change in the earnings dispersion from 2001 to 2013 for the baseline sample within each province or territory, sector, firm size category (measured by employment), and gender category.

Changes in the earnings dispersion between 2001 and 2013 were not uniform across provinces and territories (Panel A of Table 1). The overall earnings dispersion (p90/p10 ratio) declined within the territories and each province, except for those most reliant on natural resources (i.e., Newfoundland and Labrador, Saskatchewan, Alberta, and British Columbia). In most jurisdictions that experienced declines in the overall dispersion, these declines occurred at both the top and bottom of the distribution. Moreover, in these provinces, declines in the lower end of the distribution (p50/p10 ratio) were much larger than those in the upper end (p90/p50 ratio). For resource-rich provinces—except Newfoundland and Labrador—there were increases in overall inequality because of increases in the dispersion at the top of the distribution that offset decreases at the bottom. Most provinces and territories experienced a decline in the dispersion at the lower end of the distribution, although to varying degrees. As shown in the previous section, minimum wage was positively correlated with the 10th percentile of earnings, and this cross-province variation in the bottom half of the earnings dispersion may partially reflect the cross-province variation in the minimum wage and changes to the minimum wage over time.

Across economic sectors, changes in the earnings dispersion were more or less on par with the national trend, at least with respect to the direction of change (Panel B of Table 1). All sectors experienced decreases in the overall earnings dispersion (p90/p10 ratio) and in the dispersion at the lower end of the distribution (p50/p10 ratio) between 2001 and 2013. All sectors—except utilities—experienced an increase in the dispersion at the upper end, with the resources sector experiencing the highest increase in the p90/p50 ratio (7.5%), and manufacturing experiencing the lowest increase (1.2%), which is consistent with the economic development in these two sectors in the post-2000 period. At the same time, manufacturing had the largest decrease in the p50/p10 ratio (13.6%), which also led to the largest decrease in the overall earnings dispersion across sectors (12.5%).

In terms of firm size, earnings inequality increased with firm size, especially between large firms (with 500 or more employees) and firms of all other sizes (Chart 2). This is consistent with Mueller, Ouimet and Simintzi (2017), who found that wage differentials between top- and bottom-level jobs and between different top-level jobs all increase with firm size.

Over time, workers in small and medium-sized firms (up to 499 employees) experienced a decrease in the overall earnings dispersion, while those in the largest firms (firms with at least 500 employees) experienced an increase of about 7.2% (Panel C of Table 1). All workers—except those in the smallest firms (fewer than 50 employees)—experienced an increase in the dispersion at the upper end of the distribution, which was also positively related to firm size. Workers in firms of all sizes experienced a decrease in the dispersion at the lower end of the earnings distribution.

Overall, the largest difference in the change in the earnings dispersion across firm-size categories was in the top half of the distribution, i.e., large firms (with 500 or more employees) experienced a large increase in the dispersion in the top half of the distribution, while smaller firms experienced a modest increase or decrease. This may be partly because large firms, which are usually more productive, have an increasing demand for more highly skilled workers, which inflates the skill premium.

Table 1
Percentage change in the earnings dispersion between 2001 and 2013, by province or territory, sector, firm size and gender

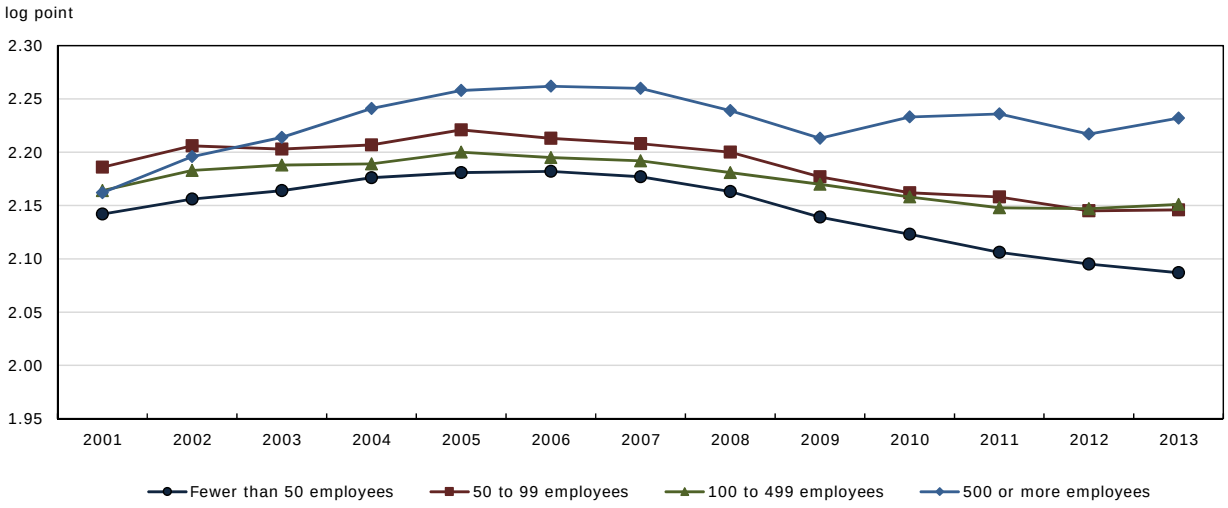
	p90/p10 ratio	p90/p50 ratio	p50/p10 ratio
		percent	
Panel A: Province or territory			
Newfoundland and Labrador	0.8	-4.6	5.7
Prince Edward Island	-5.7	-1.4	-4.3
Nova Scotia	-15.2	-5.0	-10.7
New Brunswick	-17.1	-4.9	-12.8
Quebec	-2.7	-0.4	-2.3
Ontario	-0.1	5.8	-5.6
Manitoba	-8.2	1.0	-9.1
Saskatchewan	0.4	5.0	-4.4
Alberta	2.1	5.9	-3.6
British Columbia	4.3	6.7	-2.2
Northwest Territories, Yukon and Nunavut	-6.4	-4.6	-1.9
Panel B: Sector			
Agriculture	-10.0	1.8	-11.6
Resources[1]	-2.9	7.5	-9.7
Utilities	-9.7	-2.1	-7.8
Construction	-5.9	1.9	-7.6
Manufacturing	-12.5	1.2	-13.6
Services	-0.4	3.3	-3.5
Panel C: Firm size (employment)			
Fewer than 50 employees	-5.4	-1.5	-3.9
50 to 99 employees	-4.0	1.5	-5.4
100 to 499 employees	-1.3	3.5	-4.7
500 or more employees	7.2	10.1	-2.6
Panel D: Gender			
All	-0.9	4.5	-5.2
Male	1.2	7.3	-5.7
Female	1.3	2.8	-1.5

1. The resources sector refers to the mining, quarrying, and oil and gas extraction industries.

Notes: Services sectors refer to all services industries included in this study from wholesale trade industry to other services industry. p90/p10 refers to the ratio between the 90th and 10th percentiles of the earnings distribution; p90/p50 refers to the ratio between the 90th and 50th percentiles of the earnings distribution; p50/p10 refers to the ratio between the 50th and 10th percentiles of the earnings distribution.

Source: Statistics Canada, Canadian Employer–Employee Dynamics Database.

Chart 2
Overall earnings dispersion (90-10 log earnings differential), by firm size



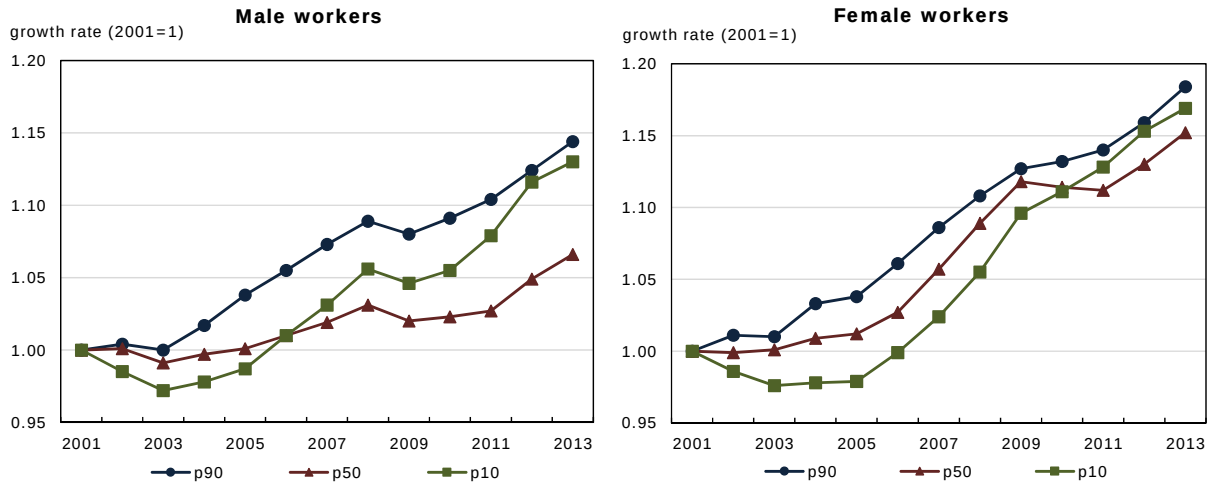
Source: Statistics Canada, Canadian Employer–Employee Dynamics Database.

Both male and female workers experienced a similar and slight increase in the overall earnings dispersion (p90/p10 ratio) between 2001 and 2013 (Panel D of Table 1). However, the evolving trends of the earnings distribution are quite different between male and female workers. Male workers experienced a large increase in the dispersion at the upper end of the distribution and a large decrease at the lower end, while female workers experienced a slight increase at the upper end and a slight decrease at the lower end. This is because male workers experienced a pronounced polarization in earnings, as earnings at both the top and the bottom of the distribution increased much faster than the median (Chart 3). From 2001 to 2013, the earnings of male workers increased by 14% and 13% at the 90th and 10th percentiles, respectively, while earnings at the median grew by only 7%, which resulted in a convergence in the overall earnings dispersion. In contrast, female workers experienced similar growth at all three percentiles, 18%, 15% and 17% for the 90th, 50th and 10th percentiles, respectively. Compared with male workers, female workers experienced higher growth in all three percentiles, especially at the median (Chart 3).

When all workers (both male and female) were considered, the overall earnings distribution converged slightly. This is because of the composition effect, which results in the growth of both the top and the median earnings for all workers being disproportionally more affected by male workers, while the growth at the bottom of the distribution—especially at the 10th percentile—was more affected by female workers. This led to a more modest polarization in the earnings distribution for all workers than for male workers alone.[18]

18. Over the same period, earnings for all workers grew by 14%, 9% and 15% at the 90th, 50th and 10th percentiles, respectively.

Chart 3
Earnings growth for male and female workers



Notes: p90 refers to the 90th percentile of the earnings distribution; p50 refers to the 50th percentile of the earnings distribution; p10 refers to the 10th percentile of the earnings distribution.
Source: Statistics Canada, Canadian Employer–Employee Dynamics Database.

4 Between-firm and within-firm earnings dispersions

The earnings dispersions shown in the previous section do not differentiate between workers within the same firm and those in different firms. This distinction is important because it can help better understand the role of firms in explaining the overall earnings inequality. According to the recent literature on this topic, within-firm earnings differences contribute to inequality differently than between-firm earnings differences. In particular, the literature documents that—in many countries—increases in between-firm earnings differences explain a large share of the rise in total inequality (e.g. Card, Heining and Kline 2013 for Germany; Faggio, Salvanes and Van Reenen 2010 and Mueller, Ouimet and Simintzi 2017 for United Kingdom; Barth et al., 2016 and Song et al., 2019 for the U.S.; and Helpman et al., 2017 for Brazil).[19] However, there has been no Canadian evidence on this because of a lack of matched employer–employee data. This section decomposes the baseline sample's total earnings variation into contributions from within-firm and between-firm variations.

To simplify the decomposition, earnings variance is used to measure inequality. This makes it easier for the earnings dispersion to be separated into between-firm and within-firm components as follows:

$$\text{var}(w^{if}) = \underbrace{\sum_{f=1}^{F} \frac{N^f}{N}[\bar{w}^f - \bar{w}^A]^2}_{between-firm} + \underbrace{\sum_{f=1}^{F} \frac{N^f}{N}\text{var}(w^{if} \mid i \in f)}_{within-firm} \quad (1)$$

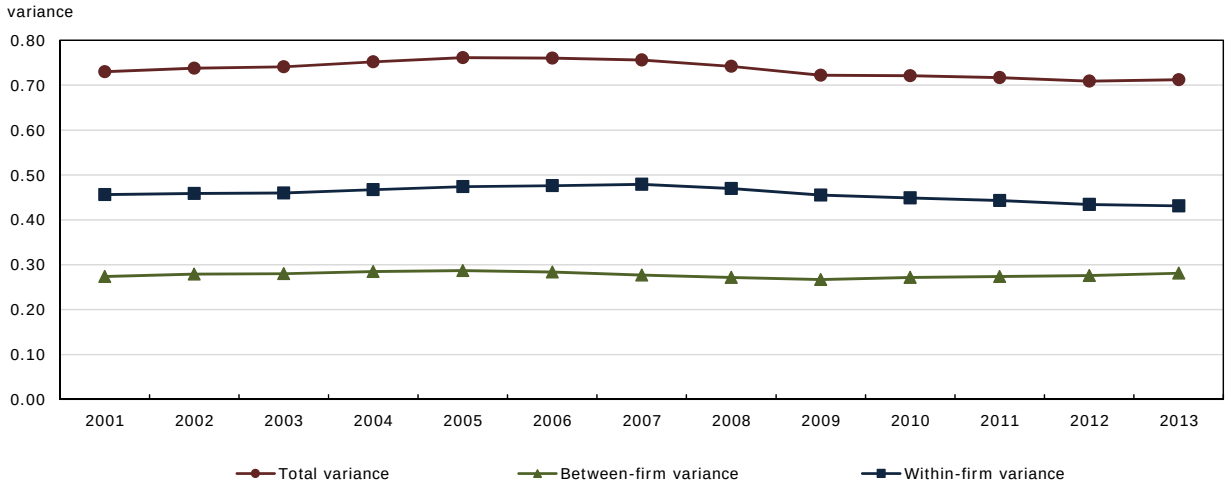
In Equation (1), w^{if} is the earnings of worker i at firm f, $\bar{w}^f$ is the average earnings in firm f and $\bar{w}^A$ is the average earnings for the entire sample, N^f is the employment at firm f, and N is total employment of all F firms in the sample. Given Equation (1), the overall variance in worker earnings equals the employment-weighted variance of firm-level average

19. Alvarez et al. (2018) found that the inequality in Brazil decreased from 1996 to 2012. However, firms still played an important role in this decrease, not through the compression of firm productivity, but through lower pass-through from firm productivity to pay.

earnings (the first term on the right-hand side of Equation [1]) and the employment-weighted average variance of within-firm earnings (the second term on the right-hand side of Equation [1]).

Over the entire study period of 2001 to 2013, the contribution of the within-firm earnings variance to overall inequality was much greater than that of the between-firm variance. The within-firm variance accounted for more than 60% of the total earnings variance, on average. This variance also increased until 2007, but decreased thereafter. In contrast, the between-firm variance increased slightly. Between 2001 and 2013, the average within-firm variance decreased by 5.7%, while the between-firm variance increased by 2.8%. As a result, the total variance decreased by 2.5% from 2001 to 2013.

Chart 4
Decomposition of the total earnings variance—the within-firm and between-firm earnings variances



Source: Statistics Canada, Canadian Employer–Employee Dynamics Database.

This Canadian evidence on the evolution of within-firm and between-firm earnings variances after 2000 is qualitatively consistent with Song et al. (2019), who also found an increase in between-firm earnings variance and a decrease in within-firm earnings variance in the United States from 2000 to 2013. However, the increase in between-firm earnings variance was much larger in the United States, which led to an increase in the total earnings variance.[20]

The between-firm earnings variance can be further decomposed into variance between firms in different groups (e.g., different industries) and variance between firms in the same group. The following equation shows this decomposition:

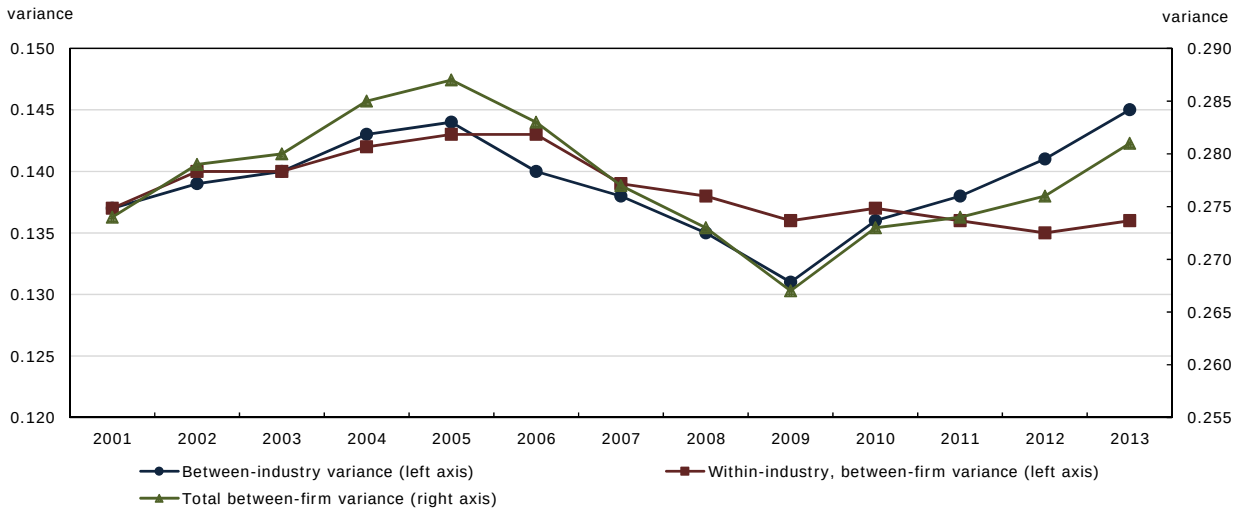
$$\operatorname{var}\left(w^{ifm}\right) = \underbrace{\sum_{m=1}^{M}\sum_{f=1}^{F^m}\frac{N^{fm}}{N}\left[\overline{w}^{m} - \overline{w}^{A}\right]^2}_{between-group} + \underbrace{\sum_{m=1}^{M}\sum_{f=1}^{F^m}\frac{N^{fm}}{N}\left[\overline{w}^{f} - \overline{w}^{m}\right]^2}_{within-group,\ between-firm} + \underbrace{\sum_{m=1}^{M}\sum_{f=1}^{F^m}\frac{N^{fm}}{N}\operatorname{var}\left(w^{ifm} \mid i \in f\right)}_{within-firm} \quad (2)$$

20. The OECD report found increases in between-firm and within-firm wage variances for Canada (OECD 2019). However, the study period was 1991 to 2016, which is different from the period used in the current study.

In Equation (2), w^{ifm} is the specific earnings of worker i in firm f that belongs to group m, $\overline{w}^{f}$ is the average earnings of workers in f, $\overline{w}^{m}$ is the average earnings of workers in group m, N^{fm} is firm f's employment in group m, F^{m} is the number of firms in group m, and M is the total number of groups. Therefore, the total between-firm variance in Equation (1) can be fdecomposed into the variance of group-average earnings weighted by the group employment share (the first term on the right-hand side of Equation [2]) and the average[21] variance[22] in firm-level average earnings within each group (the second term on the right-hand side of Equation [2]).

The decomposition of the between-firm variations described by Equation (2) was implemented with respect to differences across industries (i.e., three-digit NAICS codes) and is illustrated in Chart 5. In terms of their levels, the between-industry and the within-industry, between-firm variations were of similar magnitude, each accounting for roughly 50% of the total between-firm variation in earnings.[23] However, in terms of their changes, the between-industry variation was responsible for the overall increase in earnings variation between firms. Between 2001 and 2013, both the total between-firm and the between-industry firm variations in earnings first increased and then decreased to their lowest levels in 2009, before increasing again to end higher than in 2001. By contrast, the within-industry, between-firm variation increased until 2006, before declining until 2013 and ending at a slightly lower level than in 2001.

Chart 5
Decomposition of the total between-firm earnings variance, by industry, 2001 to 2013



Source: Statistics Canada, Canadian Employer–Employee Dynamics Database.

In summary, the fall in overall inequality between 2001 and 2013 was primarily driven by the decline in the within-firm variance in earnings. The slight increase in between-firm earnings variance placed upward pressure on overall inequality and seems to have been driven entirely by a widening gap in the fortunes of workers in firms in different industries. Even though the earnings variance between firms within narrowly defined industries was considerable,[24] this second source of inequality between firms declined between 2001 and 2013.

21. The average is weighted according to group employment shares.
22. The within-group variance in average firm-level earnings is calculated by weighting firm-level deviations by firm employment share in the group.
23. The decomposition was also done by province and firm-size category. For these dimensions, within-group, between-firm variations dominated the total between-firm variations.
24. Barth et al. (2016) obtained similar results in the United States—both industries and establishments were important in explaining the between-establishment earnings variation.

5 Firm-level productivity dispersion

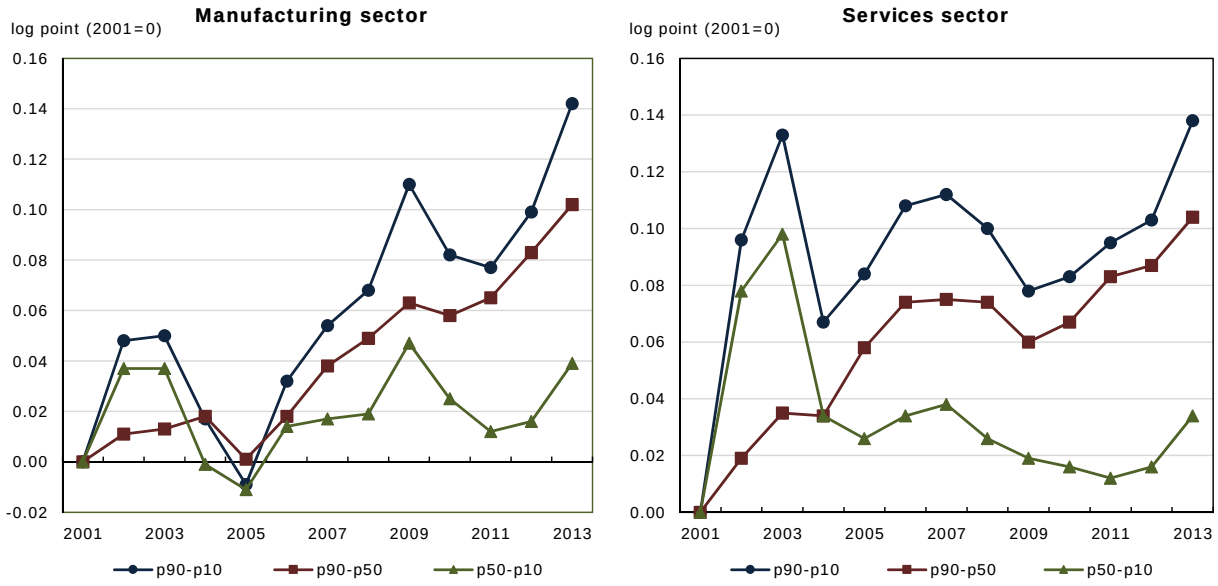
As presented in previous sections, although the overall earnings dispersion declined, the between-firm variance in earnings widened slightly in Canada between 2001 and 2013. Diverging differences in firm performance could be the source of this inequality. Most prominently, firm productivity is generally positively correlated with average pay. If productivity differences between firms increase, more productive employers could pay their workers increasingly more than less productive firms. In fact, according to recent firm-level evidence, the dispersion of firm productivity increased in the post-2000 period in many OECD member countries where between-firm inequality also increased (Berlingieri, Blanchenay and Criscuolo 2017). This section explores the dispersion of firm-level productivity in Canada based on the sample of firms described in Section 2.

The overall dispersion of LP increased after 2001 in both the manufacturing and services sectors (Chart 6).[25] The overall increase was accompanied in manufacturing by a slight decrease in the early 2000s and a slowdown after the 2008 financial crisis. A similar trend was also observed in the services sector. By 2013, the dispersion of LP—as measured by the ratio between the 90th and 10th percentiles—had increased by about 15%[26] relative to its level in 2001. This increase was primarily driven by the increase in the dispersion at the upper rather than the lower part of the productivity distribution. LP was much more divergent in more productive firms (p90-p50) than in less productive firms (p50-p10) in both the manufacturing and services sectors. This differs from Berlingieri, Blanchenay and Criscuolo (2017), who found that the opposite was true in many other OECD member countries.

Dispersion trends for MFP (Chart 7) were similar to those for LP (Chart 6). The overall distribution of firm MFP increasingly diverged in the manufacturing and services sectors over time. Dispersion at both the top and bottom of the distribution also increased. Unlike LP (Chart 6), MFP became increasingly divergent in less productive firms (p50-p10) than in more productive firms (p90-p50) in the services sector.

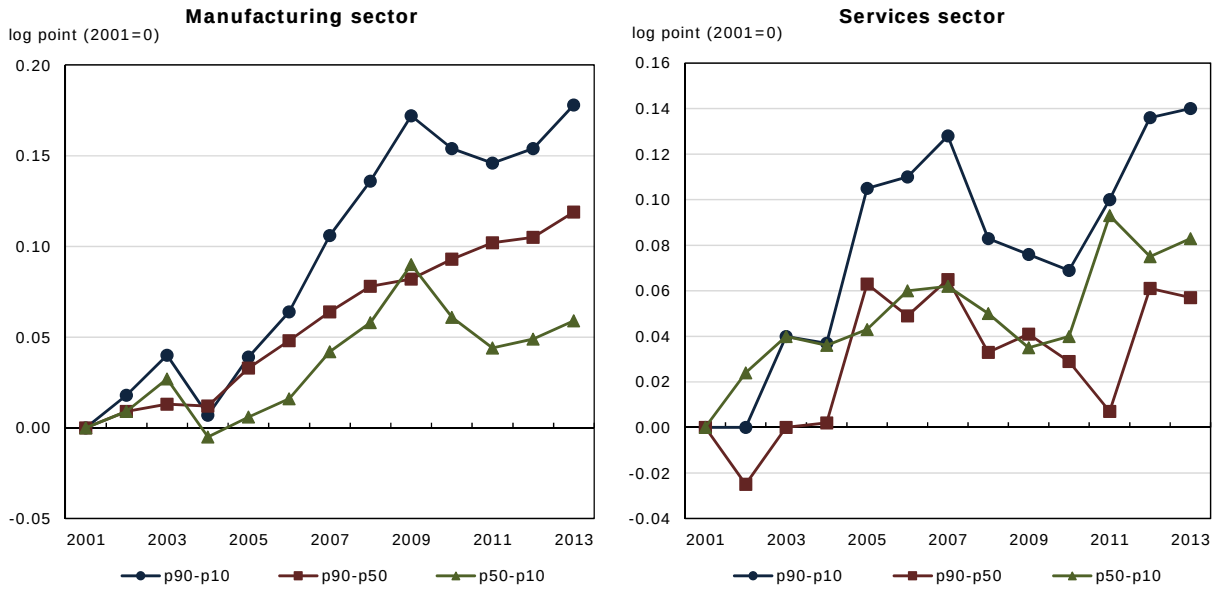
25. Gu, Yan and Ratté (2018) found a similar trend in the manufacturing sector using the Annual Survey of Manufactures and the National Accounts Longitudinal Microdata File.
26. This number was calculated by taking the exponent of the corresponding log differential from Chart 6.

Chart 6
Changes in the labour productivity dispersion in Canada from 2001 to 2013, by sector



Notes: p90-p10 refers to the difference between the 90th and 10th percentiles of the distribution of log labour productivity; p90-p50 refers to the difference between the 90th and 50th percentiles of the distribution of log labour productivity; p50-p10 refers to the difference between the 50th and 10th percentiles of the distribution of log labour productivity.
Source: Statistics Canada, Canadian Employer–Employee Dynamics Database.

Chart 7
Changes in the multifactor productivity dispersion in Canada from 2001 to 2013, by sector



Notes: p90-p10 refers to the difference between the 90th and 10th percentiles of the distribution of log multifactor productivity; p90-p50 refers to the difference between the 90th and 50th percentiles of the distribution of log multifactor productivity; p50-p10 refers to the difference between the 50th and 10th percentiles of the distribution of log multifactor productivity.
Source: Statistics Canada, Canadian Employer–Employee Dynamics Database.

6 The link between the earnings and productivity dispersions

As briefly described in the previous section, the firm productivity dispersion is expected to be positively correlated with the between-firm earnings dispersion. One possible explanation for this is that firms experiencing productivity increases because of technology adoption are likely to pass on some of these increases to their workers by increasing wages using rent-sharing mechanisms. This section formally examines the relationship between the earnings and productivity dispersions, with a focus on the correlation between the two, rather than on the causality.[27] For this purpose, the following regression was estimated:

$$ED_{jt} = \alpha + \beta PD_{jt} + y_t + z_j + \varepsilon_{jt}, \quad (3)$$

where ED_{jt} measures the dispersion of firm-level earnings within industry j (i.e., three-digit NAICS code) and in year t, PD_{jt} represents firm productivity dispersion, and y_t and z_j reflect year and industry fixed effects, respectively. Table 2 presents estimates of β based on various measures of the earnings (columns) and productivity (rows) dispersions.

Column 1 shows that the overall dispersions in earnings and LP—each measured by the logged ratio of the 90th and 10th percentiles of their respective distributions—were positively correlated. Specifically, the estimated coefficient suggests that an increase of 1% in the dispersion of LP correlated with a 0.116% increase in the earnings dispersion.[28] Table 2 also shows that the variance in earnings—as an alternative measure of the earnings dispersion—was positively and significantly correlated with the variance of LP (Column 4). The correlation coefficient was 0.107, which is only slightly smaller than the earnings dispersion measure used in Column 1.

The correlation between the earnings and productivity dispersions was also positive and significant at the top and bottom halves of the distributions (Columns 2 and 3), although it was stronger in the bottom half (Column 3). The weaker correlation in the top half of the distribution likely suggests that the firms at the top of the productivity distribution may pay top-level jobs excessively high wages relative to their productivity, in line with the recent theory on CEO compensation put forth by Gabaix and Landier (2008). Alternatively, the rise of "superstar firms" may reduce the bargaining power of workers in certain occupations, particularly for medium-skilled workers, whose pay may not fully reflect the productivity advantage of those firms (Autor et al. forthcoming).

The correlation between the earnings and MFP dispersions was also examined (Columns 5 to 8) and the results show that the link was not significant, except for in the bottom half of the distribution (Column 7). This may be because of the way the Solow-based MFP is constructed, which removes some heterogeneity across firms and relies on the assumption of constant returns to scale.[29]

27. Another possible explanation behind this positive correlation is that firms with increasing wages are likely to look for other factors to substitute for labour, such as capital or technology, to reduce their labour costs. This leads to further productivity gains compared with firms with decreasing wages.
28. Berlingieri, Blanchenay and Criscuolo (2017) estimated the same coefficient equal to 0.36 on average across the 14 countries included in their study.
29. Berlingieri, Blanchenay and Criscuolo (2017) also found a weaker correlation with the earnings dispersion when MFP was calculated based on the Solow residual rather than on other measures, such as those estimated using Wooldridge (2009).

Overall, these results suggest that there is a positive co-movement between the LP and between-firm earnings dispersions. However, this link was weaker in Canada than in other OECD member countries (Berlingieri, Blanchenay and Criscuolo 2017). This could be partly attributable to differences in market competitiveness between Canada and other countries. According to the World Economic Forum (2020), Canada is ranked lower than most of the countries examined in the OECD study in terms of the product market index that measures the extent of market power, openness to foreign firms and degree of market distortions. A country with a less competitive market tends to have a weaker link between wages and productivity.

The correlation between the earnings and productivity dispersions can be further examined using firm-level data (i.e., regressing firm-level earnings against firm-level productivity), as illustrated in the following equation:

$$\ln \overline{E}_{jrft} = \alpha + \beta \ln prod_{jrft} + \gamma \ln emp_{jrft} + \delta \ln \overline{E}_{jrt} + \mu_{jrf} + \varepsilon_{jrft}, \quad (4)$$

where $\ln \overline{E}_{jrft}$ is the firm-level average log earnings for firm f in industry j (i.e., three-digit NAICS code), region r (census division), and time t, $\ln prod_{jrft}$ is the corresponding firm-level productivity measure, $\ln emp_{jrft}$ measures the firm's size in terms of employment, $\ln \overline{E}_{jrt}$ denotes the average log earnings across firms in the same industry and region as firm f, and μ_{jrf} controls for firm-specific characteristics that do not change over time (i.e., firm fixed effects).

The key coefficient in Equation (4) is β. This coefficient is often called the elasticity of rent sharing (see Card et al. [2018] for a review of the literature) and it measures the percentage change in firm-level earnings with respect to changes in firm productivity. The estimates of the elasticity of rent sharing are presented in Panel A of Table 3, where Column 1 shows the estimate of LP and Column 2 shows the estimate of MFP.

The rent-sharing—or pass-through—elasticity estimates presented in Table 3 show that firm-level earnings were positively correlated with firm-level productivity, even after controlling for firm size, average earnings in the same industry and region, and firm fixed effects (Columns 1 and 2). The estimates of LP and MFP suggest that, on average, a 1% increase in firm-level LP or MFP resulted in a 0.129% and 0.109% increase in firm-level average earnings, respectively. The magnitudes of these estimates are also comparable to estimates found in the literature (Card et al. 2018).[30]

The estimated pass-through elasticity from productivity to earnings also suggests that, between 2001 and 2013, the rising dispersion of LP contributed to about 22% of the increase in the earnings dispersion between firms if all else remains the same.[31] However, pass-through elasticity is assumed to be constant over time. Panel B of Table 3 reruns Equation (4) using an ordinary least squares regression separately for 2001 (Column 3) and 2013 (Column 4). The results show that pass-through elasticity decreased over time from 0.435 to 0.358, and the difference was significant at the 1% level. This suggests that, although firms became more divergent in terms of productivity, the productivity gains passed on to workers shrank over time. This placed downward pressure on the earnings inequality between firms.

30. Card et al. (2018) found that elasticity estimates in a number of studies in different countries ranged from 0.03 to 0.29.
31. A simple variance decomposition of Equation (4) links the contribution of the firm productivity dispersion to the between-firm earnings dispersion as $\beta^2 \operatorname{var}(\ln prod_{jrft})$. Given that the variance of firm LP increased by 9.3 percentage points and the variance of firm-level earnings increased by 0.7 percentage points within the sample used to estimate Equation (4), the contribution of the change in the LP dispersion to the change in the earnings dispersion follows as $(0.129 \times 0.093) \div 0.007 = 22\%$.

This finding is consistent with another recent Canadian study that found that the pay premiums of frontier firms relative to non-frontier firms decreased over time (Grekou, Gu and Yan 2020).[32] It is also consistent with a Brazilian study that found that declining firm productivity pay premiums contributed to the decrease in earnings inequality (Alvarez et al. 2018).

Equation (4) can be used to study how firm-level productivity affects the within-firm earnings dispersion. This is done by using the variance of logged earnings within the firm as the dependent variable. These results are presented in Panel C of Table 3.

Based on the estimates in Columns 5 and 6, it appears as if the within-firm earnings variation is also positively correlated with firm-level productivity, i.e., earnings tend to become more unequal within more productive firms. This may be in part because more productive firms are more likely to adopt performance-based pay policies that increase the variation of individual workers' performance (Lazear 2000). Within-firm earnings variance is also positively related to firm size, after controlling for firm productivity. Earnings among workers tend to be more unequal within larger firms. This is consistent with Mueller, Ouimet and Simintzi (2017), who found that larger firms exhibited greater pay inequality in the United Kingdom. This was attributable not only to wage differences between the top-level and bottom-level jobs, but also to wage differences between different top-level jobs that increase with firm size.

32. Grekou, Gu and Yan (2020) also found that the productivity difference between frontier and non-frontier firms played an important role in overall between-firm earnings variance.

Table 2
Correlation estimates between the firm-level earnings dispersion and the productivity dispersion

	Earnings dispersion							
	p90-p10	p90-p50	p50-p10	Variance	p90-p10	p90-p50	p50-p10	Variance
Productivity dispersion	**Column 1**	**Column 2**	**Column 3**	**Column 4**	**Column 5**	**Column 6**	**Column 7**	**Column 8**
LP (p90-p10)								
Coefficient	0.116 **	…	…	…	…	…	…	…
Standard error	0.009	…	…	…	…	…	…	…
LP (p90-p50)								
Coefficient	…	0.088 **	…	…	…	…	…	…
Standard error	…	0.011	…	…	…	…	…	…
LP (p50-p10)								
Coefficient	…	…	0.143 **	…	…	…	…	…
Standard error	…	…	0.035	…	…	…	…	…
Variance (LP)								
Coefficient	…	…	…	0.107 **	…	…	…	…
Standard error	…	…	…	0.014	…	…	…	…
MFP (p90-p10)								
Coefficient	…	…	…	…	0.035	…	…	…
Standard error	…	…	…	…	0.042	…	…	…
MFP (p90-p50)								
Coefficient	…	…	…	…	…	-0.044	…	…
Standard error	…	…	…	…	…	0.029	…	…
MFP (p50-p10)								
Coefficient	…	…	…	…	…	…	0.166 †	…
Standard error	…	…	…	…	…	…	0.100	…
Variance (MFP)								
Coefficient	…	…	…	…	…	…	…	0.041
Standard error	…	…	…	…	…	…	…	0.026
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	1,209	1,209	1,209	1,209	1,209	1,209	1,209	1,209
R-squared	0.954	0.913	0.912	0.955	0.945	0.907	0.896	0.952

… not applicable

** significantly different from reference category ($p < 0.01$)

† significantly different from reference category ($p < 0.10$)

Notes: p90-p10 refers to the difference between the 90th and 10th percentiles of the log earnings distribution; p90-p50 refers to the difference between the 90th and 50th percentiles of the log earnings distribution; p50-p10 refers to the difference between the 50th and 10th percentiles of the log earnings distribution. LP (p90-p10) refers to the difference between the 90th and 10th percentiles of the distribution of log labour productivity; LP (p90-p50) refers to the difference between the 90th and 50th percentiles of the distribution of log labour productivity; LP (p50-p10) refers to the difference between the 50th and 10th percentiles of the distribution of log labour productivity; variance (LP) refers to the variance of log labour productivity. MFP (p90-p10) refers to the difference between the 90th and 10th percentiles of the distribution of log multifactor productivity; MFP (p90-p50) refers to the difference between the 90th and 50th percentiles of the distribution of log multifactor productivity; MFP (p50-p10) refers to the difference between the 50th and 10th percentiles of the distribution of log multifactor productivity; variance (MFP) refers to the variance of log multifactor productivity.

Source: Statistics Canada, Canadian Employer–Employee Dynamics Database.

Table 3
Firm-level correlation between earnings and productivity

	Panel A: Firm-level average earnings (fixed effect)		Panel B: Firm-level average earnings (OLS)		Panel C: Within-firm variance of logged earnings (fixed effect)	
	2001 to 2013	2001 to 2013	2001	2013	2001 to 2013	2001 to 2013
Variables	**Column 1**	**Column 2**	**Column 3**	**Column 4**	**Column 5**	**Column 6**
ln(*LP*)						
Coefficient	0.129 **	…	0.435 **	0.358 **	0.039 **	…
Standard error	0.001	…	0.002	0.002	0.001	…
ln(*MFP*)						
Coefficient	…	0.109 **	…	…	…	0.034 **
Standard error	…	0.001	…	…	…	0.001
Size (log of employment)						
Coefficient	0.104 **	0.081 **	0.066 **	0.068 **	0.046 **	0.040 **
Standard error	0.001	0.001	0.001	0.001	0.000	0.001
Average log earnings (industry–region level)						
Coefficient	0.105 **	0.116 **	0.251 **	0.174 **	0.020 **	0.025 **
Standard error	0.001	0.002	0.004	0.004	0.001	0.001
Year fixed effect	Yes	Yes	No	No	Yes	Yes
Firm fixed effect	Yes	Yes	No	No	Yes	Yes
Industry fixed effect	No	No	Yes	Yes	No	No
Number of observations	2,476,783	2,313,170	174,482	204,529	2,476,783	2,313,170
R-squared	0.885	0.883	0.621	0.622	0.574	0.572

… not applicable

** significantly different from reference category ($p < 0.01$)

Notes: OLS: ordinary least squares. ln(*LP*) refers to the log of labour productivity at the firm level; ln(*MFP*) refers to the log of multifactor productivity at the firm level.

Source: Statistics Canada, Canadian Employer–Employee Dynamics Database.

7 Conclusion

Using new Canadian matched employer–employee data, this paper presents new evidence on the earnings dispersion from 2001 to 2013. It shows that the overall earnings dispersion declined slightly over the study period. This decline is attributable to the convergence of earnings in the bottom half of the distribution, which is closely related to the rise in the minimum wage in Canada during this period. It is also the result of the convergence of earnings in small and medium firms (with fewer than 500 employees), while the earnings dispersion among workers in large firms (500 employees or more) continued to rise.

This paper also differentiates between the between-firm and within-firm earnings dispersions. The results from this analysis indicate that the overall earnings dispersion declined because decreases in the within-firm dispersion more than offset slight increases in the between-firm dispersion. Moreover, the increasing between-firm earnings dispersion was found to be driven entirely by firms across industries rather than by firms within the same industry. This could mean that rising pay premiums in some Canadian industries (e.g., the resources and retail trade sectors) over the study period created positive pressure on inequality (Morissette, Picot and Lu 2013).

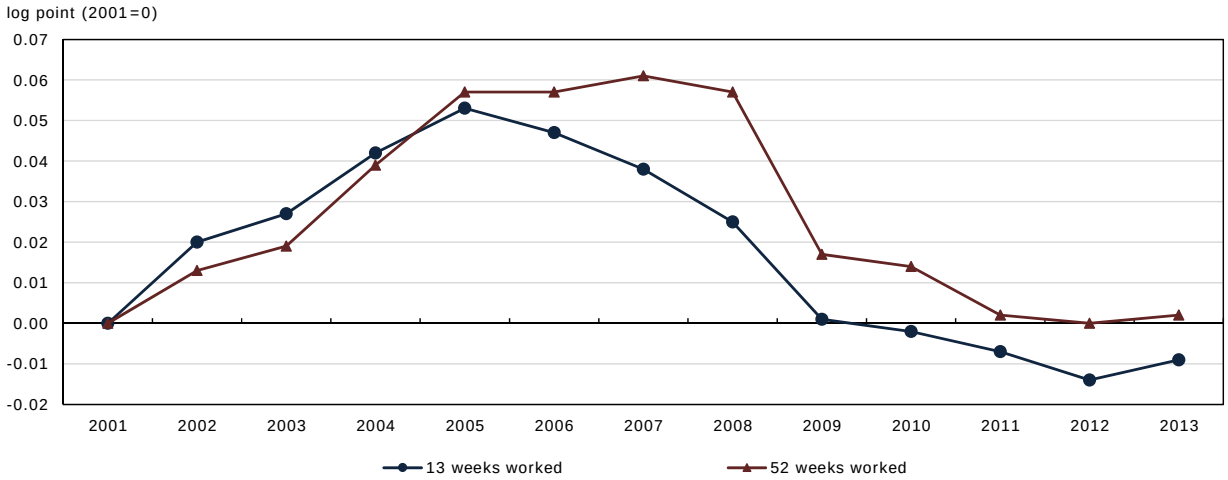
In terms of firm-level productivity, this study found that labour productivity (LP) and multifactor productivity became more divergent in Canada over time. This evidence is broadly consistent with that found in other countries. However, productivity in Canada became much more divergent among more productive firms than among less productive firms, unlike in other OECD member countries, where the opposite was found.

Lastly, this paper found a positive correlation between the LP and between-firm earnings dispersions and found that this correlation tended to be stronger in the bottom half of the distribution. The results from firm-level earnings regressions suggest that, although the increase in the between-firm earnings dispersion between 2001 and 2013 was small in magnitude, about 22% of this increase can be linked to a diverging firm-level LP dispersion. Moreover, the results also show that pass-through elasticity from productivity to earnings decreased over time. This suggests that, although firms became more divergent in terms of productivity, the productivity gains passed on to workers shrank over time, placing downward pressure on the earnings variation between firms.

The rising dispersion in average earnings between firms, coupled with the declining within-firm earnings dispersion, seems to support the theory that there is a sorting process through which workers with similar skills are moved into the same firms in the Canadian labour market. Future research using information from both workers and firms can shed more light on what underlies the earnings dispersion and its changes over time—whether that be differences between workers, differences between firms (including productivity and other traits), or the sorting of workers between firms that changes the composition of workers within and between firms.

Appendix A: Sensitivity analysis with different minimum earnings thresholds

Chart A.1
Changes in the overall earnings dispersion (p90-p10) from 2001 to 2013, with different minimum earnings thresholds



Source: Statistics Canada, Canadian Employer–Employee Dynamics Database.

Appendix B: Sample coverage

Table B.1
Coverage of the baseline sample

	Full sample			Baseline sample		
	Employers	Individual workers	Employment	Employers	Individual workers	Employment
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
			number			
2001	661,500	12,455,300	9,651,600	229,600	7,988,400	8,357,200
2002	674,200	12,566,600	10,082,600	232,700	8,013,200	8,702,100
2003	692,600	12,740,700	10,335,100	238,300	8,189,300	8,945,400
2004	720,800	13,097,200	10,333,600	243,300	8,335,300	8,902,700
2005	735,100	13,304,300	10,545,700	245,400	8,461,000	9,077,200
2006	765,500	13,603,100	10,854,300	247,900	8,554,400	9,304,400
2007	799,300	14,255,800	11,443,100	252,500	8,736,000	9,602,300
2008	827,000	14,613,200	11,888,600	254,700	8,812,400	9,800,400
2009	838,400	14,324,600	11,553,100	252,700	8,503,000	9,456,700
2010	855,000	14,220,000	11,620,100	254,300	8,524,800	9,528,600
2011	874,400	14,136,000	11,521,200	254,800	8,598,600	9,692,900
2012	896,100	14,413,000	11,804,800	256,000	8,749,300	9,933,900
2013	916,900	14,617,700	12,010,100	255,500	8,796,200	10,035,900

Source: Statistics Canada, Canadian Employer–Employee Dynamics Database.

Appendix C: Estimating the relationship between minimum wages and earnings in the bottom half of the distribution

Following Fortin and Lemieux (2015), the following regression was estimated to assess the relationship between rising minimum wages and earnings in the bottom half of the distribution:

$$(E_{it}^{q} - E_{it}^{0.5}) = a^{q}\left(ME_{it} - E_{it}^{0.5}\right) + b^{q}\left(ME_{it} - E_{it}^{0.5}\right)^{2} + c_{i}^{q}t + \theta_{i}^{q} + \delta_{t}^{q} + \varepsilon_{it}^{q}, \quad (5)$$

where E_{it}^{q} denotes the earnings at a particular percentile q, for province i and year t, $E_{it}^{0.5}$ is the earning at the median, ME_{it} is the provincial minimum earnings implied by the corresponding minimum wages at year t, $c_{i}^{q}t$ is a province-specific linear time trend, and θ_{i}^{q} and δ_{t}^{q} are province and year fixed effects, respectively. The left-hand side of the equation represents relative earnings, and $ME_{it} - E_{it}^{0.5}$ on the right-hand side represents relative minimum earnings.

In theory, if the minimum wage is very low, it is not binding on the 10th percentile of wage distribution. As the minimum wage increases—and nears the 10th percentile—the slope on the 10th percentile ($a^{0.1}$ in Equation (5) for a linear case) is expected to be positive because of spillover effects. If the minimum wage is equal to the 10th percentile, the slope should be equal to 1. As hourly wages are not available in the dataset, the minimum wages were replaced with the minimum earnings for each province, which are equal to province-specific minimum wages multiplied by 13 weeks and the national average of usual hours worked per week by full-time employees. However, the relationship between relative wage percentiles and relative minimum wage is expected to pass through to earnings.

Table C.1 shows the results for the relative earnings at the 10th percentile using both linear and quadratic specifications. The national average of usual hours worked per week was used to calculate the minimum earnings and year fixed effects were included in the regression, so the variation in ME_{it} is primarily the result of the variation in minimum wage. Therefore, the coefficients reflect the response of the earnings at the 10th percentile to the minimum wage. For all workers (male and female), the estimated coefficients are positive and significant under the linear specification (Column 1). Under the quadratic specification (Column 4), the response to the minimum wage is convex—as expected—and jointly significant. These results are consistent with those found by Fortin and Lemieux (2015) on the relationship between hourly wages and the minimum wage. This effect is more significant for female workers than for male workers (Column 2 versus Column 3, and Column 5 versus Column 6). This may be partly because there were proportionally more female workers who earned minimum wage or below (Fortin and Lemieux 2015), or because female workers who earned minimum wage wanted to work more hours as the minimum wage increased.

Table C.1
Estimated effect of minimum earnings on the 10th earnings percentile

	Linear specification			Quadratic specification		
	Both males and females	Males only	Females only	Both males and females	Males only	Females only
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
Relative minimum earnings						
Coefficient	0.467 **	0.337 **	0.527 **	0.836	0.102	1.490 **
Standard error	0.054	0.063	0.071	0.729	1.074	0.470
Relative minimum earnings squared						
Coefficient	…	…	…	0.092	-0.053	0.278 †
Standard error	…	…	…	0.179	0.245	0.140
Province fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Joint test (p-value)	…	…	…	0.000	0.002	0.000

… not applicable

** significantly different from reference category ($p < 0.01$)

† significantly different from reference category ($p < 0.10$)

Source: Statistics Canada, Canadian Employer–Employee Dynamics Database.

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