Submitted to *Quantitative Economics*

Four Decades of Canadian Earnings Inequality and Dynamics across Workers and Firms

AUDRA BOWLUS
Department of Economics, University of Western Ontario

ÉMILIEN GOUIN-BONENFANT
Department of Economics, Columbia University

HUJU LIU
Economic Analysis Division, Statistics Canada

LANCE LOCHNER
Department of Economics, University of Western Ontario

YOUNGMIN PARK
Canadian Economic Analysis Department, Bank of Canada

This paper studies the evolution of individual earnings inequality and dynamics in Canada from 1983 to 2016 using tax files and administrative records. Linking individual tax filers to their employers (and rich administrative records on firms) beginning in 2001, it also documents the relationship between the earnings dynamics of workers and the size and growth of their employers. It highlights three main patterns over this period: First, with a few exceptions (sharp increase in top 1% and declining gender gap), Canada has experienced relatively modest changes in overall earnings inequality, volatility, and mobility between 1983 and 2016. Second, earnings inequality and the distribution of earnings growth vary substantially over the business cycle. Third, the earnings dynamics of individuals are strongly related to the size and employment growth of their employers.

KEYWORDS. Earnings inequality, earnings dynamics, firm dynamics.

JEL CLASSIFICATION. E24, J24, J31, J62, L25.

Audra Bowlus: abowlus@uwo.ca
Émilien Gouin-Bonenfant: eg3041@columbia.edu
Huju Liu: huju.liu@statcan.gc.ca
Lance Lochner: llochner@uwo.ca
Youngmin Park: ypark@bankofcanada.ca

We thank Jim Davies for his help on Canadian policy. We also thank the organizers for and participants at the Global Income Dynamics Project conferences, seminar/conference participants at the Bank of Canada, 2021 Canadian Economics Association Annual Conference, 2021 Annual Meeting of the Society for Economic Dynamics, as well as anonymous reviewers for their comments and suggestions. Mauricio Torres Ferro and Tom Trivieri provided excellent research assistance. We received financial support for accessing and vetting the data from the Productivity Partnership. Lochner and Bowlus thank the Social Sciences and Humanities Research Council for its generous support. The views expressed in this paper are those of the authors and do not necessarily represent those of the Bank of Canada or Statistics Canada.

1. Introduction

The rising inequality observed in many developed countries over the past several decades has garnered considerable attention. Changes in earnings inequality may signal structural transformations in the technology of production, shifts in the nature of international trade, evolving labor market institutions, or the influence of new economic policies and their incentives for work. Because the persistence of earnings differences across individuals is critical for understanding the implications of inequality for individual welfare, the evolution of earnings volatility and mobility are also of great interest. In this paper, we study the evolution of earnings inequality, volatility, and mobility in Canada from 1983 to 2016. We also study the extent to which the earnings dynamics of workers depend on the size and growth of the firms at which they work.

Most studies of Canadian earnings inequality rely on Census data or survey data like the Survey of Consumer Finances (SCF), Labour Force Survey (LFS), or Survey of Labour and Income Dynamics (SLID).[1] These studies generally find modest long-term changes in inequality relative to the substantial increases observed in the U.S. (e.g., see the survey in Acemoglu and Autor, 2011). Morissette and Berube (1996) and Baker and Solon (2003) provide early studies of earnings mobility and dynamics in Canada using a 1% random sample of tax records from 1975 to 1993. Both studies document considerable persistence in earnings over the lifecycle, with Baker and Solon (2003) further showing that the variance of both transitory and persistent components increased over that period. Studying Canadian income mobility over more recent decades (using both survey and administrative data), several studies have documented increasing mobility with the duration between periods, although these studies still find considerable persistence in the tails of the earnings distribution (Beach and Finnie, 1998, 2004, Bowlus and Robin, 2012, Lammam, Karabegović, and Veldhuis, 2012). We are unaware of any Canadian studies focusing on the relationship between the earnings dynamics of workers and the employment or productivity dynamics of their firms; however, Gee, Liu, and Rosell (2020) highlight the important role of firms in explaining cross-sectional earnings inequality in Canada.

Like other articles in this issue, we exploit several administrative and tax files. These records allow us to observe annual earnings for all Canadians who file income taxes in every year that they file from 1983 to 2016. Beginning in 2001, we are also able to link these individuals to their employers (and corresponding firm records), facilitating our analysis of joint worker and firm dynamics.

Our analysis provides a wide array of evidence on the evolution of earnings inequality and dynamics in Canada over the last four decades, all using the same data source, sampling scheme, and measures of earnings (with the sampling and measurement designed to facilitate comparisons with the studies focused on other countries in this is-

[1] For example, see Beaudry and Green (2000), Picot (2001), Boudarbat, Lemieux, and Riddell (2010), Brzozowski, Gervais, Klein, and Suzuki (2010), Fortin, Green, Lemieux, Milligan, and Riddell (2012), Beach (2016), Fortin and Lemieux (2015); and Green and Sand (2015). See Frenette, Green, and Picot (2006) for a discussion of the strengths and weaknesses of these data sources, and a comparison of family income inequality across them.

sue).[2] We let the data speak for themselves as much as possible. Here, we briefly highlight three broad sets of findings.

First, with a few notable exceptions, we find only modest changes in standard measures of overall earnings inequality, volatility, and mobility between 1983 and 2016. For example, the earnings for men at the 90th percentile relative to 10th percentile increased by roughly 13%, while this ratio declined by about 8% for women. This experience is quite different from the large increases in inequality documented in the U.S. (see, e.g., Acemoglu and Autor, 2011). Canadian measures of annual or 5-year earnings volatility, as well as earnings mobility over more extended periods, also show little long-term trend. Based on these summary measures, one could be forgiven for thinking that nothing has changed in the Canadian labor market since the early 1980s, but this is not quite true. The earnings of women have risen substantially relative to men (by roughly 30% at the median), and there has been a meteoric rise in earnings among those at the very top of the earnings distribution, as also documented by Saez and Veall (2005) and Veall (2012). More broadly, inequality increased somewhat over the top half of the earnings distribution, while it declined over the bottom half, resulting in modest changes overall.

Second, we find that despite little long-term trend in earnings inequality and volatility, the distributions of both earnings levels and earnings growth vary considerably over the business cycle. The major recession of the early 1990s and, to a lesser extent, the Great Recession of 2008–09 induced sharp (temporary) increases in Canadian earnings inequality. This was driven mainly by substantial earnings losses among men at the bottom of the earnings distribution and younger workers; however, men and women at the very top of the distribution (i.e., top 1%) also experienced heavy losses during these downturns. Looking at the dynamics of earnings, we see moderate increases in earnings volatility among men during recessions, but little cyclical variation in volatility among women. More notably, we observe strong cyclicality in the skewness of earnings growth, as recessions lead to more frequent occurrences of large earning losses and less frequent instances of large earnings gains.

Third, we show that the earnings dynamics of workers are strongly related to the size and employment growth of their employers. Most interestingly, we find that workers at fast-growing firms experience faster earnings growth and less downside risk than workers at rapidly shrinking firms, who experience low (or negative) average earnings growth and little upside risk. Meanwhile, workers at firms with stable employment typically experience moderate earnings growth with little upside or downside risk. Our results further reveal that the positive relationship between workers' average earnings growth and their firms' employment growth is broad-based, evident for those with high and low recent earnings levels, those at large and small firms, and those at young and old firms.

The rest of this paper is organized as follows. Section 2 begins by discussing our main source of data, sampling, and variable definitions. This is followed by a brief overview of the economic and policy environment in Canada over the period we study. Our empirical analysis is contained in Sections 3 and 4. The former contains our individual-level

[2]All statistics reported in this paper and online in Supplementary Appendices SA and SB, along with many additional statistics on inequality, earnings dynamics, and mobility, will (soon) be publicly available as part of the Global Income Dynamics Project.

analysis of earnings inequality, volatility, and mobility, while the latter contains our analysis of the joint dynamics of worker earnings and firm employment. Section 5 concludes.

2. Data and Overview of Canadian Economy from 1983 to 2016

This section briefly describes the data used in this paper, as well as the economic and policy environment in Canada over the period studied. We note that the sample selection criteria and earnings measures, as well as most statistics reported in Section 3, have been harmonized across countries (see other articles in this special issue) as part of the Global Income Dynamics Project.

2.1 *Data*

We use the Canadian Employer–Employee Dynamics Database (CEEDD) for the analysis in this paper. The CEEDD is a linkable environment developed by Statistics Canada that consists of several administrative and tax files for individuals and firms. The individual-level data are drawn from the T1 Personal Master File (T1PMF), which contains annual personal income tax records for all Canadian tax filers who filed their tax returns before a specified cut-off date, usually in December one year after the tax reference year (Messacar, 2017).[3] Over our sample period, 1983–2016, the T1PMF includes records each year for 89–93% of all 25- to 55-year-old Canadians. The Appendix provides additional details on the CEEDD and discusses concerns about the omission of late- and non-filers from the data. In short, we conclude that the modest year-to-year changes in observed filing behavior are unlikely to have any notable impacts on the evolution of broad measures of inequality during our sample period.

Our analysis focuses on annual (pre-tax) individual earnings as measured by the sum of employment income (wages, salaries, bonuses, overtime pay, paid vacation, and commissions) reported on T4 slips from all jobs and other taxable receipts from employment (e.g., tips, gratuities, director's fees) that are not reported on T4 slips. Self-employment income is not considered. All earnings from 1983 to 2016 are denominated in 2018 Canadian dollars using the Canadian Consumer Price Index. Denote these earnings for individual i in year t by $\tilde{y}_{i,t}$.

To ensure cross-country comparability and to reduce the impacts of school-to-work transitions and retirement on earnings dynamics, our analysis uses earnings observations only for individuals ages 25–55. Even within these ages, not everyone appears in the data every year. Individuals may file late, or they may not file taxes at all when they have little or no income. Some individuals may be out of the country. Due to high rates of immigration to and emigration out of Canada, we omit (or leave as missing) any earnings measures that are missing before the first year someone is observed filing their taxes or after the last year they are observed filing; otherwise, we treat missing earnings observations as zeros, setting $\tilde{y}_{i,t} = 0$.[4] Although this could be problematic for late-filers,

[3] Only about 3.5–4.8% of all tax filers do not file tax returns before this date; these late filers are not included in T1PMF.

[4] This approach implicitly assumes that individuals are out of the country prior to their first observed filing year or after their last observed filing year, while missing observations in the middle of someone's time series of filings reflect years with no earnings.

we ultimately trim these and other very low earnings measures in nearly all of our analysis to minimize the influence of temporary employment and weak labor market attachment.[5]

We define a minimum earnings threshold in year t, $\underline{y}_t$, as the amount a worker could earn by working 20 hours per week for a quarter of the year (13 weeks) at the real minimum wage for that year. Because Canada does not have a federal minimum wage, the minimum earnings threshold is based on the lowest provincial minimum wage at the time.[6] The measure of annual earnings we use in our empirical analysis, $y_{i,t}$, equals $\tilde{y}_{i,t}$ if $\tilde{y}_{i,t} > \underline{y}_t$; otherwise, it is set to missing. In much of our analysis, we focus on the natural logarithm of this annual earnings measure, $\log(y_{i,t})$. We also calculate residualized log earnings $\varepsilon_{i,t}$ from regressions of $\log(y_{i,t})$ on annual age dummies separately by gender and year, thereby removing average lifecycle effects on earnings. (These residuals are also missing whenever earnings are below the threshold.) Based on these residuals, we also construct measures of annual and 5-year (residual) log earnings growth: $\Delta^1\varepsilon_{i,t} \equiv \varepsilon_{i,t+1} - \varepsilon_{i,t}$ and $\Delta^5\varepsilon_{i,t} \equiv \varepsilon_{i,t+2} - \varepsilon_{i,t-3}$, where the latter is roughly centered on year t.[7]

Finally, we calculate two measures of "permanent" earnings to minimize the effects of year-to-year fluctuations. Our main measure of permanent earnings is designed to focus on the distribution and dynamics of earnings for individuals with moderate to strong labor market attachment, while we also consider an alternative measure that facilitates an analysis of long-term earnings mobility that incorporates workers who may be less attached, including those with very low or zero earnings for multiple years. In both cases, we begin by calculating $P_{i,t}$ as the average of non-missing earnings over three years ($\tilde{y}_{i,t}$, $\tilde{y}_{i,t-1}$, and $\tilde{y}_{i,t-2}$). Our main measure reflects this average whenever (i) $\tilde{y}_{i,t}$ is non-missing (i.e., all years from first to last observed filing) and (ii) at least two of the earnings measures are above the earnings threshold for their respective years; otherwise, this measure is set to missing. The second restriction ensures that this measure is always positive. Most of our analysis uses *residualized permanent earnings*, $\varepsilon^P_{i,t}$, after removing lifecycle effects via regressions of $\log(P_{i,t})$ on annual age dummies separately by gender and year. Our analysis of long-term earnings mobility considers an *alternative permanent earnings* measure, denoted $\tilde{P}_{i,t}$, which also begins with $P_{i,t}$; however, this measure requires only one of the three earnings measures to be above the minimum earnings threshold and is not adjusted for age, gender, or year effects.

Table 1 provides an overview of our data every 5 years. (Appendix Table 4 reports selected percentiles of the annual earnings distribution over time.) For cross-country

[5] By itself, the exclusion of late filers has little effect on earnings distributions (Messacar, 2017). As discussed next, our analysis of annual earnings measures trims very low earnings observations, so setting missing observations to zero has no effect on most of our results. Treatment of missing observations only affects our calculation of "permanent" earnings measures, which are primarily used in our analysis of earnings mobility. As discussed in Section 3.3, alternative treatments of missing observations yield nearly identical mobility patterns for permanent earnings.

[6] All reported results are very similar if we instead use the provincial population-weighted average minimum wage over time. Appendix Figure 25 shows minimum wages for each Canadian province over time.

[7] When calculating these earnings growth measures, we require that earnings in the earlier period exceeds the earnings threshold for that year, while we only require that earnings in the later year exceeds one-third of that year's threshold.

comparison, earnings *in these tables only* are converted to U.S. dollars using the 2018 exchange rate (after first deflating all values to 2018 dollars). The number of workers in our sample increases from 8 million to 10.8 million over the 30-year period. Average earnings increases by almost 30%, while the standard deviation of earnings doubles. The fraction of workers that are women increases, as does the average earnings of women relative to men. There is a gradual aging of the population due to the Baby Boom.

TABLE 1. Descriptive statistics for selected cross-sectional samples

					Mean earnings		Age shares (%)		
Year	Obs. (mill.)	Mean earnings	Std. dev. earnings	Women share (%)	Men	Women	[25,35]	[36,45]	[46,55]
1985	8.0	35,968	33,899	44.1	44,353	25,351	47.1	32.2	20.7
1990	9.3	36,590	39,464	46.7	44,886	27,107	43.9	34.5	21.6
1995	9.6	36,770	42,218	47.3	44,351	28,309	37.9	36.1	25.9
2000	10.2	40,736	74,135	48.4	49,652	31,220	33.2	36.9	29.9
2005	10.5	41,855	75,630	49.0	50,766	32,582	32.7	34.0	33.3
2010	10.6	43,719	62,609	49.2	51,841	35,331	34.0	30.8	35.3
2015	10.8	45,759	67,350	48.8	53,961	37,151	36.0	31.1	33.0

Note: Annual earnings reported in 2018 U.S. dollars.

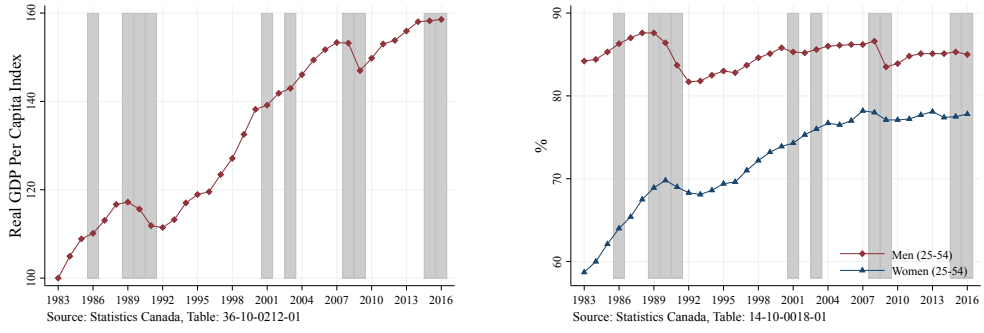
2.2 *Economic and Policy Environment in Canada: 1983–2016*

Like many developed countries, Canada has experienced the impacts of technological innovation on the demand for skill and structure of wages (see, e.g., Berman, Bound, and Machin, 1998, Green and Sand, 2015). Yet, many other economic and policy changes also shape the evolution of earnings inequality and dynamics. This section provides a brief overview of several such forces in Canada since the early 1980s.

We begin with a summary of the macroeconomic environment in Figure 1, which documents real GDP per capita and employment rates for men and women ages 25–54 over time. Shaded vertical bars in these (and subsequent figures) indicate years with at least one quarter of negative GDP per capita growth.[8] Over the past several decades, Canada has experienced moderate economic growth and considerable convergence in employment rates by gender, with male employment rates hovering around 85% and female employment rates increasing from 60% to nearly 80% at the onset of the Great Recession, stabilizing thereafter.

Two major recessions stand out—that of the early 1990s and the global Great Recession of 2008–09. The early-1990s recession was much deeper and more protracted in Canada than in the U.S., punctuated by large drops in Canadian output and employment (especially among men) between 1989 and 1992. While output and the female employment rate recovered over a few years, the male employment rate never returned

[8] Downturns in 1986, 2001, and 2003 were all only a single quarter in duration and were not formally labeled recessions. The most recent downturn reflects a 6-quarter period of economic stagnation with modest negative growth in the first two quarters of 2015 and then again in the second quarter of 2016.



(a) Real GDP per capita (b) Employment rate for men and women ages 25–54

FIGURE 1. Canadian macroeconomic conditions, 1983–2016

to its pre-recession peak. The underlying causes for this recession have been hotly debated (see, e.g., Fortin, 1996, Freedman and Macklem, 1998); however, Trefler (2004) estimates that the 1988 Canada–U.S. Free Trade Agreement led to a substantial reallocation of workers and other resources across plants and industries between 1988 and 1996. It is not surprising, therefore, that we find dramatic changes in earnings inequality and volatility over this period. By comparison, the Great Recession produced much sharper but smaller drops in output and employment in Canada. The former recovered quickly, while the latter did not. As documented below, the dynamics of earnings inequality and volatility were similar to, though generally more muted than, those observed over the early-1990s recession.

The Canadian economy relies heavily on natural resources, as well as a strong influx of skilled immigrants. The oil and gas boom from roughly 2000 to 2015 raised earnings levels, especially among the less-educated, in Alberta, Saskatchewan, and Newfoundland; however, its impact on overall inequality in Canada is likely to have been modest (Fortin and Lemieux, 2015). The impacts of immigration are more widespread, with immigrants making up slightly more than 20% of all Canadians. The introduction of an Economic Class of immigrants in 1976 and its expansion in the 1980s led to large inflows of highly educated/skilled workers and entrepreneurs, which dampened growth in Canada's university wage premium (Aydemir and Borjas, 2007).

As in other developed countries, Canada experienced a sharp decline in union membership over recent decades, especially among men (Card, Lemieux, and Riddell, 2020). Card, Lemieux, and Riddell (2004) suggest that even stronger de-unionization in the U.S. and U.K. over the 1980s and 1990s may have contributed to sharper increases in inequality in those countries. In recent years, Card, Lemieux, and Riddell (2020) estimate that unions reduce the variance of log wages among Canadian men by less than 10%, with no effects on wage inequality among Canadian women.

Another potentially important trend has been the roughly 50% increase in real minimum wages over the past few decades (see Appendix Figure 25). This is likely to impact inequality at the bottom of the distribution through direct effects on hourly wages and indirect effects on employment and hours of work. Fortin, Green, Lemieux, Milligan, and Riddell (2012) argue that minimum wage increases in Canada's three largest

provinces during the 1990s had only modest impacts on the lower end of their wage distributions, while Fortin and Lemieux (2015) show that the large increases in minimum wages (across all provinces) in the 2000s can account for the contemporaneous declines in wage inequality over the bottom half of the distribution. It is worth noting, however, that the compression effects on lower (hourly) wage levels need not translate into compression in (annual) earnings at the bottom of the distribution.

Finally, major changes in Canadian tax and transfer policies have altered work incentives in ways that are likely to have increased earnings inequality at the top of the distribution, while lowering it at the bottom.[9] For example, the top federal marginal tax rate was lowered from 34% to 29% in 1988, then raised again to 33% in 2016. Reductions in provincial tax rates during the late-1990s also tended to impact high-income families most. At the other end of the earnings distribution, major changes in unemployment benefits, child tax benefits, and social assistance directly encouraged work (Frenette, Green, and Milligan, 2009, Finnie and Irvine, 2011, Milligan and Stabile, 2007, Milligan, 2016). At the same time, provincial expansions in job-protected maternity/parental leave during the early 1990s and in 2000 have mainly impacted female labor supply and earnings (Baker and Milligan, 2008).

3. Earnings Inequality, Dynamics, and Mobility in Canada: 1983–2016

This section documents individual earnings inequality, dynamics, and mobility in Canada from 1983–2016 using the T1PMF tax file discussed in Section 2.1.

3.1 *Earnings inequality over time*

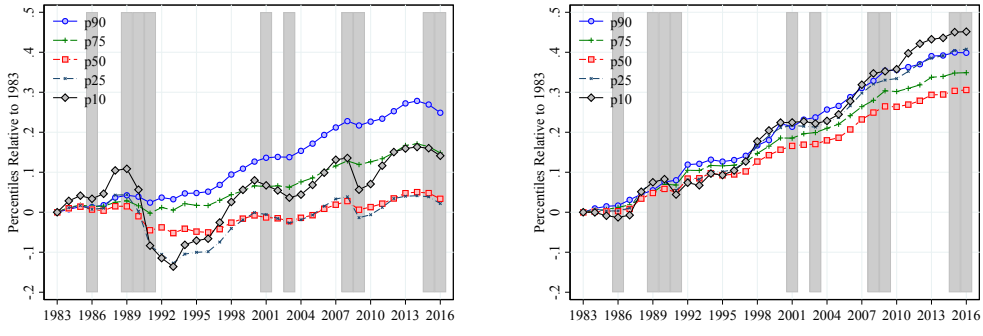
A decades-long literature on wage and earnings inequality documents worsening wage and earnings outcomes for young, low-skilled workers relative to older, high-skilled workers over time (see, e.g., the survey in Acemoglu and Autor, 2011). More recently, Hoynes, Miller, and Schaller (2012) highlight the stronger adverse employment effects of recessions on younger and less-skilled workers.[10] A largely distinct but related literature has focused on the growing concentration of income at the very top of the distribution (e.g., Piketty and Saez, 2003,). This subsection examines these issues within the Canadian context, beginning with an analysis of long-term trends and short-term cyclical patterns for earnings inequality, followed by an examination of inequality by age/cohort and a brief look at the concentration of earnings at the very top.

Long-term trends. *Since the early 1980s, inequality over the top half of the distribution has consistently increased for both genders (especially at the very top), while inequality over the bottom half declined (especially for women). This has led to a small rise in overall inequality for men and little change for women.*

[9] See Frenette, Green, and Milligan (2009) for an analysis of the effects of changes in Canadian tax and transfer policy on after-tax income inequality from 1980 to 2000.

[10] Beaudry and DiNardo (1991) show that, consistent with implicit contracting models, poor labor market conditions appear to have lasting effects on wages, while Jacobson, LaLonde, and Sullivan (1993) (and many subsequent studies) estimate lasting effects of job displacement on earnings.

Appendix Table S1 (in the online supplement) summarizes the distribution of earnings for men and women in 1985 and 2015, offering a snapshot of long-term changes in Canadian earnings inequality. In 1985, median earnings for Canadian men were about $55,000 Canadian (denominated in 2018 dollars), nearly double the roughly $30,000 earned by the median Canadian woman. Men at the 90th percentile earned nearly seven times as much as men at the 10th percentile, while women at the 90th percentile earned about nine times as much as women at the 10th percentile. As shown in Figures 2 and , which report changes in various percentiles of the log earnings distribution over time (relative to their initial 1983 values), Canadian women experienced sizeable increases in earnings throughout the distribution—by about 30 log points at the median and more everywhere else. Canadian men did not fare as well, with their sizeable earnings advantage relative to women narrowing considerably at all earnings percentiles (by half at the median).[11] While men at the top and bottom of the earnings distribution experienced healthy gains, men at the 25th and 50th percentiles are no better off today than they were more than 30 years earlier. At the very top of the earnings distribution (i.e., top 1% and above), both men and women gained substantially. Between 1983 and 2007, earnings shot up more than 50 log points for men and women at the 99th percentile and more than doubled for those in the top 0.1%. Following the Great Recession, earnings fell substantially for men in the top 0.1%, while they remained largely stagnant for their female counterparts.



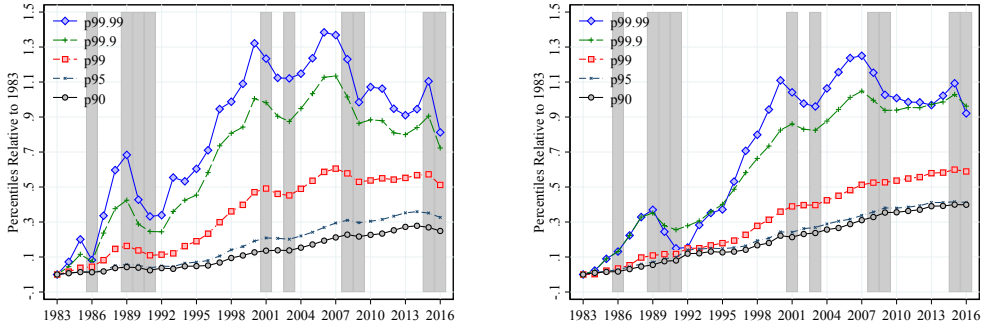
(a) Men (b) Women

FIGURE 2. Changes in percentiles of $\log(y_{i,t})$ (1983=0)

These trends imply that over the past few decades, men experienced a modest increase in earnings inequality (mostly coming during the early 1990s recession), as measured by the 90–10 percentile difference or standard deviation of log earnings (see Figure 4), while inequality declined slightly for women.[12] As discussed in Green and Sand

[11] As documented by Fortin, Green, Lemieux, Milligan, and Riddell (2012) and Green and Sand (2015), these findings are consistent with time patterns for hourly and weekly wages based on Census and LFS data.

[12] Figure 4 reports 2.56 $\times$ the standard deviation of earnings, which would equal the 90–10 difference if earnings were normally distributed. The smaller 90–10 difference (for men) indicates that the earnings distribution has fat tails relative to a normal distribution.



(a) Men (b) Women

FIGURE 3. Change in upper percentiles of $\log(y_{i,t})$ (1983=0)

Note: Due to sample sizes and confidentiality rules, we are unable to report earnings at the 99.99 percentile for women prior to 1988. In panel (b), we impute the 1983–1988 changes in $P99.99$ for women using their changes for $P99.9$.

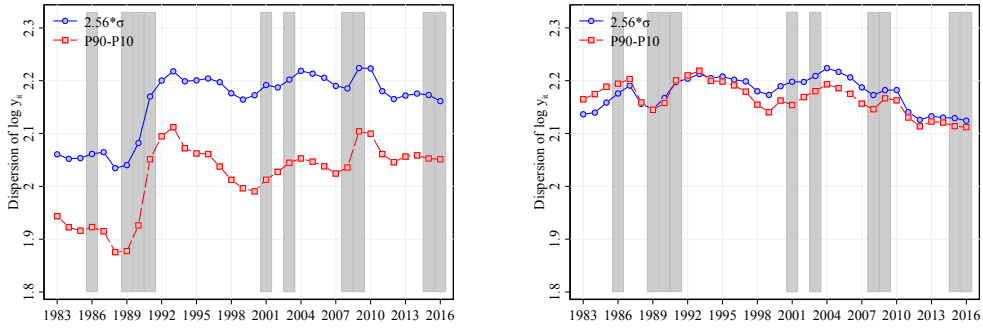
(2015), the evolution of inequality in Canada differed at the top and bottom of the earnings distribution. Figure 5 shows that both men and women saw earnings inequality increase in the top half of the distribution, while inequality declined at the bottom.[13] The main difference in long-run trends in earnings inequality between men and women was the stronger increase in inequality at the top for men, with their 90–50 difference rising 22 log points between 1985 and 2015 compared to just 9 log points for women.[14] Among women, the decline in the 50–10 difference more than offset the modest increase in the 90–50 difference.

Over the same time period, the U.S. experienced a qualitatively similar, though markedly stronger, secular increase in inequality throughout the top half of the wage and earnings distributions (e.g., see Acemoglu and Autor, 2011, Heathcote, Perri, and Violante, 2010, Guvenen, Kaplan, Song, and Weidner, 2018). Inequality over the bottom half of the distribution showed little long-term trend based on hourly and weekly wages in the CPS (Acemoglu and Autor, 2011, Heathcote, Perri, and Violante, 2010), while Guvenen, Kaplan, Song, and Weidner (2018) document a sharp increase after 2000 in the 50–10 log earnings difference (for both men and women) based on administrative data from the Social Security Administration. Overall wage and earnings inequality increased in the U.S.

These long-term trends in inequality (at both the top and bottom of the earnings distribution) are quite similar when looking at residualized annual ($\varepsilon_{i,t}$) or permanent ($\varepsilon^P_{i,t}$) earnings. (See Appendix Table S2 and Appendix Figures S1–S6.) Thus, the evolution of inequality in Canada over our sample period does not appear to be driven by

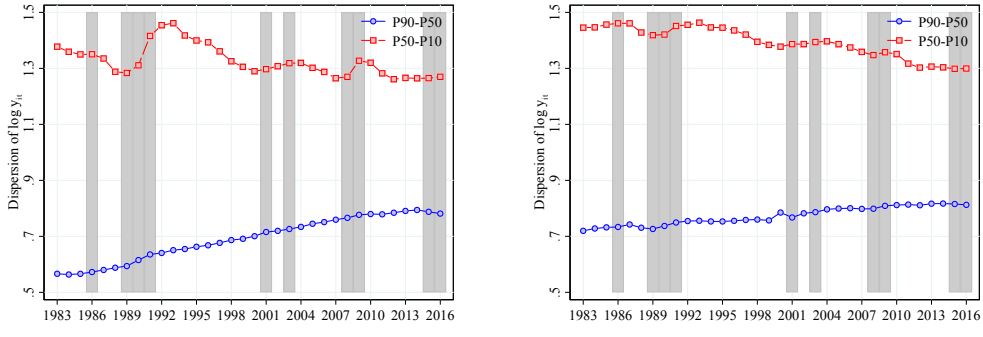
[13] Based on data from the Canadian LFS, Fortin and Lemieux (2015) conclude that much of the increase in wages at the bottom relative to middle of the distribution since the mid-2000s (especially among women) can be explained by increases in minimum wages (see Appendix Figure 25); however, Figure 5 shows no obvious break in trend for the 50–10 difference in log earnings for men or women during this period.

[14] The sharper increase in the 90–50 difference for men relative to women is largely driven by differences in trends for median earnings, which were largely stagnant for men but increased over 30 log points for women (see Figure 2).



(a) Men (b) Women

FIGURE 4. 90–10 percentile difference and 2.56 × standard deviation of $\log(y_{i,t})$



(a) Men (b) Women

FIGURE 5. 90–50 and 50–10 percentile differences for $\log(y_{i,t})$

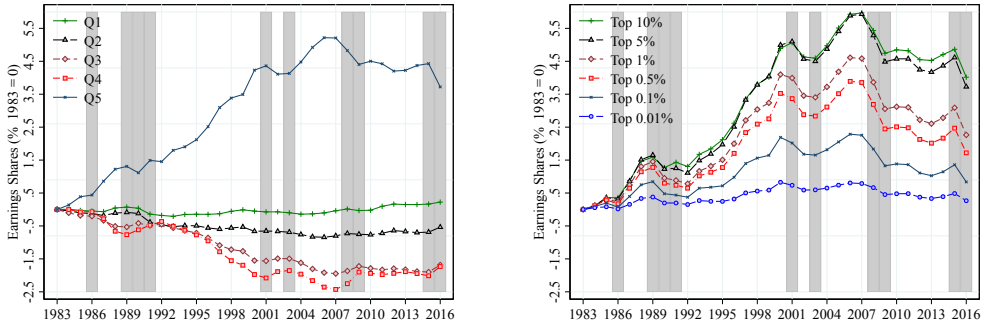
changes in the age composition of the workforce or by major changes in the variability of year-to-year fluctuations in earnings. The latter point is even more forcefully made by Morissette and Berube (1996), who show that over the early part of our time period (between 1975–84 and 1984–93), the increase in annual earnings inequality was very similar to the increase for 6- and 10-year averages of earnings.

The evolution of earnings inequality for the overall population, combining both men and women, reflects the substantial narrowing of the gender earnings gap, coupled with modest (sometimes opposing) changes within gender. Together, these influences produce time patterns for 90–10, 90–50, and 50–10 log earnings percentile differences that look quite similar to those observed for women (see Appendix Figure S7): overall inequality declined very slightly, reflecting a nearly 20 log point decline in the 50–10 difference and 15 log point increase in the 90–50 difference.

Finally, Appendix Table S3 documents the share of earnings earned by each quintile of the earnings distribution (and for top percentiles) in 1985 and 2015, while Figure 6 graphs the changes in these shares relative to their corresponding 1983 values. The top quintile of all earners increased its share of earnings from 41% in 1983 to 46% in 2006,

before falling to roughly 45% after the Great Recession.[15] These gains came largely at the expense of workers in quintiles 3 and 4, who saw their shares decrease by about 2 percentage points from roughly 18% and 26%, respectively.

Altogether, we find that broad-based measures of earnings inequality changed very little in Canada over the past few decades, although earnings rose substantially at the very top.[16]



(a) Changes in earnings shares by quintile (1983=0) (b) Changes in top earnings shares (1983=0)

FIGURE 6. Changes in earnings shares for $\log(y_{i,t})$ for men and women combined (1983=0)

Cyclical features. *There is strong cyclicality in earnings inequality, especially for men.*[17] *Declines in earnings during economic downturns were especially severe for workers in the bottom half of the distribution, as well as those at the very top.*

Figure 2 shows that the early-1990s recession drove men's earnings at the 10th percentile down more than 20% over just a few years, while it took more than 5 years for earnings at the bottom of the distribution to (nearly) recover. The Great Recession produced qualitatively similar, but more muted, effects. By contrast, men earning at the 75th and 90th percentiles experienced little to no decline during economic downturns. Figure 5 shows that the early 1990s recession, and to a lesser extent the Great Recession, generated dramatic increases in the 50–10 difference but negligible impacts on the 90–50 difference for men. Following recessions, the 50–10 difference slowly returned to pre-recession levels, while the 90–50 difference grew at a fairly constant rate through good

[15] Appendix Figure S10 shows that the Gini coefficient followed a qualitatively similar time pattern, rising from about 0.375 in 1983 to slightly more than 0.42 in 2006, then falling by about 0.01 after the Great Recession.

[16] Using a measure of per capita household earnings and combining data from the Canadian SCF and SLID, Brzozowski, Gervais, Klein, and Suzuki (2010) document a stronger increase in the variance of log earnings between 1983 and 2005 but a similar increase in the Gini coefficient relative to our findings reported in Appendix Figures S7 and S10. Our patterns for the evolution of earnings shares in Figure 6(a) are broadly consistent with the Census-based findings of Beach (2016) for 1980–2005.

[17] Brzozowski, Gervais, Klein, and Suzuki (2010) show that the cyclical nature of earnings in Canada is driven by cyclicality in both wages and hours of work, both seemingly stronger for men than women over the 1980s and 1990s.

times and bad. These patterns are similar but weaker for women, with one notable exception: women experienced gradual declines in the 50–10 difference during good times that more than offset the sharp increases during recessions, producing the long-term decline in inequality among women discussed earlier.

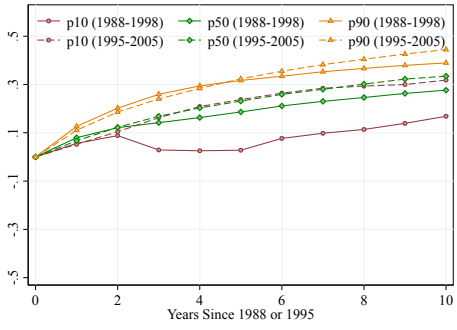
As shown in Guvenen, Kaplan, Song, and Weidner (2018), most of these patterns are evident in the U.S. as well, where the 50–10 difference is strongly counter-cyclical while the 90–50 difference is not, and cyclicality is much stronger for men than for women. A notable exception is the sharp increase in the 50–10 difference for American men and women from 2000 to the onset of the Great Recession. By contrast, this measure of inequality at the bottom declined slightly in Canada over this period despite two short economic downturns.

The cyclicality of earnings inequality, especially at the bottom of the distribution, is also apparent for residualized permanent earnings, $\varepsilon^P_{i,t}$, as shown in Appendix Figure S5. This finding is broadly consistent with growing recent evidence on the disproportionate impacts of recessions on low-skilled workers (Hoynes, Miller, and Schaller, 2012, Forsythe, 2019, Hershbein and Kahn, 2018). Further evidence on the differential impacts of the early-1990s recession on workers of different skill levels is exhibited in Figure 7, which documents the evolution of 10th, 50th, and 90th percentiles of log earnings residuals over the periods 1988–1998 and 1995–2005 (relative to 1988 or 1995, respectively) separately for different quartiles of recent residualized permanent earnings (ε^P_t measured in 1987 or 1994, respectively). Figures 7(a) and 7(b) show that, among workers with low permanent earnings, inequality grew substantially more during the early-1990s recession relative to the boom period of the late 1990s. Notably, the stronger increase in inequality over the early-1990s recession (for those with low permanent earnings) is driven entirely by a widening at the bottom of the distribution: earnings at the 10th percentile increased much less (or fell much more) through the early-1990s recession than during the later period of sustained economic growth. By contrast, Figure 7(d) shows that residual earnings distributions evolved very similarly across the two periods for workers in the top permanent earnings quartile. Appendix Figure S11 shows qualitatively similar (though more muted) patterns over the Great Recession.

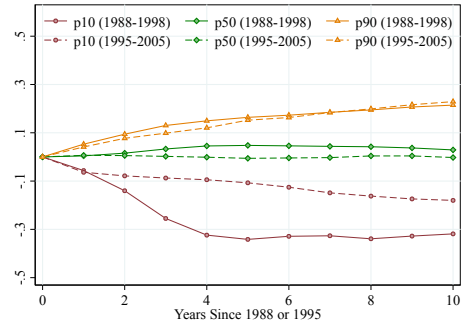
Finally, we draw attention to Figure , which shows that among those with earnings in the top 0.1%, earnings are just as cyclical as for workers at the bottom of the distribution. Unlike workers throughout most of the distribution, those at the very top saw their earnings fall more during the Great Recession than during the early-1990s recession. This cyclicality at the very top is broadly consistent with findings for the U.S. (Guvenen, Kaplan, and Song, 2014).

Inequality by age and cohort. *Long-term trends in Canadian earnings inequality are largely independent of age; however, earnings are much more cyclical for young workers and those at the bottom of the distribution, generating strong cyclicality in early-career earnings inequality.*

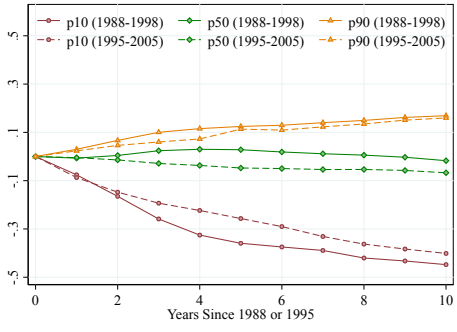
Figure 8 documents median log earnings for men and women at ages 25, 30, and 35, along with observed lifecycle trajectories for cohorts that were age 25 in 1985, 1990,..., 2010. (Appendix Figure S12 reports analogous figures for the 10th and 90th percentiles.) The long-term trends for workers ages 30 and 35 largely mimic our earlier results for



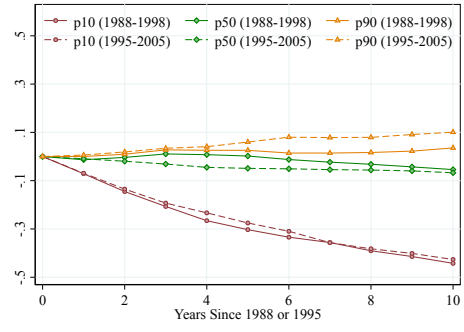
(a) Quartile 1 for $\varepsilon^P_{i,1987}$ (solid) or $\varepsilon^P_{i,1994}$ (dashed)



(b) Quartile 2 for $\varepsilon^P_{i,1987}$ (solid) or $\varepsilon^P_{i,1994}$ (dashed)



(c) Quartile 3 for $\varepsilon^P_{i,1987}$ (solid) or $\varepsilon^P_{i,1994}$ (dashed)



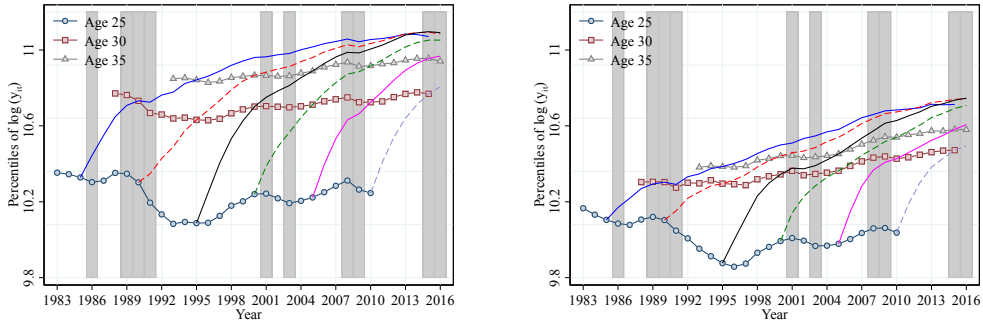
(d) Quartile 4 for $\varepsilon^P_{i,1987}$ (solid) or $\varepsilon^P_{i,1994}$ (dashed)

FIGURE 7. Changes in percentiles of $\varepsilon_{i,t}$ over 1988–1998 and 1995–2005 by residualized permanent earnings quartile in 1987 or 1994, respectively

the full population (see Figure 2): median earnings were stagnant for men and rising for women, while earnings at the 10th and 90th percentiles rose for both genders. By contrast, median earnings fell slightly for 25-year-old men and women. The implications of these patterns for earnings inequality by age are reported in Figures 9 and 10: the long-run stability of the 90–10 difference reflects an offsetting increase in the 90–50 difference and decline in the 50–10 difference.

Figure 8 shows that the early-1990s recession had a devastating impact on the earnings of 25-year-old Canadian men and women but much smaller effects on 30 year-olds, although Appendix Figure S12 indicates that 30 year-olds at the 10th percentile certainly felt the impacts. Earnings of 35 year-olds at the median and 90th percentile experienced almost no visible business cycle effects on their earnings, while the early-2000s downturns and Great Recession induced modest earnings declines for those at the 10th percentile. These results are in line with the stronger effects of recessions on low-skilled workers documented by Hoynes, Miller, and Schaller (2012). They imply stronger cyclicality in earnings inequality among young workers—especially young men—driven by changes in both 90–50 and 50–10 differences (see Figure 10).

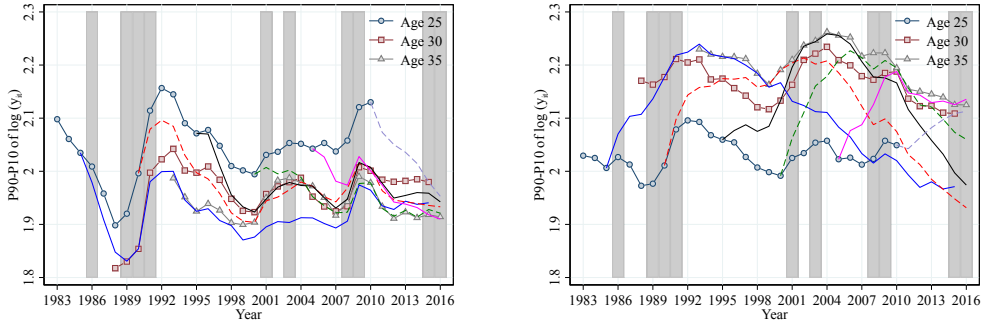
Guvenen, Kaplan, Song, and Weidner (2018) document a similar decline in the early 1990s and rise in the late 1990s for median earnings among 25-year-old men; however,



(a) Men (b) Women

FIGURE 8. Age and cohort profiles for median $\log(y_{i,t})$

Note: Lines with markers reflect median $\log(y_{i,t})$ for reported ages, while lines without markers reflect lifecycle profiles for median $\log(y_{i,t})$ for cohorts turning age 25 in 1985, 1990,..., 2010.



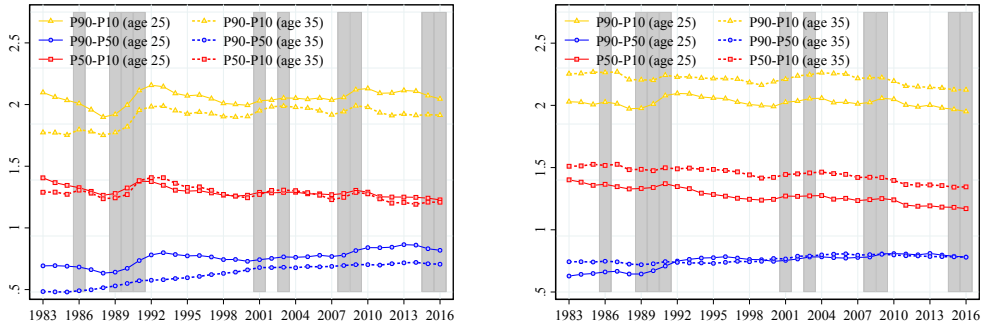
(a) Men (b) Women

FIGURE 9. Lifecycle inequality (90–10 percentile differences) in $\log(y_{i,t})$ across cohorts

Note: Lines with markers reflect 90–10 percentile differences for reported ages, while lines without markers reflect lifecycle profiles for 90–10 percentile differences for cohorts turning age 25 in 1985, 1990,..., 2010.

the decline is noticeably more pronounced among 35-year-old American men compared to Canadian men. Differences between Canadian and American women are more noteworthy. While 25-year-old Canadian women saw close to 30 log point drops in their median earnings over the early 1990s, followed by a protracted partial recovery over the next 15 years, young American women experienced only modest declines in median earnings over the early 1990s, followed by a sharp increase during the late 1990s. Median earnings increased slowly and consistently over time for 35-year-old Canadian women, while they increased sharply over the late 1990s and then remained flat thereafter for American women. These comparisons highlight the strength of the early-1990s recession in Canada and tepid recovery over the late 1990s, especially for young Canadian women.

As most economic models predict, the lifecycle profiles plotted in Figure 8 and Appendix Figure S12 are generally increasing and concave, especially those at the 90th per-



(a) Men ages 25 and 35

(b) Women ages 25 and 35

FIGURE 10. 90–10, 90–50, and 50–10 percentile differences for $\log(y_{i,t})$ by age and gender

centile, which show little disruption from the business cycle. We also observe less lifecycle earnings growth for women throughout the distribution and over time. The impacts of recessions on lifecycle profiles are most stark at the bottom of the earnings distribution, where the early-1990s recession, as well as the Great Recession, led to modest declines in earnings for men from all cohorts. Any lingering effects on earnings for cohorts that were young during the depths of recessions appear to be modest, at best. For example, we see fairly rapid log earnings growth over ages 25–30 for the cohort of 25 year-olds in 1995 compared to the cohort turning age 25 five years earlier or later. The effects of contemporaneous economic conditions on earnings are clearly dominant.

Figure 9 shows that inequality rises quickly during recessions and falls more slowly during booms, whether we follow a given cohort as they age or look across cohorts at a specific age. Among men, the evolution of inequality over the lifecycle is driven largely by aggregate economic conditions, while there is a clear tendency for inequality to rise over the early part of women's careers and fall later in their careers.

Our long time series helps distinguish between cohort differences in lifecycle profiles that are driven mostly by (sometimes protracted) business cycle effects and longer-term trends. To appreciate this, consider that Beaudry and Green (2000) exploit SCF data from 1971–1993, while Beach and Finnie (2004) use LAD tax data from 1982–1999 to study cohort lifecycle profiles. Together, they document an upward shift in earnings profiles for cohorts entering in the 1960s and 1970s, followed by downward shifts for those entering in the 1980s and early 1990s. Throughout the 1980s, lifecycle profile shifts remained largely parallel; however, they appear to have steepened for cohorts entering in early 1990s. Although we do not observe cohorts entering in the 1970s, it is clear from our analysis that the patterns observed for cohorts entering over the late 1980s and early 1990s do not represent long-term shifts in earnings profiles. Instead, they reflect the devastating and drawn-out impacts of the early-1990s recession. Earnings profiles shifted back up in the late 1990s and changed little for cohorts turning age 25 between 2000 and 2010.

Earnings concentration at the very top. *The concentration of earnings at the very top of the distribution grew considerably between 1983 and the Great Recession, falling thereafter.*

Appendix Table S3 documents the substantial concentration of earnings at the top of the distribution. More than a quarter of total earnings goes to the top 10% of all earners. Between 1985 and 2015, the share of earnings going to the top 1% rose by 53% (from 5.2% to 8.0% of all earnings), while the share going to the top 0.01% nearly doubled (from 0.46% to 0.86%). Figure 6(b) shows that top earnings shares increased until 2007 and declined thereafter. Short-term fluctuations in top earnings shares are mostly procyclical; however, they have not recovered since the sharp decline associated with the Great Recession.[18]

Saez and Veall (2005) and Veall (2012) report similar patterns for top income shares in Canada over 1982 to 2010 using the Longitudinal Administrative Data (LAD), a 20% random sample of all tax filers. Saez and Veall (2005) further show that top income shares in Canada evolved very similarly to those in the U.S. (potentially due to the highly integrated labor market for skilled workers). Moreover, top total income shares are similar to top earnings shares for recent years in Canada, as labor income has become the dominant source of income, even at the very top.

Most recently, the sharp decline in earnings shares for workers in the top 1% in 2016 could reflect changes in response to the 2015–2016 economic downturn, although this downturn was quite mild. Alternatively, it could reflect behavioral responses (in labor supply or income reporting for tax purposes) to the 2016 increase in the top marginal income tax rate (from 29% to 33%). Regardless, Milligan and Smart (2015) find that tax changes do not explain the long-run trends in Canadian top income shares.

3.2 *Earnings growth: volatility, skewness, and kurtosis*

We now turn to an analysis of residual log earnings growth over time. The distribution of earnings growth is of considerable interest, because it reflects individual earnings risk as well as heterogeneity in lifecycle skill growth. Both have important implications for individual consumption/savings decisions, asset prices, and the aggregate distribution of wealth.

A wave of interest in earnings volatility (i.e., the dispersion of residual log earnings growth) was initially sparked by Gottschalk and Moffitt (1994), who documented an increase in U.S. earnings volatility and variation in transitory earnings shocks over the 1970s and early 1980s. More recently, debate has arisen regarding U.S. trends in volatility over the 1980s and 1990s, with survey-based data suggesting fairly stable or growing volatility over time and administrative data suggesting a strong secular decline. See Moffitt (2020) for a review of this literature and efforts to reconcile results across studies and data sources.

Since earnings growth varies substantially over the lifecycle, this analysis focuses on annual and 5-year changes in residualized log earnings, $\Delta^1\varepsilon_{i,t}$ and $\Delta^5\varepsilon_{i,t}$.[19] As in the

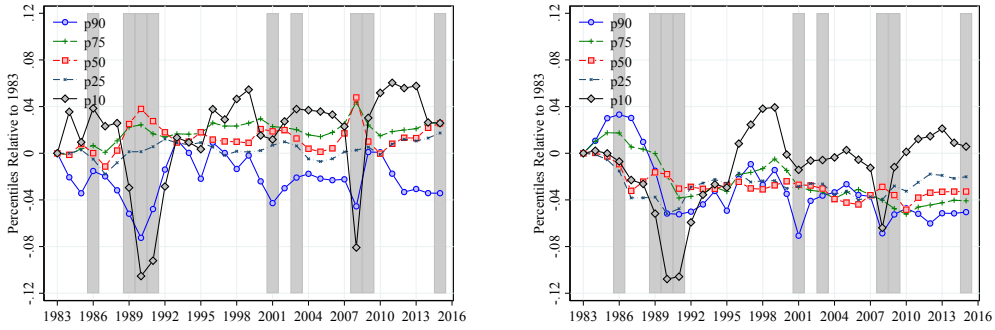
[18] Most of the rise and fall in top earnings shares were driven by the top 0.5% of earners. (See Appendix Figure S15, which shows the evolution of shares going to various ranges within the top 10%.) Appendix Figure S16 shows that the extreme right tail (top 1% and top 5%) of the population earnings distribution shifted further to the right and flattened over time.

[19] In interpreting variation in annual and 5-year growth, it is useful to keep in mind that the former reflects a roughly equal balance of temporary and persistent changes in earnings, while the latter largely re-

previous subsection, we organize much of our discussion around long-term trends and cyclical variation; however, we also provide a detailed look at the distribution of earnings growth and how it varies with individuals' recent earnings levels and age.

Long-term trends. *Annual log earnings volatility was much greater for women than men in the early 1980s; this remained true nearly 40 years later given the long-term stability of annual log earnings growth distributions for both genders. By contrast, the distribution of 5-year earnings growth became noticeably more compressed for women over the past few decades, while it changed very little for men.*

Appendix Table S4 provides a summary of long-run changes in the distribution of earnings growth, while Figure 11 displays the full evolution of annual residual log earnings growth at different percentiles (relative to baseline growth rates in 1983) over our sample period; Figures 12 and 13 report different measures of annual earnings volatility based on dispersion in $\Delta^1 \varepsilon_{i,t}$.[20] Altogether, these figures indicate little long-term trend in annual earnings volatility for both men and women. Appendix Figure S18 shows that, for men, the distribution of 5-year earnings growth evolved quite similarly to that of annual growth; however, there was a strong secular decline in the dispersion of 5-year earnings growth among women.



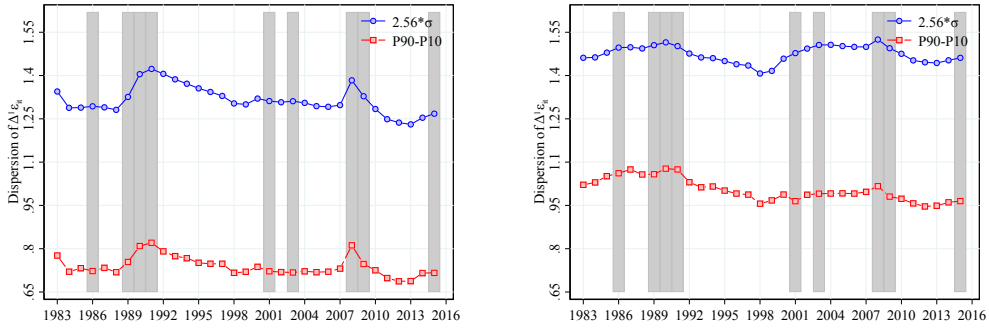
(a) Men (b) Women

FIGURE 11. Changes in percentiles of $\Delta^1 \varepsilon_{i,t}$ (1983=0)

These trends in earnings volatility differ substantially from those documented in studies using similar administrative data in the U.S. (Sabelhaus and Song, 2010, Guvenen, Ozkan, and Song, 2014, Bloom, Guvenen, Pistaferri, Sabelhaus, Salgado, and Song, 2017). For example, Bloom, Guvenen, Pistaferri, Sabelhaus, Salgado, and Song (2017) find that the 90–10 difference in log earnings growth (for both men and women) declined by roughly 30 log points between 1983 and 2012—more than three times the declines we observe during this period. By contrast, recent studies based on U.S. survey data report

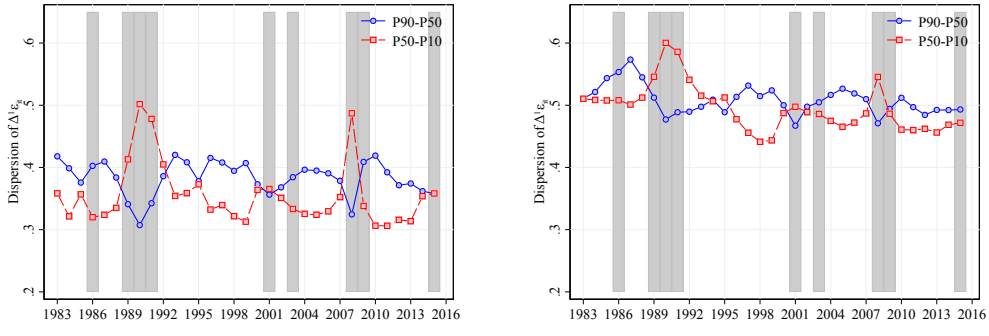
flects the influence of more persistent changes. The evolution of earnings inequality based on arc percent changes is qualitatively similar to that reported here for growth in log earnings.

[20] Appendix Figures S17–S19 show analogous patterns for 5-year log earnings growth.



(a) Men (b) Women

FIGURE 12. 90–10 percentile difference and 2.56 × standard deviation of $\Delta^1\varepsilon_{i,t}$



(a) Men (b) Women

FIGURE 13. 90–50 and 50–10 percentile differences for $\Delta^1\varepsilon_{i,t}$

modest trends in volatility, while earlier survey-based studies typically concluded that volatility increased in the U.S. over this period.[21]

The skewness of earnings innovations can influence both consumption/savings behavior and asset prices (Mankiw, 1986, Kocherlakota and Pistaferri, 2009). Figure 14(a) reports the evolution of Kelley skewness for $\Delta^1\varepsilon_{i,t}$ over time, while the time series for its moment-based coefficient of skewness is reported in Appendix Figure S20(a).[22] Skewness patterns are quite similar for men and women, and given the discussion so far, it is not surprising to see little long-term trend.

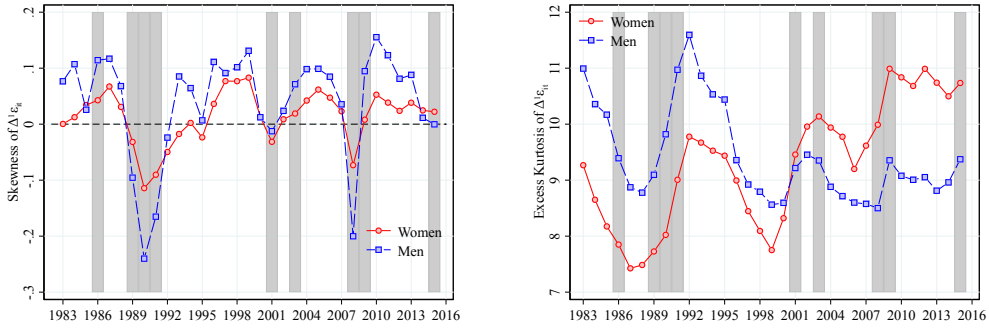
We also explore the kurtosis of log earnings growth distributions, with higher values indicating greater mass in the center and tails of distributions relative to the "shoulders". Figure 14(b) reports excess Crow-Siddiqui kurtosis over time, with positive values

[21] See Moffitt (2020) for a summary of several recent survey-based studies in the U.S. Dynan, Elmendorf, and Sichel (2012) review many earlier survey-based studies.

[22] For variable x with mean μ, standard deviation σ, and 90, 50, and 10 percentiles $P90$, $P50$, and $P10$, the Kelley skewness measure is $[(P90-P50)-(P50-P10)]/(P90-P10)]$, while the coefficient of skewness is given by $E\left[((x-\mu)/\sigma)^3\right]$. Both skewness measures equal zero for symmetric distributions, while positive (negative) values imply that more of the distribution lies to the right (left) of the median or mean.

ranging from 7.5 to 12.0 indicating much stronger kurtosis than implied by a normal distribution (i.e., leptokurtic). This means that earnings growth tends to be very close to zero, with an excess frequency of very high/low growth outliers. While kurtosis has declined slightly for men over the long term, it has substantially risen for women since 2000. As reported in Appendix Figure S20(b), the standard moment-based measure of excess kurtosis also suggests that log earnings growth is leptokurtic; however, it suggests a modest long-run increase in kurtosis for both men and women.[23]

To visualize earnings growth distributions and their departures from normality, Supplementary Appendix SA.2 also shows the empirical densities (Appendix Figures S23–S24) and log densities (Appendix Figures S25–S26) for residual log earnings growth in 2005 (other years look similar). Compared to the best-fitting normal distribution, the distribution of earnings growth has greater mass at the center and tails, with the left tail notably thicker than the right.



(a) Kelley skewness

(b) Excess Crow-Siddiqui kurtosis

FIGURE 14. Skewness and excess kurtosis of $\Delta^1\varepsilon_{i,t}$

Cyclical features. *The distribution of earnings growth changes considerably over the business cycle, with dispersion increasing for men and skewness becoming strongly negative for both genders during recessions.*

Figure 11 shows strong cyclical variation in annual log earnings growth, $\Delta^1\varepsilon_t$, at the high (strong positive growth) and low (strong earnings declines) ends of the distribution. For men, we observe a modest increase in median earnings growth during recessions, but sizeable reductions in earnings growth at both the top and bottom. For example, during the early-1990s recession, median annual log earnings growth rose by about 5 log points, while low- and high-end annual growth rates dropped by 5–15 log points. Similar patterns are observed for women; however, movements at the bottom and middle of the distribution were more muted. Appendix Figure S17 shows that cyclical variation in 5-year log earnings growth was generally much stronger for both men and women,

[23] For variable x with mean μ, standard deviation σ, and 97.5, 75, 25, and 2.5 percentiles $P97.5$, $P75$, $P25$, and $P2.5$, the excess Crow-Siddiqui kurtosis measure is $(P97.5 - P2.5)/(P75 - P25) - 2.91$, while the moment-based excess kurtosis measure is given by $E\left[((x-\mu)/\sigma)^4\right] - 3$, where both "excess" measures subtract off the corresponding measure of kurtosis for the normal distribution.

indicating strong persistent adverse effects of major recessions on earnings for many workers. Among women, economic downturns produced much larger and more drawn-out declines in $\Delta^5\varepsilon_t$ at the top compared to the bottom of the distribution.

Figure 11 and Appendix Figure S17 show that Canadian recessions have been associated with sizeable reductions in the prevalence of high earnings growth and increases in the likelihood of severe earnings losses. For men, these changes were reversed during times of economic growth, so there were only modest long-term changes in the distributions of annual and 5-year log earnings growth. This was also true for the distribution of annual log earnings growth among women; however, the female distribution of 5-year growth became much more compressed after the early-1990s recession.

The cyclical patterns evident in Figure 11 imply moderate increases in male earnings volatility during recessions (Figure 12), driven entirely by greater losses at the bottom of the earnings growth distribution during recessions.[24] Indeed, the rise in dispersion at the bottom of the $\Delta^1\varepsilon_{i,t}$ distribution (during recessions) is partially offset by reductions at the top as reported in Figure 13, which shows 90–50 and 50–10 differences in log earnings growth. This figure also shows that, for women, changes in dispersion at the top are roughly offset by opposing changes in dispersion at the bottom, resulting in very little cyclicality in female earnings volatility. Altogether, these patterns imply strong procyclicality in the Kelley skewness of log earnings growth as reported in Figure 14(a). Looking at the U.S., Guvenen, Ozkan, and Song (2014) and Bloom, Guvenen, Pistaferri, Sabelhaus, Salgado, and Song (2017) document similar cyclical patterns for skewness in earnings growth but weaker cyclical variation in earnings volatility.[25] As discussed in Mankiw (1986), Constantinides and Duffie (1996), and recently Guvenen, Ozkan, and Song (2014), the cyclical nature of both volatility and skewness may help explain asset prices and the equity premium puzzle.

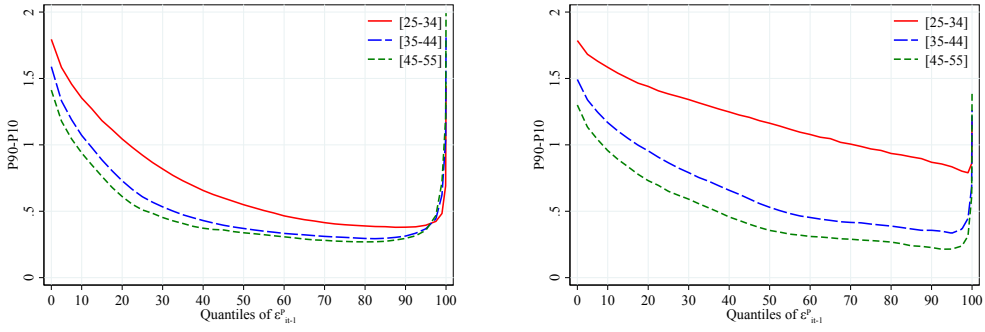
Finally, Figure 14(b) suggests that log earnings growth becomes more leptokurtic (as measured by excess Crow-Siddiqui kurtosis) during recessions; however, Appendix Figure S20(b) suggests that kurtosis (based on the standard moment-based measure) declined for men during the early-1990s recession and Great Recession, while kurtosis measures are less cyclical for women.

Earnings growth by recent earnings levels and age. *Among workers with low recent earnings levels, the distribution of earnings growth exhibits strong dispersion but little skewness or kurtosis. The dispersion of earnings growth is also high for younger (relative to older) workers; however, the skewness and kurtosis of earnings growth are less clearly related with age.*

To study differences in the distribution of log earnings growth by recent earnings levels and age, we pool all observations from 1986–2011. Figure 15 reports the 90–10 percentile difference for $\Delta^1\varepsilon_{i,t}$ by quantiles of (lagged residual) permanent earnings $\varepsilon^P_{i,t-1}$ for three age groups. Workers with higher recent earnings generally experience

[24] Complementary efforts to separately identify transitory and permanent shocks to earnings (in the U.S.) conclude that the variance of transitory shocks is counter-cyclical (e.g., Moffitt and Gottschalk, 2012).

[25] See Hoffmann and Malacrino (2019), Kurmann and McEntarfer (2019), and Busch, Domeij, Guvenen, and Madera (forthcoming) for recent studies of the extent to which procyclical skewness for earnings growth is explained by procyclical skewness patterns for growth in wages vs. annual hours of work.



(a) 90–10 percentile difference (men)

(b) 90–10 percentile difference (women)

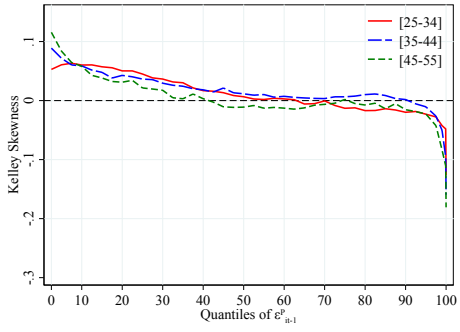
FIGURE 15. 90–10 percentile difference of $\Delta^1\varepsilon_{i,t}$ by permanent earnings and age group

Note: These figures are based on all observations from 1986–2011

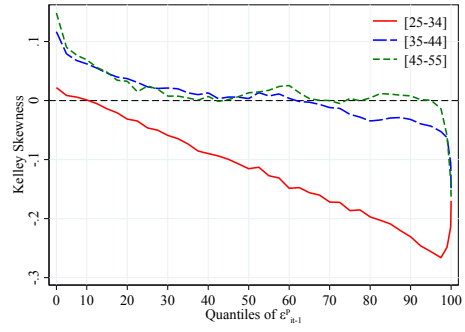
lower dispersion in their future earnings growth, although this relationship is reversed for those with very high recent earnings. Conditional on permanent earnings, future earnings growth is more variable among younger workers, especially young women. The strong volatility in earnings for young women is largely driven by dispersion at the low end of the distribution, as is clear from the strong negative Kelley skewness of earnings growth for most women ages 25–34 in Figure 16. Interestingly, there is little difference in skewness by age for men or for women ages 35 and over. The skewness of earnings growth is generally declining (or becomes more negative) for workers with higher levels of permanent earnings, although the differences are quite modest for men and older women. Figure 16 also shows excess Crow-Siddiqui kurtosis by age and permanent earnings. This measure of kurtosis is increasing in both age and permanent earnings levels for both men and women in the bottom third of the permanent earnings distribution. At higher permanent earnings levels, the kurtosis of earnings growth is largely independent of age for men, while it becomes hump-shaped for women. Except for young women, kurtosis is decreasing in permanent earnings over the upper half of the distribution.

While the dispersion patterns reported in Figure 15 are similar to their U.S. counterparts documented in Guvenen, Karahan, Ozkan, and Song (2019), the skewness and kurtosis patterns in Figure 16 are not — among American men, log earnings growth becomes more negatively skewed and leptokurtic as age or recent earnings levels increase. Interestingly, our moment-based measures of skewness and kurtosis reported in Appendix Figure S27, as well as measures based on 5-year earnings growth (Appendix Figures S28 and S29), are more consistent with their findings and the predictions of standard job ladder models (e.g., Burdett and Mortensen, 1998, Hubmer, 2018).[26]

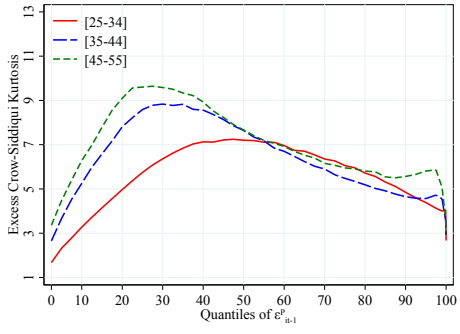
[26]These models predict that large earnings changes are mostly associated with job losses or job switches, which are more frequent early in workers' careers. Both high earners and older workers have, on average, climbed further up the job ladder, thus there is more room to fall down and experience large earnings drops. The greater chance of large, yet infrequent, earnings losses can lead to more negative skewness and kurtosis in the earnings growth distribution for high-earning, older workers.



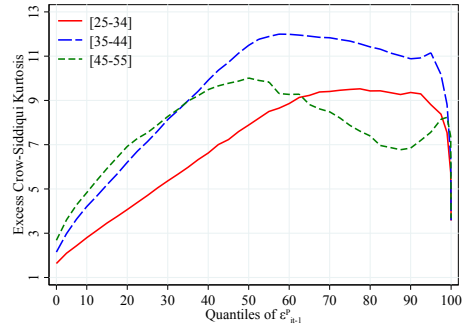
(a) Kelley skewness (men)



(b) Kelley skewness (women)



(c) Excess Crow-Siddique kurtosis (men)



(d) Excess Crow-Siddique kurtosis (women)

FIGURE 16. Skewness and excess kurtosis of $\Delta^1\varepsilon_{i,t}$ by permanent earnings and age group

Note: These figures are based on all observations from 1986–2011

3.3 *Earnings mobility*

Another way to study the dynamics of earnings, especially over extended periods of time, is to examine earnings mobility, the likelihood of moving from one part of the earnings distribution to another. Such movements across the distribution speak to whether there is churning across the distribution or stagnation. This is important, because high levels of mobility indicate less inequality in long-run earnings for any given level of cross-sectional inequality in annual earnings. The common rags-to-riches story is one part, but of equal interest is the likelihood of movements down the distribution.

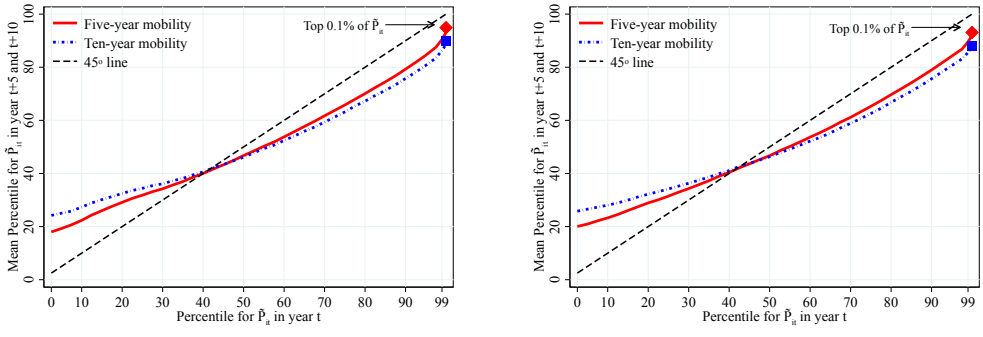
Here, we examine mobility across distributions of our alternative permanent earnings measure $\tilde{P}_{i,t}$, which averages earnings over years $t-2$, $t-1$, and t (and includes up to two zero/low earnings observations) in order to smooth out some of the transitory variation.[27] We measure relative movements within earnings distributions, and explore

[27] For years in which individuals do not file taxes or indicate zero earnings on their tax return, a value of zero is included in this average. Thus, $\tilde{P}_{i,t}$ may reflect extended periods out of the labor force, out of the country, or in unemployment. We have conducted sensitivity analyses which exclude years of zero earnings by non-filers. The results are virtually identical, suggesting that temporary periods out of the labor force or country are similar to temporary periods of minimal or zero earnings in terms of mobility.

mobility across 5- and 10-year time spans for men and women for different ages and time periods.

We document the following patterns for earnings mobility in Canada: *(i) mobility is similar for men and women, decreasing in age, and increasing in the duration between periods; (ii) mobility is stronger at the bottom of the earnings distribution than at the top; and (iii) over time, the mobility patterns for both men and women have remained stable.*

Figure 17 shows the average percentile of permanent earnings in the future period for each percentile grouping in year $t = 2005$, where percentiles have been grouped into 2.5 percentage point bins along the x-axis. Also shown is the average percentile after 5 years and 10 years for the top 0.1% of the permanent earnings distribution in t. As expected, mobility is positive at the bottom of the distribution and negative at the top. The figures show greater mobility at the bottom than the top, with very similar patterns for men and women and the cross-over occurring around the 40th percentile for both the 5-year and the 10-year transitions. Consistent with much of the literature (for Canadian evidence, see Beach and Finnie, 1998, Lammam, Karabegović, and Veldhuis, 2012), mobility is greater over 10 years than 5 years. Finally, these figures show very little difference in mobility between those in the top 2.5 percentage point bin (97.5–100) and those at the top 0.1%.

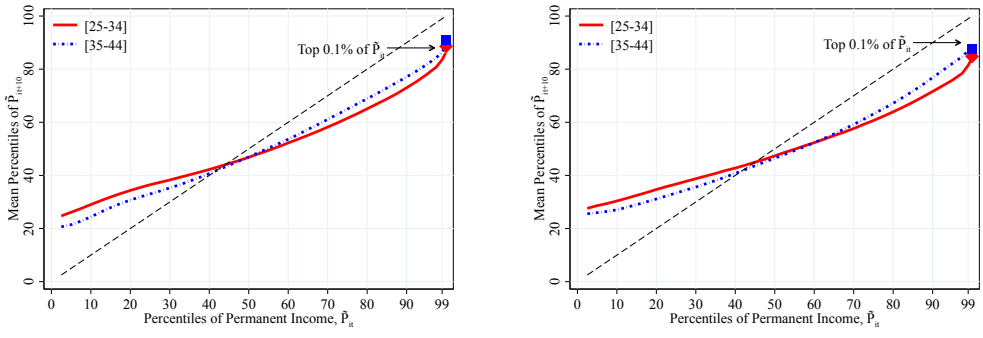


(a) Men (b) Women

FIGURE 17. 5- and 10-year mobility of alternative permanent earnings $\tilde{P}_{i,t}$ for $t = 2005$

Note: This figure shows the average percentile of permanent earnings in the future period for each percentile grouping in year $t = 2005$, where percentiles have been grouped into 2.5 percentage point bins along the x-axis. Also shown is the average percentile after 5 years and 10 years for the top 0.1% of the permanent earnings distribution in t.

Figure 18 shows how mobility over a 10-year period varies across the permanent earnings distribution for men and women ages 25–34 and 35–44. (Appendix Figure S30 shows these same patterns for 5-year mobility.) These figures indicate that earnings mobility is stronger among younger workers of both genders. We also examine the evolution of long-term mobility over time in Appendix Figures S31 and S32, which document 5- and 10-year mobility in permanent earnings beginning in 1985, 1995, and 2005. Remarkably, for both men and women, there is very little change over time in either the 5-year or 10-year mobility relationships.



(a) Men (b) Women

FIGURE 18. 10-year mobility in alternative permanent earnings, $\tilde{P}_{i,t}$, by age

Note: This figure shows the average percentile of $\tilde{P}_{i,t+10}$ for each percentile grouping of $\tilde{P}_{i,t}$ (for all t from 1985 to 2006), where percentiles have been grouped into 2.5 percentage point bins along the x-axis. Also shown is the average percentile after 10 years for the top 0.1% of the alternative permanent earnings distribution in t.

4. THE ROLE OF FIRM DYNAMICS

As discussed in the previous section, recessions are associated with large and persistent changes in earnings dynamics for workers. In Canada's early-1990s recession, male employment rates fell by roughly 5 percentage points (see Figure 1). Over that same period, there was a large and persistent decline in earnings across much of the earnings distribution, coupled with a sharp and sustained increase in the dispersion and (negative) skewness of earnings growth (see Figures 2, 12, and 14(a)).

Motivated by these observations, we now examine whether similar patterns appear at a more micro level—within firms. That is, we explore the relationship between firm-level employment dynamics and the individual-level earnings dynamics of workers at those firms, breaking down the analysis between workers who change employers (i.e., movers) and those who remain at the same employer (i.e., stayers). Our empirical evidence is particularly well-suited to discipline structural models of earnings dynamics that incorporate firm dynamics. Regarding this point, an active literature studies models of hiring and wage-setting in the labor market where firms experience stochastic shocks that lead them to grow or shrink over time (e.g., Kaas and Kircher, 2015, Coles and Mortensen, 2016, Gouin-Bonenfant, 2018, Bilal, Engbom, Mongey, and Violante, 2019, Elsby and Gottfries, 2019). However, there is limited evidence—beyond the literature on the wage-productivity pass-through (see Card, Cardoso, Heining, and Kline, 2018 for a recent review of the empirical evidence)—on how the earnings of workers correlate with the employment dynamics of their employers.

We first describe the data that we use and then document a number of empirical regularities.

4.1 *The matched employer-employee sample: 2001–2016*

The CEEDD, discussed in Section 2.1 and the Appendix, links several firm-level administrative data files to the worker-level T1PMF tax file that we have used thus far. We now

briefly describe the four main firm-based data sources that we use for our analysis of worker and firm dynamics. First, we use corporate tax returns (T2), which include financial information that allows us to construct our measure of firm-level value-added. Second, we use payroll records to obtain our measure of annual employment (i.e., firm size). Third, we use employment records to obtain our measure of layoffs. Finally, we use business register data to obtain information on the age and industry of firms. These files are available from 2001 to 2016.

Sample restrictions. We restrict the sample to private sector firms (i.e., all businesses except those in public administration, education, and health care) that are incorporated and have at least 5 employees. We focus on incorporated firms in order to have financial information (only corporations file a T2). We focus on firms with at least 5 employees so that our measure of annual employment growth has a reasonable distribution.[28] To construct the matched employer–employee sample, we start from the set of worker–year observations that satisfy the sample restrictions described in Section 2.1. We match each of these observations with their "main employer", defined as the employer which was the largest source of labor earnings throughout the year.

Table 2 contains summary statistics for the first and last year of the sample, both for our restricted sample, as well as for the full sample (i.e., all firms and workers). The restricted sample contains roughly 30% of all firms (see Panel A) and roughly 60% of all employees (see Panel B). Firms in the restricted sample tend to be larger, and workers tend to have higher annual earnings. Moreover, women are under-represented in the restricted sample.

TABLE 2. Matched sample: summary statistics

		A. Firms		B. Employees			
Year	Sample	Obs.	Emp.	Obs.	Age	Annual earnings	% Women
2001	Full	758,031	16.27	9,689,005	39.98	52,687	48.54
2001	Restricted	208,203	38.62	6,024,677	39.41	56,044	40.48
2016	Full	866,941	17.48	10,236,659	39.87	57,876	48.99
2016	Restricted	252,569	38.86	6,263,151	39.52	60,407	39.87

Note: Panel A contains firm-level summary statistics: "Obs." refers to the number of firms in each sample; "Emp." refers to the average firm size (i.e., number of employees per firm). Panel B contains employee-level summary statistics: "Obs." refers to the number of employees in each sample; "Age" and "Annual earnings" are cross-sectional averages in each sample; "% Women" corresponds to the percentage of women in each sample.

Variable definitions. In all subsequent analysis, we define earnings growth as the change in residual log annual earnings between year t and $t+1$ (i.e., the variable defined as $\Delta^1 \varepsilon_{i,t}$ earlier).[29] Note that, while we match workers to their "main employer",

[28] For example, the addition of one new worker to a one- or two-person firm implies 100% or 50%, respectively, increases in employment.

[29] Our analysis excludes workers who drop out of the labor market between years t and $t+1$, as they have low or zero earnings in year $t+1$. They could be included if earnings growth is defined as a percentage change (rather than a log change), but doing so gives very similar results.

our measure of annual earnings corresponds to the sum of earnings from all jobs held throughout the year. We estimate how the mean and dispersion of earnings growth vary with the size of the employing firm at time t as well as the employment growth rate of the time t employing firm between years t and $t+1$. Firm size is defined as annual employment. We measure annual employment using payroll records, which contain monthly data on the number of employees. We average monthly employment over the course of the year to obtain annual employment. Employment growth is defined as the change in (log) annual employment between time t and $t+1$.

We also disaggregate the analysis by *mobility status*. In particular, we sort workers into three groups: stayers (i.e., those who remain at the same main employer between time t and $t+1$), non-laid-off movers (i.e., those who change their main employer between time t and $t+1$ without experiencing a layoff), and laid-off movers (i.e., those who change their main employer between time t and $t+1$ and experience a layoff). We define a layoff as a permanent separation from a worker's main employer due to a shortage of work.[30] To determine whether a worker was laid off, we use employment records filed by the employer. If, in year t or $t+1$, a worker is laid off from his or her (year-t) main employer, then we assign this worker to the group of laid-off movers.

As a result of our sample restrictions, some workers and firms drop out of the sample, leading to missing observations for earnings growth. Appendix Figure S43 reports the fraction of missing values for earnings growth along several dimensions (i.e., initial firm size, employment growth, mobility status). We have replicated our analysis using the full sample (i.e., without imposing sample restrictions based on firm characteristics), and all of the empirical facts documented below remain largely unchanged.

Finally, we explore the link between earnings dynamics and labor productivity growth, defining labor productivity as nominal value-added per worker (i.e., revenue minus non-labor expenses divided by employment). We residualize our measure of labor productivity by regressing its logarithm on the interaction between year and industry dummies.[31] Labor productivity growth is the change in residual (log) labor productivity between time t and $t+1$.

4.2 *Empirical facts*

We now present four facts regarding the relationship between firm size (defined as number of employees), firm growth (defined as employment growth), and the earnings dynamics of workers.

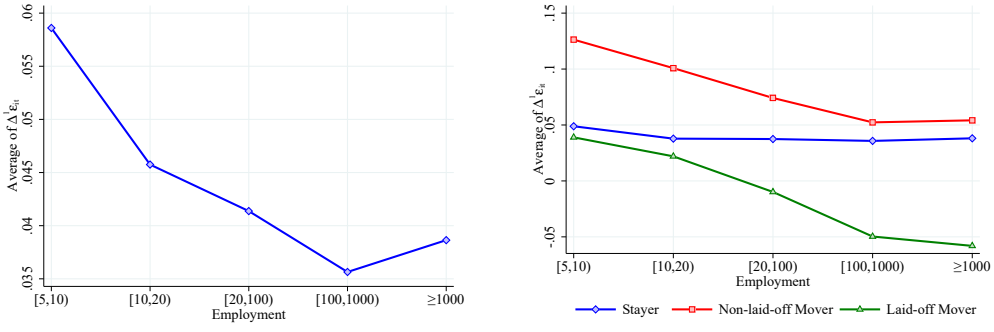
Fact #1: Average earnings growth is decreasing in firm size. It is well known that large firms tend to pay higher wages.[32] We now show that there are substantial differences in the average earnings *growth* of workers across firm size groups. Figure 19(a)

[30] Permanent separation means that the worker does not return during the same year or next year. "Shortage of work" includes, for example, end of contracts/season/school year, shutdown of operations, position eliminated, company restructuring, and bankruptcy.

[31] Employment growth could be residualized in a similar way. Doing so yields very similar results.

[32] See Morissette (1993) for evidence from Canada and Berlingieri, Calligaris, and Criscuolo (2018) for recent cross-country evidence. In Appendix Figure S33, we document a positive relationship between residual earnings and firm size in our sample.

shows that average earnings growth among employees is weakly decreasing in firm size, with average earnings growth of workers at the smallest firms (i.e., less than 10 employees) roughly 2 log points higher than for workers at the largest firms (i.e., with 1000 or more employees).



(a) Earnings growth (all)

(b) Earnings growth (by mobility status)

FIGURE 19. Average residual earnings growth by firm size groups

We next show that the relationship between earnings growth and firm size is entirely driven by movers rather than stayers. Figure 19(b) contains average earnings growth by initial firm size group separately for stayers, non-laid-off movers, and laid-off movers. The average earnings growth of non-laid-off movers at the smallest firms is roughly 7 log points higher than for non-laid-off movers at the largest firms. For movers who experience a layoff, the magnitude of the relationship is even stronger, with an average residual earnings growth differential of roughly 10 log points between the smallest and largest firm size groups. In contrast, average earnings growth is unrelated to firm size for stayers.

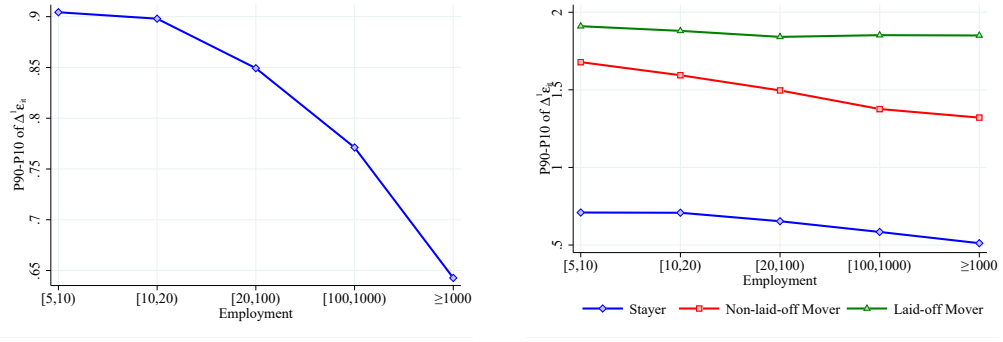
TABLE 3. Transition probability by firm size groups

	Firm size (number of employees)				
Mobility status	$[5,10)$	$[10,20)$	$[20,100)$	$[100,1000)$	≥ 1000
Stayers	0.84	0.83	0.82	0.81	0.85
Movers (no layoff)	0.12	0.13	0.15	0.16	0.13
Movers (layoff)	0.039	0.038	0.036	0.030	0.016

Note: Each entry reflects the proportion of each mobility status by firm size.

For completeness, Table 3 reports the fraction of stayers, non-laid-off movers, and laid-off movers by firm size. The two most notable features are that (i) the vast majority of workers remain at the same employer from one year to the next (roughly 85%) and (ii) the fraction of laid-off movers is strongly decreasing in firm size, falling from 3.9% at firms with less than 10 employees to 1.6% at firms with more than 1000 employees.

Fact #2: Earnings growth dispersion is decreasing in firm size. We now move on to studying the relationship between firm size and the volatility of earnings growth, focusing on log residual earnings growth dispersion as measured by the 90–10 percentile difference. Figure 20(a) shows that earnings growth dispersion is strongly decreasing in firm size. To put this into perspective, the roughly 25 log point difference between earnings growth dispersion of workers at the largest and smallest firms is much greater than the fluctuations in earnings dispersion over the business cycle as documented in Figure 12. In Appendix Figure S34, we show that lower and upper earnings growth dispersion (i.e., the 50–10 and 90–50 percentile differences) decline roughly equally with firm size.



(a) Earnings growth dispersion (all) (b) Earnings growth dispersion (by mobility status)

FIGURE 20. Residual earnings growth dispersion by firm size groups

Note: Earnings growth dispersion is defined as the 90–10 difference in residual log earnings growth.

Figure 20(b) disaggregates the results by mobility status. Two patterns stand out. First, the earnings dispersion of movers (both laid-off and non-laid-off) is much higher than for stayers, irrespective of the size of the employer. Focusing on workers at the largest firms (i.e., at least 1000 employees), the earnings dispersion of movers is 1.85 for those who experience a layoff and 0.91 for those who do not.[33] In comparison, it is only 0.51 for stayers. Second, earnings dispersion is decreasing with firm size for both stayers and non-laid-off movers, with a "slope" that is comparable to that of the pooled sample. Comparing workers at the largest firms to those at the smallest, we see that earnings growth dispersion declines by roughly 20 log points for stayers and 30 log points for non-laid off movers (similar to the 25 log point decline in the pooled sample). Altogether, these findings suggest that firm heterogeneity is not only an important deter-

[33]The high dispersion in earnings growth experienced by laid-off movers could be due to part-year nonemployment as well as changes in wages. For instance, if a worker gets laid off in year t and spends several months unemployed, annual earnings during year t will be much lower than usual. To reduce the importance of part-year nonemployment in year t, we replicate Figure 20(b) in Supplementary Appendix SB with earnings growth measured as the two-year difference (i.e., from $t-1$ to $t+1$ rather than from t to $t+1$). The results are very similar, with a slightly higher dispersion of earnings growth for laid-off movers at firms with more than 100 employees (see Appendix Figure S41(b)).

minant of average earnings growth, but it also affects the dispersion of earnings growth across workers.

It is worth noting, however, that worker heterogeneity can also play a role through differences in the composition of workers across firms. Because earnings growth is more dispersed among women, younger workers, and low earners (see Figure 15), a high concentration of these workers at smaller firms could lead to the negative relationship between earnings growth dispersion and firm size. Appendix Figure S35 shows that around one-third of the difference in earnings growth dispersion between the smallest and largest firms is explained by differences in worker composition across firm size groups.

Fact #3: Average earnings growth increases with firm employment growth. While the aggregate growth rate of employment exhibits some variability over the business cycle, the distribution of employment growth rates across firms is extremely dispersed (see Bottazzi and Secchi, 2006 for empirical evidence). We now estimate whether employment growth rates are related to the average earnings growth of workers. To account for the fact that smaller firms tend to grow faster, we sort firm-year observations into 10 employment growth deciles within year and firm size group.[34]

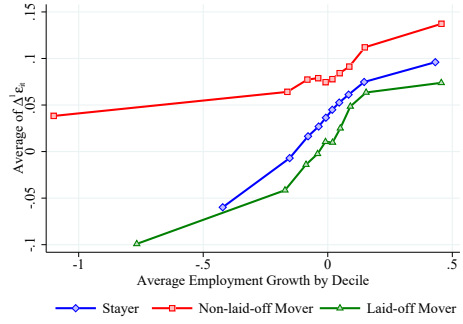
Figure 21(a) contains the average earnings growth of workers by firm growth deciles. A clear pattern emerges where earnings growth is strongly increasing in firm growth. For example, workers employed at firms in the top firm growth decile experience earnings growth that is roughly 15 log points higher than workers at firms in the bottom firm growth decile. It is worth stressing that these magnitudes are extremely large. As a point of comparison, the average earnings growth differential by firm size groups was at most 2 log points. A more puzzling finding is the positive relationship between firm growth and earnings growth for movers (see Figure 21(b)).

One might hypothesize that high-skilled workers and top managers are rewarded more than the average workers for the growth of the firm, but our results point in the other direction. Figure 21(c) disaggregates the earnings growth of stayers by their (residualized) permanent earning levels (i.e., the variable defined earlier as ε_t^P), sorting workers within each firm into five quintiles based on their permanent earnings. The figure shows that the relationship between earnings growth and firm growth is systematically stronger for workers at the lower end of the earnings distribution within firms. For those with the lowest permanent earnings (first quintile), the earnings growth differential between the top and bottom decile of firm growth is roughly 20 log points, compared to only 10 log points for workers with the highest permanent earnings (fifth quintile). Figure 21(d) shows that the same pattern holds when looking at the very top of the permanent earnings distribution within firms.[35] Finally, Appendix Figures S37(a) and S37(b) break down the relationship between earnings growth (for stayers) and firm growth by initial firm size and firm age, respectively. Our main finding is robust, with a slightly stronger relationship for small firms.

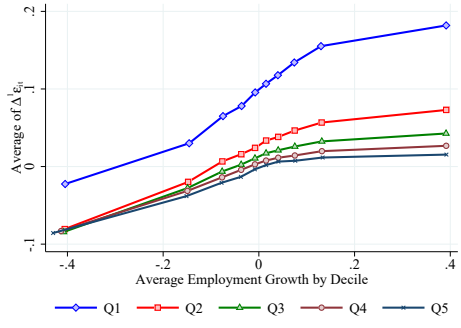
[34] As Appendix Figure S36 shows, a multivariate linear regression that simultaneously controls for firm size and firm growth yields results that are very similar to those in Figures 19(a) and 21(a).

[35] When conditioning on workers in different permanent earnings quintiles (Figure 21(c)), we consider workers from firms with at least 10 observed employees. When conditioning on top permanent earnings percentiles (Figure 21(d)), we consider workers from firms with at least 100 observed employees.

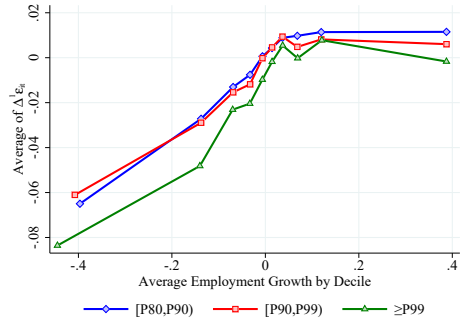
(a) All



(b) By mobility status



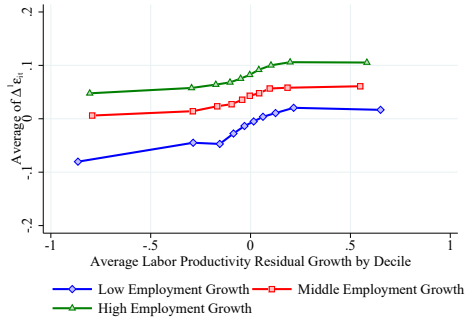
(c) By permanent earnings quintile (stayers only)



(d) By permanent earnings top percentiles (stayers only)

FIGURE 21. Average earnings growth by employment growth groups

Note: Panel (c) restricts the sample to firms with at least 10 observed workers, while panel (d) restricts the sample to firms with at least 100 observed workers.



(a) By labor productivity growth deciles (stayers only)

(b) By employment growth deciles (stayers only)

FIGURE 22. Average earnings growth by labor productivity growth and employment growth groups

The relationship that we uncover between earnings growth and firm employment growth is reminiscent of the finding that there is a positive (yet incomplete) pass-

through of firm productivity to wages (e.g., Guiso, Pistaferri, and Schivardi, 2005). If employment growth were fully determined by productivity growth, then our results would merely be a restatement of the existence of a wage-productivity pass-through. In practice, there is considerable heterogeneity in productivity growth rates conditional on employment growth, which allows us to examine the relative effect of productivity growth versus employment growth on earnings.

For simplicity, we construct three employment growth groups: "low employment growth" reflects firms in the bottom 3 deciles of employment growth, "middle employment growth" reflects the middle 4 deciles, and "high employment growth" reflects the top 3 deciles. As we can see in Figure 21(a), the "middle employment growth" group contains firms with stable employment (growth generally less than 10% annually in absolute value), while the two other groups contain firms with very rapid employment growth or sizeable employment losses.

Figure 22(a) plots the average earnings growth of workers (stayers only) by labor productivity growth decile for each of the three employment growth groups.[36] Two patterns stand out. First, average earnings growth is increasing in labor productivity growth. For example, in the "middle employment growth" group, workers at firms in the top decile of labor productivity growth experience average earnings growth of roughly 5.5 log points higher than those at firms in the bottom decile. This is consistent with an imperfect pass-through of productivity to wages, as the previous literature has documented.[37] Second, the effect of employment growth on average earnings growth is large, even conditional on labor productivity growth. For instance, among workers in the bottom decile of labor productivity growth, workers in "high employment growth" firms experience average earnings growth that is about 13 log points higher than workers in "low employment growth" firms.

The importance of firm employment growth is even more clear in Figure 22(b). Here, we construct three labor productivity growth groups, defining "low productivity growth" as firms in the bottom 3 deciles of productivity growth, "middle productivity growth" as firms in the middle 4 deciles, and "high productivity growth" as firms in the top 3 deciles. Figure 22(b) plots the average earnings growth of workers (stayers only) by employment growth decile for each of the three labor productivity growth groups. Again, we see that average earnings growth is increasing for workers in firms with high employment growth even when controlling for labor productivity growth. Moreover, the gradient between earnings growth and employment growth is much steeper than that between earnings growth and labor productivity growth.

So far, our analysis has excluded workers whose employer exits between time t and $t+1$. Supplementary Appendix SB shows that including those observations produces results that are coherent with what we have found thus far. In particular, Appendix Figure S38(b) shows that movers out of exiting firms experience an average earnings growth

[36] Labor productivity growth deciles are constructed based on ranking within year and labor productivity quintile.

[37] Note, however, that our measure of firm productivity (i.e., value added per worker in revenue terms) is different from other productivity measures sometimes used, such as total factor productivity. For instance, a change in (revenue) labor productivity can be due to an increase in the capital stock per worker or a change in the price markup.

comparable to that of movers out of rapidly shrinking firms (i.e., first decile of employment growth).

Overall, our analysis indicates that the earnings trajectory of workers is tightly linked to the employment growth of their employing firms. Workers who join high-growth firms experience above-average earnings growth, while those who join rapidly shrinking firms experience below-average earnings growth. Furthermore, the relationship between employment growth appears to be even stronger than that for labor productivity growth.[38] It is worth pointing out that the positive relationship between employment growth and earnings growth is consistent with the presence of monopsony power. At their core, labor market monopsony models hypothesize an upward-sloping labor supply curve, meaning that firms must increase the wage they offer in order to attract additional workers (see Manning, 2013 for a review of monopsony models).

Fact #4: Earnings growth dispersion is a U-shaped function of firm employment growth. We now turn to the relationship between earnings growth dispersion and firm employment growth. Figure 23(a) shows that earnings growth dispersion (i.e., 90–10 difference for residual log earnings growth) is a U-shaped function of firm employment growth. Workers at rapidly shrinking and at fast-growing firms face considerable dispersion in their earnings growth, while workers at firms with stable employment experience much less dispersion in their earnings growth. Inspecting the relationship by mobility group, we find that the U-shaped relationship is entirely driven by stayers (see Figure 23(b)). In contrast, the earnings growth dispersion of movers appears to be increasing in firm employment growth.[39]

We next decompose the earnings growth dispersion for stayers into lower-half dispersion (i.e., the 50–10 difference) and upper-half dispersion (i.e., the 90–50 difference). This reveals opposing "hockey stick" patterns, where workers at low-growth firms face a high level of lower-half dispersion while workers at high-growth firms face a high level of upper-half dispersion (see Figure 23(c)). This finding is consistent with the idea that downside risk increases when firms contract, while upside risk increases when firms expand employment. These patterns mimic the *macro* relationship between aggregate employment and earnings dispersion first documented in Guvenen, Ozkan, and Song (2014). In particular, expansions are characterized by an increase in upper-half dispersion (upside risk), while recessions are characterized by an increase in lower-half dispersion (downside risk).

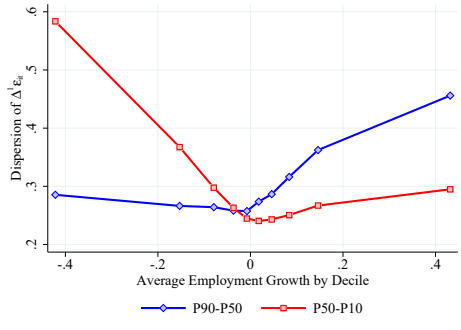
Next, we disaggregate the analysis (for stayers) by sorting workers into permanent earnings quintiles. We see that the U-shaped relationship holds within each quintile (see Figure 23(d)), where the two lowest earnings quintiles (especially the lowest) experience a much higher level of earnings growth dispersion than the other three quintiles. Finally,

[38]One caveat is that our measure of labor productivity growth may be "noisier" than our measure of employment growth, which would lead to a greater attenuation bias for the productivity growth – earnings growth relationship.

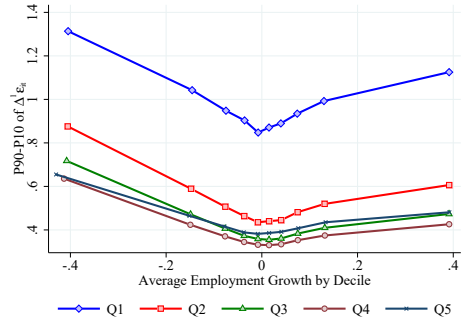
[39]To reduce the importance of part-year nonemployment in year t for laid-off movers, we replicate Figure 23(b) with earnings growth and employment growth measured as the two-year difference (i.e., from $t-1$ to $t+1$ rather than from t to $t+1$). See Appendix Figure S42(b) for the results as well as details on the data construction. The results are qualitatively similar, but the U-shape pattern for stayers is not as strong.

(a) Earnings growth dispersion (all)

(b) Earnings growth dispersion by mobility status



(c) Upper and lower earnings growth dispersion (stayers only)



(d) By permanent earnings quintile (stayers only)

FIGURE 23. Residual earnings growth dispersion by employment growth groups

in Appendix Figure S39, we repeat the analysis by sorting workers into firm size and firm age groups. Our main result is robust: the earnings growth dispersion of stayers is a U-shaped function of firm growth (with dispersion especially high for stayers at sharply contracting firms). As we did for fact #3, we repeat the analysis by including exiting firms and obtain coherent results (see Appendix Figure S40).

Altogether, our findings demonstrate that workers who join fast-growing firms can expect not only faster earnings growth on average, but also an earnings growth distribution that is more positively skewed with very limited downside risk. By contrast, workers at rapidly shrinking firms experience low average earnings growth with little upside risk and a negatively skewed distribution. Finally, workers joining firms with stable employment typically experience moderate earnings growth and little dispersion.

5. CONCLUSIONS

This paper provides a comprehensive examination of earnings inequality, volatility, and mobility in Canada from 1983 to 2016. Further, starting in 2001, we use Canadian matched employer–employee data to explore the joint dynamics of workers and firms. Our most novel contribution with these data is our analysis of the relationship between the earnings growth of workers and the employment growth of their employers.

Our first main finding sets Canada apart from many other countries (especially the U.S.): we find only modest changes in most measures of overall earnings inequality, volatility, and mobility between 1983 and 2016. For example, the 90–10 male earnings ratio grew far less in Canada than it did in the U.S., while the ratio actually declined slightly for Canadian women. Underlying this stability, we find that the 90–50 earnings ratio increased slowly but consistently over time; however, this was largely offset by reductions in the 50–10 ratio. This apparent stability hides a few notable trends, however, including a nearly 30% increase in earnings of women relative to men (at the median) and a meteoric rise in earnings among those at the very top of the earnings distribution. Meanwhile, earnings volatility (as measured by 90–10, 90–50, or 50–10 ratios for annual earnings growth) declined only slightly over the lengthy period we study, while 5-year and 10-year mobility patterns showed very little change over time for men and women.

It is natural to ask how Canada avoided the strong secular increase in inequality (except at the very top) experienced in the U.S. and many other developed countries. Noting sizeable increases in the returns to schooling, many studies point to (skill-biased) technological change as an important factor in rising inequality around the world. Although the Canadian tax files do not contain information about education, previous studies have shown that returns to schooling increased much less in Canada than in the U.S. (e.g., Boudarbat, Lemieux, and Riddell, 2010, Bowlus, Liu, and Robinson, 2019). Observing better labor market performance among less-educated older workers in Canada relative to the U.S., Bowlus, Liu, and Robinson (2019) conjecture that this may be the result of higher Canadian unionization rates and growth in public sector employment protecting these workers from wage reductions. Card, Lemieux, and Riddell (2004) further suggest that weaker union declines in Canada (relative to the U.S. and U.K.) may partially explain its more modest increases in inequality over the 1980s and 1990s. Finally, we note that the earnings of less-skilled workers in Canada have been bolstered by more regular increases in provincial minimum wages, a sizable resource sector, and strengthened work incentives in social assistance programs that are not limited to single mothers (as in the U.S.).

Over this same period, Canada has experienced a more modest increase in earnings over the upper part of the distribution (except at the very top) compared to the U.S. Two supply-based changes have been identified here. First, Fortin, Green, Lemieux, Milligan, and Riddell (2012) argue that the returns to higher education rose less in Canada due to faster growth in post-secondary enrolment. Second, Aydemir and Borjas (2007) estimate that Canada's focus on admitting high-skilled immigrants dampened its university earnings premium, while greater numbers of low-skilled immigrants led to an increase in the U.S. premium. Yet, these forces did little to hold back the top 1% in Canada, who experienced dramatic increases in earnings comparable to those observed in the U.S. The reasons for this are not yet understood, but Saez and Veall (2005) speculate that it may be due to the tightly integrated labor market for highly skilled workers.

Our second set of findings highlights substantial changes in the distributions of earnings levels and growth rates over the business cycle. Sharp (temporary) increases in earnings inequality and moderate increases in earnings volatility occurred during both the early-1990s recession and the Great Recession. These increases were mainly

driven by significant earnings losses among younger workers and men at the bottom of the earnings distribution, producing strong negatively skewed distributions of earnings growth. Interestingly, those at the very top of the earnings distribution (i.e., top 1%) also experienced heavy losses during these economic downturns. Altogether, these cyclical patterns are broadly similar to those documented in the U.S. (e.g., Bloom, Guvenen, Pistaferri, Sabelhaus, Salgado, and Song, 2017, Guvenen, Kaplan, Song, and Weidner, 2018).

These findings highlight the devastating losses experienced by many Canadian workers (especially younger workers) during major economic downturns. Based on aggregate employment and output, as well as earnings inequality and volatility, the early-1990s recession had much larger effects than other recessions, including the Great Recession, which was much deeper and longer lasting in the U.S. Although the American and Canadian economies are tied through trade, tourism, and labor flows, it is clear that important differences in sectoral composition and economic policies have resulted in heterogeneous responses to shared economic disruptions. Much work is still needed to better understand these differences.

Our analysis of firm and worker dynamics reveals a third important finding. Workers at fast-growing firms experience faster earnings growth and less downside risk than workers at rapidly shrinking firms, who experience low (or negative) average earnings growth and little upside risk. Further, workers at firms with stable employment typically experience moderate earnings growth with little upside or downside risk. The strong positive relationship between earnings growth and firm employment growth exists across firms of different sizes and ages, as well as across workers with different levels of recent earnings. The latter suggests that workers across the firm skill distribution (or firm hierarchy) share in the benefits of expansion.

Our findings on worker earnings and firm employment dynamics deepen our understanding of the sources of individual earnings growth and idiosyncratic earnings risk. Employers play an important role in shaping the earnings trajectories of their workers, not just their earnings levels. But, the extent to which idiosyncratic earnings risk is explained by the risks faced by firms remains an open question. Layoffs are an important source of downside risk, while changing employers voluntarily presents an opportunity for upward mobility. Considerable cross-sectional variation in individual earnings risk across the firm growth distribution suggests that cyclical fluctuations in the firm growth distribution could be an important source of variation in individual earnings risk over the business cycle.

Of course, the empirical relationship between earnings dynamics and firm dynamics need not reflect a causal relationship. Even so, our findings can help in identifying and disciplining economic mechanisms important for the joint dynamics of firms and their workers. For example, the fact that firm growth is still correlated with earnings growth even after workers leave the firm may indicate that high-growth firms tend to hire high-growth workers. The fact that earnings growth is more strongly correlated with firm employment growth than productivity growth may suggest that firms must pay more when they want to expand their workforce; however, they may choose not to adjust employment immediately in response to productivity shocks. We leave a more in-depth treatment of these issues for future research.

APPENDIX: DATA AND BACKGROUND

We use the Canadian Employer–Employee Dynamics Database (CEEDD) for the analysis in this paper. The CEEDD is a linkable environment developed by Statistics Canada that consists of several administrative and tax files, including individual tax files (T1 General – Income Tax and Benefit Return), individual employment remuneration files (T4 Statement of Remuneration Paid), individual records of employment (Record of Employment (ROE)), the Longitudinal Immigration Database (IMDB), corporation tax files (T2 Corporation Income Tax Return), unincorporated business tax files (T1 Business Declarations), payroll records (PD7), and business register (BR). Altogether, it provides rich information on individual demographics, employment, job mobility, self-employment and entrepreneurship, and firm characteristics.

The individual part of the CEEDD, which goes back to the early 1980s, enables a long-term analysis of income inequality and dynamics. It contains information on demographics (year of birth, gender, marital status, province or territory of residence) and income (employment income, self-employment income, pension income, investment income, government transfers, etc.); however, information on educational attainment and occupation is unavailable.

The individual-level data are drawn from the T1 Personal Master File (T1PMF), which contains annual personal income tax records for all Canadian tax filers who filed their tax returns before a specified cut-off date. While the exact cut-off date varies over time, it is usually sometime in December one year after the tax reference year (Messacar, 2017). Only about 3.5–4.8% of all tax filers do not file tax returns before this date.[40] These late filers are not included in T1PMF; however, they are included in the T1 Historical Personal Master File (T1HPMF), which is more comprehensive than T1PMF, but less timely.

We use the T1PMF (rather than T1HPMF), because it covers a more recent and longer time period. At the time this analysis was conducted, T1PMF covered the period 1983–2016, while T1HPMF only covered 1987–2014. Importantly, the exclusion of late filers does not appear to distort measures of the income distribution. While Messacar (2017) finds that late tax filers tend to be more prevalent among young individuals, non-residents, emigrants, very low earners, and those with final tax balances close to zero, this has little effect on estimated earnings distributions, including top-earnings percentiles.[41] Over our sample period (1983–2016), the T1PMF includes records each year for 89–93% of all 25- to 55-year-old Canadians (Figure 24).

A standard concern when studying inequality based on tax records is the potential for non-filing, especially among very low earners. Fortunately, as discussed by Frenette, Green, and Picot (2006), even zero-earners in Canada have had a strong incentive to

[40] The cut-off date before which a tax return may be included in T1PMF differs from the date by which an individual must submit a return to the Canada Revenue Agency (CRA) or after which interest charges or penalties begin to accrue on outstanding tax balances owed. The latter date is typically April 30 in Canada.

[41] Regarding top-earnings percentiles, Messacar (2017) finds little difference when late filers are included or excluded from the analysis. For example, in 2010, he finds differences of only $200 and $2,550 at the 99th and 99.9th percentiles of employment income, respectively. He also finds that the likelihood of delayed tax filing is only weakly correlated with changes in individual circumstances (e.g., changes in employment earnings or receiving unemployment benefits).

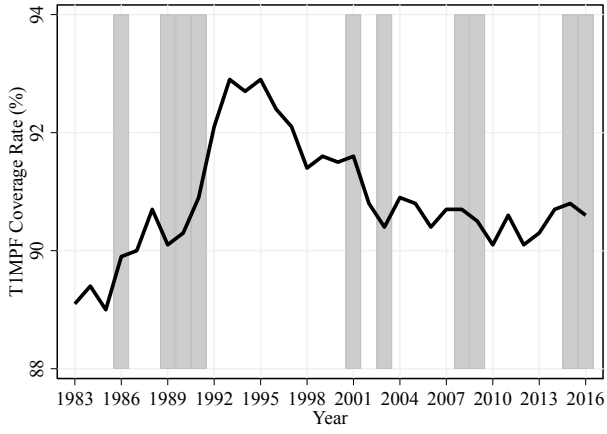


FIGURE 24. T1PMF coverage rates for 25- to 55-year-old Canadians, 1983–2016

Note: Figure reports the ratio of T1PMF filers (in %) to annual population estimates based on Canadian Censuses (from Statistics Canada Table 17-10-0005-01).

file their taxes after the 1993 introduction of the refundable Child Tax Benefit (and the earlier introduction of the Goods and Services Tax Credit in 1989–1990). Despite these increased incentives to file, Figure 24 shows that coverage rates for the T1PMF increased by less than 3% between the mid-1980s and mid-1990s (peaking at roughly 93%).[42] The modest year-to-year changes in observed filing behavior are unlikely to have any notable impacts on the evolution of broad measures of inequality during our sample period. Indeed, we observe no unusual changes at the low end of the earnings distribution between 1992 and 1993, when (and where) filing incentives increased the most.[43]

Table 1 in the paper provides an overview of our data every 5 years, while Table 4 reports selected percentiles of the annual earnings distribution over time for men and women combined. For cross-country comparison, earnings *in these tables only* are converted to U.S. dollars using the 2018 exchange rate (after first deflating all values to 2018 dollars).

Figure 25 shows that minimum wages increased in the 3 largest provinces during the 1990s, while they increased sharply for all provinces during the 2000s. The lowest provincial minimum wage is denoted by the solid black line with diamond markers.

[42]Based on the T1 Family File, which combines records from the T1PMF and other tax forms, Frenette, Green, and Picot (2006) report a 1% increase in tax file coverage rates (from 95% to 96%) between 1992 and 1993.

[43]To the extent that any marginal-filing low earners (from high-filing years) earn less than the minimum earnings trimming threshold imposed below, they would have no effect on our analysis of annual earnings. To the extent that some of these marginal filers earn between our minimum threshold and the 10th percentile, any increase in their filing rate would lower the 10th percentile values. Our figures show no evidence of unusual changes in these low earnings percentiles between 1992 and 1993.

TABLE 4. Selected percentiles of annual earnings distribution (men and women combined)

Year	$P1$	$P5$	$P10$	$P25$	$P50$	$P75$	$P90$	$P95$	$P99$	$P99.9$
1985	2,131	4,458	7,460	16,627	32,075	49,425	65,964	77,268	113,502	268,906
1990	2,075	4,626	7,798	17,003	32,221	49,259	66,940	79,466	121,651	315,828
1995	2,131	4,458	7,460	16,627	32,075	49,425	65,964	77,268	113,502	268,906
2000	2,200	5,045	8,483	18,199	33,515	52,113	72,590	88,891	159,125	593,560
2005	2,236	5,054	8,537	18,387	33,918	53,292	75,842	93,849	169,383	623,492
2010	2,566	5,492	9,169	19,406	35,422	56,354	80,244	100,141	176,748	552,109
2015	2,872	6,147	10,027	20,628	36,788	58,875	83,446	104,879	186,188	570,090

Note: Annual earnings reported in 2018 U.S. dollars.

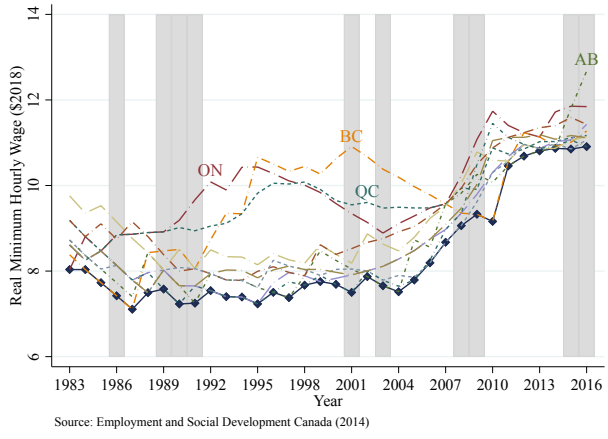


FIGURE 25. Real minimum wages in Canada, 1983–2016

Note: The solid black line with diamond markers reflects the lowest provincial minimum wage each year.

REFERENCES

Acemoglu, D., and D. Autor (2011), "Skills, tasks and technologies: Implications for employment and earnings," in *Handbook of Labor Economics*, vol. 4B, pp. 1043–1171. Elsevier. [2, 3, 8, 10]

Atkinson, A. B., T. Piketty, and E. Saez (2011), "Top Incomes in the Long Run of History," *Journal of Economic Literature*, 49(1), 3–71. [8]

Aydemir, A., and G. J. Borjas (2007), "Cross-Country Variation in the Impact of International Migration: Canada, Mexico, and the United States," *Journal of the European Economic Association*, 5(4), 663–708. [7, 35]

Baker, M., and K. Milligan (2008), "How Does Job-Protected Maternity Leave Affect Mothers' Employment," *Journal of Labor Economics*, 26(4), 655–691. [8]

Baker, M., and G. Solon (2003), "Earnings dynamics and inequality among Canadian men, 1976-1992: Evidence from longitudinal income tax records," *Journal of Labor Economics*, 21(2), 289–321. [2]

Beach, C. (2016), "What has happened to middle-class earnings in Canada?," in *Income inequality: The Canadian story*, ed. by D. A. Green, W. C. Riddell, and F. St.-Hillaire, pp. 157–176. Institute for Research on Public Policy. [2, 12]

Beach, C., and R. Finnie (1998), "Earnings mobility 1982-1994: Women gaining ground and lower paid males slipping," *Canadian Business Economics*, 6(4), 3–25. [2, 24]

Beach, C., and R. Finnie (2004), "A longitudinal analysis of earnings change in Canada," *Canadian Journal of Economics*, 37(1), 219–240. [2, 16]

Beaudry, P., and J. DiNardo (1991), "The effect of implicit contracts on the movement of wages over the business cycle: Evidence from micro data," *Journal of Political Economy*, 99(4), 665–688. [8]

Beaudry, P., and D. A. Green (2000), "Cohort patterns in Canadian earnings: Assessing the role of skill premia in inequality trends," *Canadian Journal of Economics*, 33(4), 907–936. [2, 16]

Berlingieri, G., S. Calligaris, and C. Criscuolo (2018), "The productivity-wage premium: Does size still matter in a service economy?," *AEA Papers and Proceedings*, 108, 328–33. [27]

Berman, E., J. Bound, and S. Machin (1998), "Implications of skill-biased technological change: international evidence," *Quarterly Journal of Economics*, 113(4), 1245–1279. [6]

Bilal, A. G., N. Engbom, S. Mongey, and G. L. Violante (2019), "Firm and Worker Dynamics in a Frictional Labor Market," Working Paper 26547, National Bureau of Economic Research. [25]

Bloom, N., F. Guvenen, L. Pistaferri, J. Sabelhaus, S. Salgado, and J. Song (2017), "The Great Micro Moderation," Working Paper. [18, 21, 36]

Bottazzi, G., and A. Secchi (2006), "Explaining the distribution of firm growth rates," *The RAND Journal of Economics*, 37(2), 235–256. [30]

Boudarbat, B., T. Lemieux, and W. C. Riddell (2010), "The evolution of the returns to human capital in Canada, 1980–2005," *Canadian Public Policy*, 36(1), 63–89. [2, 35]

Bowlus, A. J., H. Liu, and C. Robinson (2019), "Different Paths? Human Capital Prices, Wages, and Inequality in Canada and the United States," *Journal of Labor Economics*, 37(S2), S689–S734. [35]

Bowlus, A. J., and J.-M. Robin (2012), "An international comparison of lifetime inequality: How continental Europe resembles North America," *Journal of the European Economic Association*, 10(6), 1236–1262. [2]

Brzozowski, M., M. Gervais, P. Klein, and M. Suzuki (2010), "Consumption, income, and wealth inequality in Canada," *Review of Economic Dynamics*, 13(1), 52–75. [2, 12]

Burdett, K., and D. T. Mortensen (1998), "Wage differentials, employer size, and unemployment," *International Economic Review*, 39(2), 257–273. [22]

Busch, C., D. Domeij, F. Guvenen, and R. Madera (forthcoming), "Skewed Idiosyncratic Income Risk over the Business Cycle: Sources and Insurance," *American Economic Journal: Macroeconomics*. [21]

Card, D., A. R. Cardoso, J. Heining, and P. Kline (2018), "Firms and labor market inequality: Evidence and some theory," *Journal of Labor Economics*, 36(S1), S13–S70. [25]

Card, D., T. Lemieux, and W. C. Riddell (2004), "Unions and wage inequality," *Journal of Labor Research*, 25(4), 519–562. [7, 35]

Card, D., T. Lemieux, and W. C. Riddell (2020), "Unions and wage inequality: The roles of gender, skill and public sector employment," *Canadian Journal of Economics*, 53(1), 140–173. [7]

Coles, M. G., and D. T. Mortensen (2016), "Equilibrium Labor Turnover, Firm Growth, and Unemployment," *Econometrica*, 84(1), 347–363. [25]

Constantinides, G. M., and D. Duffie (1996), "Asset pricing with heterogeneous consumers," *Journal of Political Economy*, 104(2), 219–240. [21]

Dynan, K., D. Elmendorf, and D. Sichel (2012), "The evolution of household income volatility," *The BE Journal of Economic Analysis & Policy*, 12(2). [19]

Elsby, M. W. L., and A. Gottfries (2019), "Firm Dynamics, On-The-Job Search and Labor Market Fluctuations," Working paper. [25]

Finnie, R., and I. Irvine (2011), "The Redistributional Impact of Canada's Employment Insurance Program, 1992–2002," *Canadian Public Policy*, 37(2), 201–218. [8]

Forsythe, E. (2019), "Why Don't Firms Hire Young Workers During Recessions?," Working Paper. [13]

Fortin, N., D. A. Green, T. Lemieux, K. Milligan, and W. C. Riddell (2012), "Canadian Inequality: Recent Developments and Policy Options," *Canadian Public Policy*, 38(2), 121–145. [2, 7, 9, 35]

Fortin, N., and T. Lemieux (2015), "Changes in wage inequality in Canada: An interprovincial perspective," *Canadian Journal of Economics*, 48(2), 682–713. [2, 7, 8, 10]

Fortin, P. (1996), "The great Canadian slump," *Canadian Journal of Economics*, 29(4), 761–787. [7]

Freedman, C., and T. Macklem (1998), "A Comment on 'The Great Canadian Slump'," *Canadian Journal of Economics*, 31(3), 646–665. [7]

Frenette, M., D. A. Green, and K. Milligan (2009), "Taxes, transfers, and Canadian income inequality," *Canadian Public Policy*, 35(4), 389–411. [8]

Frenette, M., D. A. Green, and G. Picot (2006), "Rising Income Inequality in the 1990s: An Exploration of Three Data Sources," in *Dimensions of Inequality in Canada*, ed. by D. A. Green, and J. R. Kesselman, pp. 173–204. University of British Columbia Press, Vancouver. [2, 37, 38]

Gee, K.-F., H. Liu, and C. Rosell (2020), "Understanding Developments in Individuals' Earnings Dispersion in Canada Using Matched Employer–Employee Data," Catalogue no. 11F0019M 444, Statistics Canada. [2]

Gottschalk, P., and R. Moffitt (1994), "The Growth of Earnings Instability in the U.S. Labor Market," *Brookings Papers on Economic Activity*, 25(2), 217–272. [17]

Gouin-Bonenfant, E. (2018), "Productivity Dispersion, Between-firm Competition and the Labor Share," Meeting Papers 1171, Society for Economic Dynamics. [25]

Green, D. A., and B. M. Sand (2015), "Has the Canadian labour market polarized?," *Canadian Journal of Economics*, 48(2), 612–646. [2, 6, 9]

Guiso, L., L. Pistaferri, and F. Schivardi (2005), "Insurance within the firm," *Journal of Political Economy*, 113(5), 1054–1087. [32]

Guvenen, F., G. Kaplan, and J. Song (2014), "How risky are recessions for top earners?," *American Economic Review*, 104(5), 148–53. [13]

Guvenen, F., G. Kaplan, J. Song, and J. Weidner (2018), "Lifetime Incomes in the United States over Six Decades," Working Paper. [10, 13, 14, 36]

Guvenen, F., F. Karahan, S. Ozkan, and J. Song (2019), "What Do Data on Millions of U.S. Workers Reveal about Life-Cycle Earnings Dynamics?," Working Paper. [22]

Guvenen, F., S. Ozkan, and J. Song (2014), "The nature of countercyclical income risk," *Journal of Political Economy*, 122(3), 621–660. [18, 21, 33]

Heathcote, J., F. Perri, and G. L. Violante (2010), "Unequal we stand: An empirical analysis of economic inequality in the United States, 1967-2006," *Review of Economic Dynamics*, 13(1), 15–51. [10]

Hershbein, B., and L. B. Kahn (2018), "Do recessions accelerate routine-biased technological change? Evidence from vacancy postings," *American Economic Review*, 108(7), 1737–1772. [13]

Hoffmann, E. B., and D. Malacrino (2019), "Employment time and the cyclicality of earnings growth," *Journal of Public Economics*, 169, 160–171. [21]

Hoynes, H., D. L. Miller, and J. Schaller (2012), "Who Suffers During Recessions?," *Journal of Economic Perspectives*, 26(3), 27–48. [8, 13, 14]

Hubmer, J. (2018), "The job ladder and its implications for earnings risk," *Review of Economic Dynamics*, 29, 172–194. [22]

Jacobson, L. S., R. J. LaLonde, and D. G. Sullivan (1993), "Earnings losses of displaced workers," *American Economic Review*, 83(4), 685–709. [8]

Kaas, L., and P. Kircher (2015), "Efficient firm dynamics in a frictional labor market," *American Economic Review*, 105(10), 3030–3060. [25]

Kocherlakota, N., and L. Pistaferri (2009), "Asset pricing implications of Pareto optimality with private information," *Journal of Political Economy*, 117(3), 555–590. [19]

Kurmann, A., and E. McEntarfer (2019), "Downward Nominal Wage Rigidity in the United States: New Evidence from Worker-Firm Linked Data," School of Economics Working Paper Series 2019-1, LeBow College of Business, Drexel University. [21]

Lammam, C., A. Karabegović, and N. Veldhuis (2012), "Measuring income mobility in Canada," Discussion paper, Studies in Economic Prosperity. Fraser Institute. [2, 24]

Mankiw, G. (1986), "The equity premium and the concentration of aggregate shocks," *Journal of Financial Economics*, 17(1), 211–219. [19, 21]

Manning, A. (2013), *Monopsony in motion*. Princeton University Press. [33]

Messacar, D. (2017), "Big tax data and economic analysis: Effects of personal income tax reassessments and delayed tax filing," *Canadian Public Policy*, 43(3), 261–283. [4, 5, 37]

Milligan, K. (2016), "The Tax Recognition of Children in Canada: Exemptions, Credits and Cash Transfers," *Canadian Tax Journal*, 64(3), 601–618. [8]

Milligan, K., and M. Smart (2015), "Taxation and top incomes in Canada," *Canadian Journal of Economics*, 48(2), 655–681. [17]

Milligan, K., and M. Stabile (2007), "The integration of child tax credits and welfare: Evidence from the Canadian National Child Benefit program," *Journal of Public Economics*, 91(1-2), 305–326. [8]

Moffitt, R. (2020), "Reconciling Trends in U.S. Male Earnings Volatility: Results from a Four Data Set Project," Working Paper 27664, National Bureau of Economic Research. [17, 19]

Moffitt, R., and P. Gottschalk (2012), "Trends in the transitory variance of male earnings: Methods and evidence," *Journal of Human Resources*, 47(1), 204–236. [21]

Morissette, R. (1993), "Canadian jobs and firm size: Do smaller firms pay less?," *Canadian Journal of Economics*, 26(1), 159–174. [27]

Morissette, R., and C. Berube (1996), "Longitudinal Aspects of Earnings Inequality in Canada," Working Paper 94, Statistics Canada. [2, 11]

Picot, G. (2001), "Working Time, Wages, and Earnings Inequality among Men and Women in Canada, 1981-1993," in *Working Time in Comparative Perspective*, ed. by G. Wong, and G. Picot, vol. 1, pp. 109–143. W.E. Upjohn Institute for Employment Research, Kalamazoo, MI. [2]

Piketty, T., and E. Saez (2003), "Income Inequality in the United States, 1913–1998," *The Quarterly Journal of Economics*, 118(1), 1–41. [8]

Sabelhaus, J., and J. Song (2010), "The Great Moderation in Micro Labor Earnings," *Journal of Monetary Economics*, 57(4), 391–403. [18]

Saez, E., and M. R. Veall (2005), "The Evolution of High Incomes in Northern America: Lessons from Canadian Evidence," *American Economic Review*, 95(3), 831–849. [3, 17, 35]

Trefler, D. (2004), "The Long and Short of the Canada-U.S. Free Trade Agreement," *American Economic Review*, 94(4), 870–895. [7]

Veall, M. R. (2012), "Top income shares in Canada: Recent trends and policy implications," *Canadian Journal of Economics*, 45(4), 1247–1272. [3, 17]