Changes in Wage Inequality in Canada: An Interprovincial Perspective

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Abstract. This paper uses the Canadian Labour Force Survey to understand why the level and dispersion of wages have evolved differently across provinces from 1997 to 2013. The starker interprovincial differences are the much faster increase in the level of wages and decline in wage dispersion in Newfoundland, Saskatchewan, and Alberta. This is accounted for by the growth in the extractive resources sectors, which benefited less educated and younger workers the most. We also find that increases in minimum wages since 2005 are the main reason why wages at the very bottom grew more than in the middle of the distribution.

Résumé. Cet article utilise l'Enquête de la population active canadienne pour étudier les différences interprovinciales dans l'évolution du niveau et de la dispersion des salaires de 1997 à 2013. Les différences les plus remarquables sont l'augmentation beaucoup plus rapide du niveau des salaires et la baisse de la dispersion salariale à Terre-Neuve, en Saskatchewan et en Alberta. Ces différences sont reliées à la croissance du secteur des ressources extractives dont les travailleurs moins instruits et plus jeunes ont tout particulièrement bénéficié. Nous constatons également que l'augmentation des salaires minimums provinciaux depuis 2005 constitue la principale raison pour laquelle les salaires au bas de la distribution ont augmenté plus que les salaires médians.

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1. Introduction.

As is well known, earnings inequality has been increasing in Canada over the last few decades (Fortin et al., 2012). While the growing concentration of income at the top of the distribution has attracted a lot of attention (e.g., Saez and Veall 2005), other dimensions of inequality have seen some increases as well. For instance, Boudarbat et al. (2010) document a steady increase in the gap between university and high school educated workers since 1980, while Green and Sand (2013) show that inequality has expanded both at the bottom and top end of the distribution over the last few decades.

Despite the large number of studies looking at changes in inequality at the national level, relatively little is known about changes at the provincial level, especially in recent years. One exception is Veall (2012) who shows that the income share of the top 1% is higher, and has increased faster in Ontario, Alberta and British Columbia than in the rest of the country. In addition to showing that overall inequality has been going up since the early 1980s using census data, Green and Sand (2013) also document a more modest increase in inequality using more recent data from the Labour Force Survey. They also find important differences across provinces. In particular they show that, relative to Ontario, Alberta experienced a dramatic increase in mean wages, as well as a decline in inequality between 2000 and 2011. A natural explanation for these differences is the boom in the energy sector. Marchand (2014) shows using local variation within Western provinces that the energy boom has contributed to both an increase in earnings and a decline in poverty.

In this paper, we use data from the 1997 to 2013 Labour Force Survey (LFS) to study why the level and dispersion of wages has evolved differently across provinces. We focus on the LFS as it provides timely access to recent data. Unlike the census, survey design and questions about wages and earnings have been stable over time in the LFS. In terms of wage levels, the dominant trend is the much faster increase in wages in Newfoundland, Saskatchewan, and Alberta than in other provinces since the late 1990s. Using Ontario as a benchmark, average wages have grown by an additional 23 percentage points in these three provinces over the last 14 years. Standard explanatory factors in micro-level wage regressions (experience, education, industry, occupation, etc.) explain very little of these dramatic developments. But as in Beaudry et al. (2012), the data patterns are consistent with a model where positive shocks in a given sector have large spillover effects on wages in other sectors of the local economy. In the case of Newfoundland, Saskatchewan, and Alberta, employment in the extractive resources sector (mining, oil and gas) has grown by about 50% between 1999 and 2013. The effect (mostly due to spillovers) of the extractive resources sector boom accounts for about two thirds of the divergence in the growth in mean wages between these provinces and the rest of the country.

Interestingly, the resource boom appears to have lifted all boats and contributed to a small decline in inequality in Alberta and Saskatchewan.[1] Less educated workers experienced larger wage growth than university graduates, which reduced returns to education and overall inequality. By contrast, the skill premium was relatively stable in the rest of the country and top-half inequality (the gap between the 90th and 50th wage percentiles) kept increasing, while it did not increase in Alberta and Saskatchewan.

Inequality also declined in the bottom half (the gap between the 50th and 10th wage percentiles) in most provinces, resulting in a polarization of wages that has been documented in other countries. We show that changes in minimum wages appear to be the main reason why wages at the very bottom (e.g. the 10th percentile) grew more than in the middle of the distribution over the last 10-15 years. Most provinces have increased their minimum wages substantially since about 2005, and changes in (province-level) wages at the bottom of the wage distribution are closely connected with changes in the provincial minimum wage.

The remainder of the paper proceeds as follows. In section 2, we present the LFS data and report some descriptive statistics. The main trends in wage levels and wage inequality at the provincial level are reported in Section 3. In Section 4, we look at the role of the minimum wage in changes at the bottom end of the distribution. The role of the extractive resources sector in interprovincial changes in the level and dispersion of wages is explored in Section 5. We conclude in Section 6.

2. Data and Descriptive Statistics.

Our empirical analysis is based on the public use files of the LFS for the years 1997 to 2013. Like the U.S. Current Population Survey, the LFS is a large monthly household survey that primarily aims at measuring the labour market activities (employment, unemployment, occupation and industry, etc.) of the population. Once sampled, respondents from households (or dwellings to be more precise) get interviewed for six months in a row. The target sample size is 52,350 households, which yields a monthly sample of about 100,000 individuals age 15 and above.

While the public use files are not as detailed as the master files available in Statistics Canada's research data centres, the information is detailed enough for the purpose of this paper. For instance, we have information on province and metropolitan area, as well as industry and occupation at the two-digit level (43 industry categories and 47 occupation categories, respectively). One shortcoming of the public use files is that age is only available in five-year bins, which prevents us from constructing standard measures of potential labour market experience (age – education – 6). Another shortcoming is that we know only of the province of residence, and not of the province of work. We cannot report on the recent trend of increased worker mobility versus residence mobility highlighted in Laporte et al. (2013).

Since January 1997, a short supplement asking information about wages, union status, firm size, and contract type (permanent vs. temporary) was added to the incoming rotation group of the LFS.[2] Since the wage questions were not asked to self-employed workers, we exclude those from the main analysis sample. In the case of wage and salary workers, the wage pertains to the main job held at the time of the survey. In the LFS, workers paid by the hour report directly their hourly wage rate. Workers not paid by the hour report earnings over the periodicity of their choice (weekly, bi-weekly, etc.) and Statistics Canada constructs an hourly rate by dividing reported earnings by usual hours in the relevant time period. We use all wage and salary workers age 15 to 64 in the analysis, except for a few cases where educational attainment is abnormally high given age (university bachelor's degree or graduate degree for individuals age 15-19).

All statistics reported in the table and in the rest of the paper are weighted using the LFS sample weights. We have a total of close to 10 million observations from 1997 to 2013 with about as many women as men. Detailed summary statistics are reported in Table A1 in the on-line appendix.

3. Trends in Wage Inequality at the Provincial and National Levels.

3.1 National-level Trends.

Before presenting a detailed analysis at the provincial level we present as benchmark a few results for Canada as a whole. Figure 1 shows the trend in the 10th, 50th, and 90th percentiles of log wages for all workers in Canada. In this and others figures, wages are in 2002 dollars (using the national CPI as deflator) and a three-year moving average is used to smooth the data. The three wage percentiles are normalized to 100 in the base year to better illustrate the relative changes in wages at different points of the distribution. While this cannot be seen in the figures, the differences between these three wage percentiles are quite large. For instance, in 2013 the 10th, 50th, and 90th percentiles of wages are $8.76, $17.07, and $34.01, respectively.

Figure 1 shows that for men and women combined, the 90th percentile has grown faster than either the 10th or 50th percentile, resulting in an increase in top end wage inequality (gap between the 90th and 50th percentiles) of about 8 log points over the 1997-2013 sample period. By contrast, both the 10th and 50th percentiles remained more or less constant in real terms until 2006, and increased modestly after that. The 10th percentile increased a little faster than the 50th percentile after 2006, leading to a small decline in inequality in the bottom half of the distribution.

In Figure 2 we take a more detailed look at wage changes at each vingtile (5th, 10th, 15th, etc.) of the distribution for men and women separately. We compare wages by pooling data over three time periods: 1998-2002, 2003-2007, and 2008-2013. To simplify the discussion we refer to these three time periods as 2000, 2005, and 2010, respectively. For each gender, the panels shows that inequality at the top end increased sharply between 2000 and 2005 (dashed line), and increased more modestly between 2005 and 2010 (dotted line). The changes are monotonic since, relative to the middle of the distribution (45th to 55th percentile), there is more and more wage growth as we move up the distribution.

By contrast, there is much less of a clear pattern at the bottom end of the distribution. The very bottom (5th percentile) swings down and then up in the two periods. This is especially the case for women for whom there is a substantial expansion of bottom-end inequality in the first period and a substantial catch-up in the second period. As we show later, these large movements at the bottom end are connected to changes in provincial minimum wages. Note also that all wage percentiles increase more for women than men in both periods, resulting in a small decline in the gender gap.

The solid line shows the changes over the entire 2000-2010 time period. There is now clear evidence, mostly for men, of the type of wage polarization that was documented in the United States during the 1990s (e.g. Autor et al., 2006). Wages at both the bottom and top end have been increasing faster than wages in the middle of the distribution.[3]

3.2 Provincial-level Trends.

Figure 3 shows the evolution of the 10th, 50th, and 90th percentiles for each province separately. The figure also reports a counterfactual 10th percentile constructed under the assumption of a constant minimum wage that we discuss in detail in the next Section. There are a number of important differences across provinces. First consider the four most populous provinces, Quebec, Ontario, Alberta and British Columbia, where over 85% of workers live. In Quebec there is very little change in either the level or dispersion of wages, as all three wage percentiles shown in the figure grow by a similar amount (5 to 7 percent). Real wage growth is also quite limited in Ontario and British Columbia except for the 90th percentile which grows by 14% in Ontario and 10% in British Columbia. As a result, top-end inequality as measured by the 90-50 gap increases by more than 10 percentage points in these two provinces.

Unlike Quebec, Ontario, and British Columbia where real wages were stagnant for most of the 1997-2013 period, in Alberta the three wage percentiles presented in the figure grew by more than 25 percent. This dramatic change is also illustrated in Figure 4 that shows the evolution of median real wages (in 2002 dollars) in all ten provinces. Back in 1997 Alberta was in fourth place in terms of median wages behind the three other large provinces. By 2013, however, the median wage in Alberta had reached close to $20 an hour, which largely exceeds the median wage in the three other large provinces (around $17 an hour).

Figure 4 also shows that two other provinces, Newfoundland and Saskatchewan, experienced much faster wage growth than the rest of the country. Between 1997 and 2013, median wages in Newfoundland closed a gap of more than $2 an hour with Quebec. The case of Saskatchewan is even more dramatic. Median wages in that province were more than $4 lower than in British Columbia in 1997 ($13.39 compared to $17.80 in BC), but the gap had completely disappeared by 2013. Saskatchewan also overtook Ontario by 2013 despite a gap of more than $3 an hour in 1997. We later discuss how the strong wage growth in Alberta, Saskatchewan, and Newfoundland over the last 15 years appears to be connected to the growth in the extractive resources sector (mining and oil and gas) in these three provinces.

Turning back to Figure 3, it is clear that Ontario and British Columbia are the only two provinces to witness a substantial increase in inequality at the top end. In other provinces the gap between the 90^{th} and the 50^{th} percentile either remained constant or grew slightly. A more noticeable pattern is that the 10^{th} percentile increased much faster than the 50^{th} or the 90^{th} percentiles in most provinces after 2006, and in particular in Newfoundland, Nova Scotia, New Brunswick and Manitoba. This clearly contributed to the polarization phenomena we documented in Figure 2a. As we will see later, provincial movements in the 10^{th} percentile are closely connected to the evolution of the minimum wage in the different provinces.

3.3 Other Dimensions of Inequality Change.

Table 1 goes beyond the trends in overall wage inequality depicted in Figures 1 to 3 by presenting the evolution in several dimensions of wage inequality at both the national and provincial level. Panel A shows what happened to the university–high school gap during the 1998-2002, 2003-2007, and 2008-2013 period. The gap is obtained by running a regression of log wages on a set of age (ten age groups going from 15-19 to 60-64), education (seven categories), gender, and year dummies for each of the three periods. The year dummies are included to control for differences in average real wages within each of the three periods. Age and gender dummies are included to control for standard composition effects.[4] The university–high school gap is the regression-adjusted log wage difference between workers with exactly a bachelor's degree and those with exactly a high-school degree.

The first three rows of Panel A show that there was a small decline of 2.8 log points in the university–high school gap over the 1998-2002 to 2008-2013 period. This is an interesting reversal relative to the 1980 to 2000 period when the gap grew steadily, especially among younger workers (Boudarbat et al., 2010). The slight decline in the university–high school gap at the national level hides some important differences across provinces. In particular, the gap remained essential unchanged in Ontario, PEI and Nova Scotia, but declined from 0.37 to 0.30 in Alberta, and from 0.38 to 0.33 in Saskatchewan. This suggests that individuals with a lower level of education may have disproportionally benefited from the resource boom in these two provinces.

Panel B presents a summary measure of the age gap computed as the regression-adjusted difference between the wage of workers age 45-49 and 25-29. Contrary to popular belief, younger workers have made some recent gains relative to prime age workers. These changes are quite substantial. In 1998-2002 workers age 25-29 ("Generation X") were earning 27 log points less than workers age 45-49 ("Baby Boomers"). By 2008-2013 the gap had shrunk to less than 22 log points. So despite the adverse effect of the recent recession, the "Millenium" generation appears to be doing relatively well in terms of relative wages. This is consistent with longer trends that show that after substantially expanding in the 1980s and early 1990s, the age gap started to decline in the mid-1990s (Boudarbat et al., 2010).

The decline in the age gap is twice as large for men (7 log points) than women (3 log points). The likely explanation for this difference is that the level of actual work experience of prime-age women has increased over time because of the secular growth in female labour force participation. There is also a fair amount of variation in both the level and change in the age wage gap across provinces. The gap remained essentially unchanged in Ontario while it declined by around 10 log points in Quebec, Saskatchewan, and most of the Atlantic provinces.

A final dimension of overall inequality considered in Table 1 is the gender gap. Panel C shows that the regression-adjusted gap declined by 5 log points between 1998 and 2013. This is a fairly large change compared to the 1990s when the gender gap was relatively stable (Fortin et al., 2012). The change is fairly evenly spread across the country, except in British Columbia where the gender gap remained at about 20 log points over the sample period. Note however that there are some fairly large differences in the level of the gender gap across provinces. In the 2008-2013 period, the gender gap ranges from 25 log points in Alberta to about 15 log points in Quebec, Ontario, and Manitoba, and less than 10 log points in Prince Edward Island. A natural explanation for the larger gender gap in Alberta is that the industry mix in that province is more favorable to men, given the relatively low representation of women in extractive resource industries.[5]

The declining gender gap helps explain why overall inequality for men and women separately increased more than inequality for both genders combined. For instance, Panel D of Table 1 shows that the 90-10 gap increased by 1.1 log points for men and women combined compared to 1.5 and 2.3 log points for men and women, respectively. Consistent with Figure 2, Panel D also shows that inequality moved in different directions in different provinces. Between 2000 and 2010 the 90-10 gap increased by 7.3 log points in British Columbia and 4.9 log points in Ontario, while it declined in most other provinces.

The university–high school gap, the age gap, and the gender gap are three sources of between-group wage inequality. All three gaps generally decline during the sample period while overall inequality increases. This suggests that between- and within-group inequality may have moved in opposite directions during the last 10-15 years. We explore this formally by conducting a standard between/within variance decomposition. The results at the national level decomposition are reported in Table 2.[6]

The decomposition for men and women pooled together are performed by running wage regressions on a full set of interactions between gender, education, and age dummies (full set of interactions between age and education dummies when estimating the models separately for men and women). Since we want to focus on the contribution of these three factors to changes in the variance of wages, we first partial out the effect of province and year effects and focus on the remaining variance in the decomposition.[7]

Table 2 shows that, depending on the year and group (men, women, or both genders pooled together), the between-group variance represents between 22% and 31% of the total variance (this fraction is the R-square of the regression). As in the case of the 90-10 gap presented in Panel D of Table 1, the variance of log wages increases slightly over time. Consistent with the evidence reported in Panels A-C of Table 1, the between-group component of the variance declines between 2000 and 2010. Therefore any increase of the variance is due to the within-group component. The relative stability of the total variance hides a sizable, and mostly offsetting, movement in the between- and within-group components. For instance, when looking at men and women together, the between-group component declines from 0.070 in 2000 to 0.058 in 2010, while the within-group component increases from 0.153 to 0.173.

A similar analysis by provinces (reported in on-line Table A2) shows that both the between- and within-group components contribute to differences in the evolution of inequality across provinces. For instance, provinces where the within-group component grew the most (e.g. Ontario and British Columbia) also experienced the largest relative increase in the between-group component. This suggests that the within- and between-components may be driven by similar underlying trends linked to changes in the return to different dimensions of skill.[8]

Interestingly, the three provinces that experienced the most growth in the level of wages (Newfoundland, Saskatchewan, and Alberta) also experienced the largest decline in the between-group component of the variance of wages. This suggests that factors, such as the growth in the extractive resources sector that pushed up wages in these three provinces, may have had a relatively higher impact on the wages of less skilled (young and less educated) workers.

3.4 Summary

Three main sets of facts emerge from this descriptive analysis. First, while top-end inequality increased in most provinces between 1997 and 2013, there is much less of a clear trend in inequality at the bottom end of the distribution. In many provinces the 50-10 gap declined substantially, especially since the mid-2000s. In the next section we will argue that changes in minimum wages go a long way towards explaining what happened at the bottom end of the distribution.

A second important finding is that there has been much more wage growth in some provinces than others. In particular, median wages have grown much faster in Alberta, Saskatchewan, and Newfoundland than in most other provinces. In Section 5 we look at whether changes in industry composition linked to the extractive resources boom can account for these dramatic developments.

A third and final finding is that the between-group component of inequality has declined over time in all provinces, and especially in Newfoundland, Alberta, and Saskatchewan. This reflects a decline in three key wage differentials linked to gender, age, and education. In Section 5 we explore whether this phenomena is also linked to the extractive resources boom that may have had a particularly large impact on the wages of less-skilled workers.

4. Minimum Wages and Wage Changes at the Bottom End.

In this section we formally explore the contribution of changes in provincial minimum wages to the evolution of wages at the bottom end of the distribution. We start by describing the evolution of minimum wages in Canada between 1997 and 2013. We then propose a regression approach to estimate the impact of minimum wage changes on various wage percentiles at the lower end of the distribution. These estimates are then used to compute the counterfactual wage distributions that would have prevailed if minimum wages had remained constant over time. Given that teenagers represent a substantial fraction (44 percent) of minimum wage workers, we also construct counterfactuals that exclude these younger workers.

4.1 Minimum Wages in Canada.

In Canada, most industries are covered under provincial labour legislation.[9] Furthermore, since 1996 the minimum wage for workers covered under the federal labour legislation is simply the prevailing provincial minimum wage. Therefore, the minimum wage is solely set at the provincial level for the time period considered in this paper (1997 to 2013).

A plot of the real value of the minimum wage (2002 dollars) (available as on-line appendix Figure A1a) shows a substantial amount of variation in the minimum wage in the four largest provinces: Quebec, Ontario, Alberta, and British Columbia. Minimum wages in Quebec and Ontario tend to closely follow each other. The real value of the minimum wage declined in both provinces between 1997 and the mid-2000s, but has been increasing since then. The only difference between the two provinces is that minimum wages are initially a little higher in Quebec during the mid-2000s, and later, since 2009, substantially higher in Ontario than in Quebec.

Alberta used to have the lowest minimum wage in the country despite also having the highest income per capita. Following a number of large increases starting in 2005, it has now mostly caught up with Ontario and especially Quebec in recent years. The situation is completely the opposite in British Columbia where the minimum wage was the highest during most sample years. But after remaining at a nominal $8.00 for about ten years, the BC minimum wage had declined to the lowest real value in the country by 2010, before increasing again since then.

Unlike the four largest provinces, the minimum wages in the other six provinces all closely follow each other between 1997 and 2013 (see the on-line appendix Figure A1b). In all six cases, the real value of the minimum wage is more or less constant between 1997 and 2005, and then increases rapidly from around $6.50 to around $8.50 between 2005 and 2012. Remarkably, minimum wages in all ten provinces were very similar by the end of 2013, ranging from $9.95 in Alberta to $10.45 in Manitoba. This stands in sharp contrast with the situation that prevailed for most of the sample period when there were important differences in minimum wages across provinces.

Given the substantial differences in median wages across provinces (Figure 4), this also means that the minimum wage is relatively much higher in low-wage than high-wage provinces. For instance, in 2012, the minimum wage in the Maritime Provinces ranges from 56% to 58% of the median wage, compared to only 40% in Alberta, and less than 50% in Quebec, Ontario, and British Columbia.

A quick examination of the trend in the 10th percentile in different provinces (Figure 3) suggests it is closely connected to the evolution of the minimum wage. As noted above, British Columbia experienced a marked decline in the real value of its minimum wage between 2002 and 2011. As it turns out, it is also the only province where the 10th percentile was mostly stagnant during that period. By contrast, the Atlantic Provinces, Manitoba and Saskatchewan all experienced a clear increase in their real minimum wages after 2005, and Figure 3 shows that the 10th percentile also started moving up quickly during that period. This suggests a clear connection between the minimum wage and the evolution of wages at the bottom end of the distribution. We next explore this connection formally using regression methods.

4.2 Regression Approach

There are several possible ways of modelling the impact of the minimum wage at the bottom end of the distribution. A conservative approach that ignores spillover effects and employment effects is the tail pasting approach of DiNardo et al. (1996) where the wage distribution at or below the minimum wage in a year where the minimum wage is high is imputed to the wage distribution in a year where the minimum wage is lower. While the approach is useful when comparing two time periods, it gets cumbersome when several years of data are used as is the case here.

The fact that the tail-pasting approach ignores spillover effects is also an important limitation, since existing studies such as Lee (1999) suggest that these effects can be substantial.[10] Given these limitations, we use Lee's regression approach instead of the tail-pasting technique to construct counterfactual wage distributions at the provincial level.

Lee's approach consists of running a regression of the difference between a given wage percentile and the median (across year and provinces) on the relative value of the minimum wage (difference between the minimum wage and the median). Consider the following relationship between these two variables:

$$(w_{it}^{q} - w_{it}^{0.5}) = g^{q}(MW_{it} - w_{it}^{0.5}) \tag{1}$$

where w_{it}^{q} is the q^{th} wage percentile in province i and year t, and MW_{it} is the corresponding minimum wage (all variables are in logs). Lee argues that the gap function $g^{q}(\cdot)$ should be convex in the relative minimum wage, $MW_{it} - w_{it}^{0.5}$. Take for example the case of the 10$^{\text{th}}$ percentile, $w_{it}^{0.1}$, a percentile generally just above the minimum wage. When the minimum wage is very low, the gap function $g^{0.1}(\cdot)$ should be flat since the minimum has "no bite", and the observed value of the percentile is the latent value. But as the minimum wage gets closer to the 10$^{\text{th}}$ percentile we should expect $g^{0.1}(\cdot)$ to start sloping up because of spillover effects. For instance, if 8% of workers are at the minimum wage there are many reasons to believe that a small increase in the minimum wage should also affect wages just above the minimum wage. When the minimum wage is larger or equal to the 10$^{\text{th}}$ percentile, the slope of $g^{0.1}(\cdot)$ should be equal to 1 as there should be a one-to-one relationship between the minimum wage and the 10$^{\text{th}}$ percentile, that is, there should be no gap between the actual percentile and the minimum wage.

Plots of the raw data on relative wages, $w_{it}^{q} - w_{it}^{0.5}$, as a function of the relative minimum $MW_{it} - w_{it}^{0.5}$ for the 5$^{\text{th}}$, 10$^{\text{th}}$, 15$^{\text{th}}$, and 20$^{\text{th}}$ percentiles show a clear positive relationship only for the 5$^{\text{th}}$ percentile.[11] In most cases, the data points lie very closely to the 45 degree line indicating a one-to-one relationship between the minimum wage and the 5$^{\text{th}}$ percentile of the wage distribution. This is not surprising since in most years and provinces, at least 5% of workers are paid a wage at (or slightly below) the minimum wage.[12] For the whole sample, a little more than 5% of workers are at or below the minimum wage. This fraction is slightly higher for women (7 percent), but substantially higher for teenagers (37 percent).[13]

The relationship between relative wage percentiles and the relative minimum wage gets increasingly weaker (flatter) for higher wages percentiles. There is still a clear visual relationship for the 10$^{\text{th}}$ or even the 15$^{\text{th}}$ percentile. This suggests some significant spillover effects since the minimum wage is rarely as high as the 10$^{\text{th}}$ percentile, and never as high as the 15$^{\text{th}}$ percentile. By the time we reach the 20$^{\text{th}}$ percentile, the relationship is essentially flat. Overall, plots of the relationship between relative wage percentiles and the relative minimum wage are consistent with the prediction that the gap function $g^{q}(\cdot)$ is convex.

Of course, the raw plots may also reflect other unmodelled factors such as secular changes in inequality that could increase relative wage gaps (e.g. the 50-10 gap) regardless of the value of the minimum wage. To address these concerns we use an empirical strategy where we include a full set of year and province dummies in the regression version of equation (1). We also add a set of province-specific linear trends to control for other factors that may differently affect relative wage gaps in different provinces.

One additional concern is that since the median wage $w_{it}^{0.5}$appears on both sides of equation (1), regression estimates could be positively biased due to measurement error (sampling error in the empirical wage percentiles). We correct for this by replacing $w_{it}^{0.5}$on the right hand side of the regression by the average of the 45th and 55th percentiles, $\omega_{it}^{0.5}=(w_{it}^{0.45}+w_{it}^{0.55})/2$. This correction has very little impact on the regression estimates, suggesting the measurement error bias is small.[14]

Following Lee (1999), we capture the possible convexity in the gap function $g^q(\cdot)$ by using a quadratic specification in the relative minimum wage. This yields the following regression model for quantile q:

$$(w_{it}^q-w_{it}^{0.5})=a^q(MW_{it}-\omega_{it}^{0.5})+b^q\left(MW_{it}-\omega_{it}^{0.5}\right)^2+c_i^q t+\theta_i^q+\lambda_t^q+\varepsilon_{it}^q\ , \qquad (2)$$

where θ_i^q and λ_t^q are the set of province and year fixed effects, respectively; c_i^q is a province-specific linear trend term; ε_{it}^q is an error term that we allow to be correlated over time in an arbitrary way (we cluster the standard errors at the province level).[15] Note that all the parameters of the regression are allowed to vary arbitrarily across quantiles. Accordingly, we estimate separate regressions for each quantile.

The regression results are reported in Table 3. As a benchmark, we first report estimates using a linear specification in the relative minimum wage. Consistent with the plots discussed above, the estimated coefficient is large and positive in the case of the 5th percentile. The point estimate indicates that a 1% increase in the minimum wage leads to a 0.64 increase in the 5th percentile. The estimated effect goes down by half at the 10th percentile, and declines further at the 15th percentile, though it remains statistically significant in both cases. The effect is no longer significant at the 20th and 25th percentiles.

Results from the quadratic specification indicate that, as expected, the gap function $g^q(\cdot)$ is convex, though the square term is not significant in the case of the 10th (and 20th and 25th) percentile. The joint test of significance of the linear and square terms indicates that, as in the case of the linear specification, the effect of the relative minimum wage is only significant for the 5th, 10th, and 15th percentiles.

4.3 Policy Counterfactuals and the Polarisation of Wages.

Using the estimates reported in Table 3, we now turn to the question of how much of changes at the bottom of the wage distribution may be linked to movements in the real value of the minimum wage. We address these issues by computing counterfactual wage percentiles that would have prevailed if the relative real minimum wage had remained unchanged over time.[16] We fix the relative minimum wage (relative to the median) to its average value of -0.8 (in logs), which corresponds to a ratio of 45%, a relatively high minimum wage.

The counterfactual wage percentiles, $\hat{w}_{it}^q$, are computed as predictions from equation (2) where the actual relative minimum wage $(MW_{it}-\omega_{it}^{0.5})$ is replaced by its average value of -

0.80 and where the squared term $(MW_{it} - \omega_{it}^{0.5})^2$ is set to 0.64. Figure 3 shows the counterfactual value of the 10th percentile that would have prevailed if the relative minimum wage had remained constant over time. This counterfactual wage can be readily compared to the actual 10th percentile which is also reported in the figure. The results indicate that the 10th percentile would have increased much less in recent years if the relative minimum wage had remained constant. Consider, for instance, the case of Nova Scotia which is quite representative of the Atlantic Provinces. After losing ground relative to the 50th and 90th percentiles until about 2005, the 10th percentile started growing much faster after 2005, which lead to a large wage compression at the bottom end of the distribution. By contrast, the counterfactual 10th percentile closely follows the median over time, and only grows slightly faster after 2005. This suggest that most of the wage polarisation observed in that province (bottom growing faster than the middle) is a consequence of the large increases in the minimum wage since 2005. While there are smaller differences in the other Atlantic Provinces, in all cases the 10th percentile increases much less relative to the rest of the distribution when the relative minimum wage is held constant.

Figure 3b shows that most of the wage polarisation observed in recent years in Ontario is also linked to changes in the minimum wage. The 50th and 10th percentiles would have grown at comparable rates had the relative minimum wage remained constant over time. Consistent with the fact that the real minimum wage remained more stable in Quebec than Ontario over time (smaller declines in the mid-2000s, and smaller increases afterwards), holding the relative minimum wage constant has less impact in Quebec.

Turning to the Western provinces, the case of Manitoba is similar to the Atlantic Provinces. The 10th percentile grows substantially faster than the 50th or 90th percentiles. However, this is mostly due to increases in the minimum wage. When holding the relative minimum wage constant, the counterfactual 10th percentile closely follows the rest of the distribution. By contrast, the minimum wage appears to have little impact in Saskatchewan and Alberta. This is not surprizing in the case of Alberta where the minimum wage is just too low to have much bite even at the bottom of the distribution. In Saskatchewan, what happens instead is that the minimum wage more or less keeps pace with wages increases in the rest of the distribution. As a result, a fairly constant fraction of workers are paid at or below the minimum wage over time (on-line Appendix Figure 3b), and the counterfactual 10th percentile is quite close to the actual 10th percentile. Finally, the difference between the actual and counterfactual 10th percentiles in British Columbia reflects the fact the minimum wage was relatively higher in that province in the early 2000s and relatively lower in the late 2000s. Except for these transitory deviations the minimum wage was stable both in real and relative terms in that province.

The take-away message from Figures 3 is that recent changes in the minimum wage go a long way towards explaining why wages at the bottom of the distribution have grown faster than wages in the rest of the distribution since 2006. This suggests that some of the polarisation of wages documented in Figure 2 may be due to the recent growth in the minimum wage in most provinces. To explore this hypothesis more formally, we compare the average growth in wages at each percentile across provinces to the counterfactual growth that would have prevailed if the minimum wage had remained constant in relative terms. Figure 5a shows the results of this exercise for all workers, men and women, combined, for the periods 2000-2005, 2005-2010, and 2000-2010.[17] Given that a substantial fraction of minimum wage workers are teenagers, we also present the results for a sample that exclude teenage workers in Figure 5b.

Figure 5a shows that the minimum wage had little impact during the 2000-2005 period (dashed line) since it did not change that much in most provinces. By contrast, recent increases in the minimum wage explain why the bottom of the distribution grew more than the rest of the distribution between 2005 and 2010 (dotted line). After holding the minimum wage constant in relative terms, changes at the bottom of the distribution are in the 6-8% range, just as for other percentiles of the distribution. This suggests that recent increases in the minimum wage explain all of the modest decrease in inequality in Canada since the mid-2000s. Finally, when combining the two periods together (solid line in Figure 5), it is clear that the polarisation of wages since 2000 is largely a consequence of changes in the minimum wage. Had the minimum wage remained constant over time, all wage percentiles up to the 70th percentile would have increased at a fairly flat rate of 7 to 9 percent. Only wages above the 70th percentile experienced faster growth. Finally, Figure 5b shows that the effect of the minimum wage remains important but smaller when teenage workers are excluded from the sample.

In conclusion, after adjusting for changes in the minimum wage, we are left with a clear, though relatively modest increase in inequality over the last 15 years driven by the growth in wage dispersion at the top end. The wage polarisation observed in the raw data at the bottom end is largely driven by rising minimum wages and concentrated among teenage workers, as opposed to other popular explanations such as the "routinization" of jobs in the middle of the distribution and the growth of the service sector (e.g. Autor and Dorn, 2013).

5. Provincial Wage Trends and the Extractive Resources Sector.

We now turn to the large interprovincial differences in wage growth documented in Figure 4. As discussed earlier, wages in Newfoundland, Saskatchewan, and Alberta grew much faster than in other provinces over the last 15 years. In this section, we investigate whether these differences can be explained by the "boom" in the extractive resources (ER) sector (mining and oil and gas extraction) experienced by these three provinces in recent years. We also explore whether this explanation can account for the relative decline in inequality and in the return to education in these provinces. This would happen if less-skilled workers benefited relatively more from the expansion in the ER sector than other workers.

5.1 Trends in Extractive Resources Sector Employment and Composition Effects

Composition effects are a simple partial equilibrium explanation for the role of the ER sector in provincial wage trends. Since wages in this sector are substantially higher than in other sectors, increasing the fraction of workers in the ER sector should have a positive effect on average provincial wages.

Table 4 reports estimate from a standard wage equation estimated for the pooled 1999-2013 sample. Note that we only estimate the model starting in 1999 since there was a major change in industry classification in the LFS after 1998. The estimated model includes a set of 42 industry dummies based on the most detailed classification available in the public use files of the LFS, and a full set of dummies for province-year and gender-education-age interactions. The excluded industry category is wholesale trade, a large sector with average wages very close to the average for the entire sample. Table 4 shows that the industry wage premium for the ER sector (mining and oil and gas extraction) is 27.3 log points. This is the fourth largest premium after utilities (31.2 log points), petroleum and coal products manufacturing (30 log points), and the federal government (27.2 log points).[18]

While the ER sector accounted for 2.6% of total employment in Canada in 2013, the fraction is much higher and growing in Newfoundland, Saskatchewan, and Alberta. For example, ER employment grew from a little more than 2.5% to 6% in Newfoundland between 1999 and 2013. As shown in Figure 6, the change is more dramatic (from 4.5 to 9 percent) when looking at men only. Figure 6 shows an equally dramatic increase in ER male employment in Saskatchewan (from 5.7 to 8.3 percent) and Alberta (from 8.2 to 11.9 percent) during the same period.

Compared to Alberta and Saskatchewan, male employment in the ER sector in Ontario, and Quebec is negligible, standing at less than 1% in 2013. In British Columbia and Manitoba, and Nova Scotia it is around 2 percent, while it is in the 1-2% range in the other provinces. Note that some of the recent increases in male employment in the ER sector in non-producing provinces, such as Nova Scotia, has been attributed to workers commuting to Alberta (Laporte et al., 2013).

As noted earlier, the fact the wages grew much faster in the three provinces where employment in the ER sector expanded rapidly strongly suggests a possible connection between these two phenomena. However, simple calculations suggest that composition effects linked to the growth in ER employment cannot account for much of the wage growth in Newfoundland, Saskatchewan or Alberta. As noted above, ER employment increased by 2-4 percentage points in these provinces between 1999 and 2013. Multiplying this by the industry premium of 0.27 implies at most a 1% increase in wages.

We explore this point more formally by constructing some counterfactual experiments for Newfoundland, Saskatchewan and Alberta (and British Columbia as a benchmark). We first compare unadjusted differences in mean wages in those provinces to those of Ontario normalized to zero in 1999. These results indicate that average wages grew by about 23 percentage points more in Newfoundland, Saskatchewan and Alberta than in Ontario between 1999 and 2013. We then sequentially adjust for demographics, industry composition, and occupations by including an increasingly rich set of controls in pooled wage regressions. [19] The results, reported in the on-line Appendix Figure A4, indicate that controlling for these composition effects have little impact on the large interprovincial differences in wage growth between 1999 and 2012.

5.2 Spillover Effects.

While composition effects related to the growth in the ER sector are small, there are good reasons to believe this may be understating the full impact of the growth of this sector on wages in general equilibrium. In a conventional neoclassical supply and demand setting, a boom in the ER sector should increase the demand for labour and raise wages in all sectors, as firms need to bid up wages to keep workers that get better wage offers in the ER sector.

A related mechanism proposed by Beaudry et al. (2012) is that a growth in "good" or high paying jobs has spillover effects on other sectors because of job search externalities. Using U.S data, Beaudry et al. show compelling evidence that a positive shock to employment in a high wage sector (like ER) has an effect on average wages in the local labour market that far exceeds simple composition effects discussed above.

We formally explore this hypothesis by turning to a province-level analysis of wage growth. We first adjust wages for composition effects linked to industry and demographics using the regression approach discussed in section 5a. We then estimate the following regression model:

$$\bar{w}_{it} = \alpha + \beta D_{it} + \theta_i + \lambda_t + \varepsilon_{it} \quad , \tag{3}$$

where $\overline{w}_{it}$ is the adjusted average wage in province i in year t; D_{it} is a province-level demand shock; θ_i is a set of province dummies; λ_t is a set of year dummies; ε_{it} is an idiosyncratic error term.[20]

We consider two possible province-level demand shocks. Following Beaudry et al. (2012), the first demand shock index is a weighted average of the industry premia listed in Table 4, using employment shares in province *i* and year *t* as weights. This aggregate industry premium captures whether changes in the industrial structure of employment are biased towards high-paying jobs. Beaudry et al. show that the coefficient on this "good job" index is roughly equal to 3, suggesting large spillover effects in the labour market. Note that the coefficient on this index would be equal to 1 if *i)* unadjusted wages were used instead of adjusted wages $\overline{w}_{it}$, and *ii)* there were only composition effects and no spillover effects.

The second demand shock variable is based on the fraction of employment in the ER sector. For the sake of comparability with the aggregate industry premium, we multiply the ER share with the wage premium in that sector (0.27), and refer to the variable as the scaled ER share. As in the case of the aggregate industry premium, with only composition effects the estimated coefficient $\hat{\beta}$ should be equal to 1 if unadjusted wages were used as dependent variable.

Before presenting the results, we should note that there are a number of econometric challenges involved in the estimation of equation (3). As in Beaudry et al. (2012), industry composition may be endogenous. Beaudry et al. address this issue using a Bartik approach where national trends in sectorial employment are used to predict the aggregate industry premium using the fact that the baseline composition in employment by sector is different in different regions. To address similar concerns about the endogeneity of the ER employment share, we also follow a Bartik approach where an interaction between the provincial ER employment in the base period (1999) and energy prices is used as instrumental variable for the scaled ER share.[21]

Table 5 reports estimates of three versions of equation (3). In panel A the aggregate industry wage premium is used as the sole measure of demand shocks. Likewise, Panel B reports the estimates where only the scaled ER share is used as demand shock. Panel C reports the results with both measures included in the same regression. For the whole sample, the estimates from equation (3) are reported in column 1. The corresponding estimates using the Bartik instrumental variable strategy are presented in column 2. Separate estimates by gender and age group reported in columns 3-8 are discussed below. Standard errors are clustered at the province level to account for possible autocorrelation in the error term.

The estimated effects of the aggregate industry wage premium is slightly larger than 4, but is not statistically different from the estimate of around 3 found by Beaudry et al. (2012). This suggests that in Canada, as in the United States, the full wage effect of an increase in the fraction of high paying jobs goes above and beyond what would be implied by simple composition effects. But in Canada, a substantial part of this effect appears to be driven by the ER sector.

The estimated coefficients on recalled ER share presented in columns 1 and 2 of panel B are in the 18 to 23 range, with the OLS and IV estimates not being significantly statistically different from each other (the p-value of the Durbin-Wu-Hausman (DWH) test of endogeneity is 0.148). The similarity of the OLS and IV estimates is perhaps not too surprising in the case of the ER sector where employment is closely connected to the local availability of these resources, which is predetermined relative to other labour market variables.

The results also indicate that spillover effects are very large, even compared to the case of the industry wage premium. To better understand the magnitude of the estimated effect, consider a one percentage point increase in the ER share. In the absence of spillover effects, composition effect should only result in a 0.27% increase in average wages. The OLS coefficient of 18.45 means that spillover effects are 18.45 larger than composition effects, and that the full effect of a 1 percentage point increase in the ER share on average wages is close to 5 percentage points (18.45 x 0.27 = 4.98). Furthermore, the industry wage premium variable is no longer significant when the scaled ER share is included in the regression (Panel C).

Although the estimated effect of the ER share on average wages is very large, there are both theoretical and empirical reasons to believe these estimates are not spurious, and reflect some special features of this particular sector. From a theoretical point of view, it may be harder to arbitrage interprovincial wage differences linked to the ER sector relative to other sectors where capital is much more mobile. In other words, the ER may be generating a large rent that can only be dissipated locally since capital investments are linked to province-specific natural resources endowments.

From an empirical point of view, one may wonder whether the large effect of the ER share is just a statistical fluke. Even if none of the industry shares had a true effect on average wages (true value of β equal to 0 in equation 3), we would expect a few of these shares (one out of twenty) to be significant on the basis of tests at the conventional significance level of 95 percent. To explore this possibility, we re-estimate equation (3) using each of the 43 employment shares as measures of D_{it}. The resulting t-statistics for each of the 43 estimates of β are reported in the on-line appendix Figure A5a.[22] While a number of industries have a statistically significant effect, the ER sector has the highest t-statistic out of the 43 industries. Furthermore, the effect of the ER share is the only one that remains significant when province-specific trends are added to the regression.[23] This suggests there is something special about the ER sector that results in much larger spillover effects than other industrial sectors. This is also consistent with the findings of Marchand (2014) based a more compelling research design that exploits differences in energy resources endowments across sub-regions of the Western provinces. Marchand concludes that the energy boom had spillover effects on other sectors such as construction, business services, and retail trade, and contributed to an increase in income and a decrease in poverty.

Using the estimates reported in Table 5, we look at how much of the interprovincial differences in average wage growth can be accounted by the various explanations discussed above. The results are reported in Table 6. In each column we report the trend growth in mean wages in each province relative to Ontario after controlling for various factors. For example, in the case of unadjusted mean wages in column 1 we run a regression model of mean wages (in each province-year) on a set of province and year dummies, and province-specific linear trends using Ontario as the base. We then express the estimated trend in percentage terms and multiply them by 14 to get the cumulative wage growth between 1999 and 2013. Consistent with earlier discussion, column 1 shows that average wages in Newfoundland, Saskatchewan, and Alberta grew by 23% relative to Ontario. Wages in Manitoba and the Maritimes also grew by around 11 percentage points relative to Ontario. Wage growth in Ontario and Quebec was comparable, and only British Columbia fared worse than Ontario.

Adjusting for demographics and industry composition (column 2) has little impact on wage trends, but taking out the effect of the aggregate industry premium in column 3 reduces by about a third the wage growth in Alberta and Saskatchewan relative to Ontario, though it has a smaller effect in Newfoundland.[24] The impact of the ER share is even larger. Column 4 shows that more than half of the 20% wage growth in Newfoundland, Saskatchewan and Alberta can be accounted by that factor. Adjusting for the aggregate industry wage premium in addition to the ER share (column 5) has little impact on the results.

5.3 Differences by Skill Groups.

The third major fact documented in Section 3 is that inequality and the return to education declined faster in some provinces than others. Table 7 summarizes the evolution of the university–high school wage gap across provinces using the same regression procedure as in Table 6, except that the dependent variable is the difference in wages by education groups instead of the level of wages. Consistent with the descriptive finding reported in Table 1, columns 1 (men) and 3 (women) show that the university–high school gap generally declined faster in Newfoundland, Saskatchewan and Alberta than in other provinces.[25] One possible explanation for this phenomenon is that less educated workers have been benefiting more in terms of wage growth from the ER boom than more educated workers.

We explore this hypothesis by re-estimating equation (3) separately by gender and education groups. The results reported in columns 2-7 of Table 5 indicate that, as expected, the effect of the scaled ER share on wages declines with the level of education (Panel B). The effect is also larger for men than women. This is not surprising since most of the workers in the ER sector are men. Interestingly, the effect of the aggregate industry premium also declines as a function of education (Panel B), though there are no clear differences between men and women.

Using the results reported in Panel B of Table 5, columns 2 and 4 of Table 7 show that in Newfoundland, Alberta and Saskatchewan, about 3-4 percentage points of the decline in the university–high school can be accounted by the growth in the ER sector. Combining the results of Tables 6 and 7 together indicates that the employment boom in the ER sector both contributed to the large growth in means wages in Newfoundland, Alberta and Saskatchewan, and to a reduction in inequality in these three provinces as less-educated workers benefited the most from these changes.

6. Conclusion.

In this paper we use data from the Canadian Labour Force Survey (1997 to 2013) to understand why the level and dispersion of wages has moved differently across provinces. In terms of levels, the dominant trend is a much faster wage growth in Newfoundland, Saskatchewan, and Alberta than in other provinces since the late 1990s. Using Ontario as a benchmark, average wages have grown by 23 percentage points more in these three provinces. Composition effects linked to standard explanatory factors in micro-level wage regressions (experience, education, industry, occupation, etc.) explain very little of these dramatic developments. But as in Beaudry et al. (2012), the data patterns are consistent with a model where positive shocks in a given sector have large spillover effects on wages in other sectors of the local economy. In the case of Newfoundland, Saskatchewan, and Alberta, employment in the extractive resources sector (mining, oil and gas) has grown by about 50% between 1999 and 2013. The effect (mostly due to spillovers) of the extractive resources sector boom helps account for about two thirds of the divergence in the growth in mean wages between these provinces and the rest of the country.

Interestingly, the resource boom appears to have lifted all boats and contributed to a small decline in inequality in Alberta and Saskatchewan. Less educated workers experienced a larger growth in wages than university graduates, which reduced returns to education and overall inequality. By contrast, the skill premium was relatively stable in the rest of the country and top-half inequality (the gap between the 90^{th} and 50^{th} wage percentiles) kept increasing, while it did not increase in Alberta and Saskatchewan.

Inequality also declined in the bottom half (the gap between the 50^{th} and 10^{th} wage percentiles) of the wage distribution in most provinces, resulting in a polarisation of wages that has been documented in other countries. We show that changes in minimum wages appear to be the main reason why wages at the very bottom (e.g. the 10^{th} percentile) grew more than in the middle of the distribution over the last 10-15 years. Most provinces have increased their minimum wages substantially since around 2005, and changes in (province-level) wages at the bottom of the wage distribution are closely connected to changes in provincial minimum wages.

TABLE 1

Summary Measures of Wage Dispersion by Province

	A. University - High School Gap				B. Age 45-49 - Age 25-29 gap			
	1998-2002	2003-2007	2008-2013	Change	1998-2002	2003-2007	2008-2013	Change
Canada	0.364	0.352	0.336	-0.028	0.270	0.242	0.217	-0.053
Men	0.302	0.288	0.279	-0.023	0.324	0.281	0.254	-0.070
Women	0.415	0.404	0.384	-0.031	0.220	0.212	0.188	-0.032
Provinces								
Nfld	0.573	0.587	0.555	-0.018	0.310	0.285	0.178	-0.132
PEI	0.428	0.428	0.434	0.006	0.268	0.243	0.226	-0.042
NS	0.384	0.406	0.387	0.003	0.311	0.267	0.226	-0.085
NB	0.482	0.468	0.443	-0.039	0.267	0.227	0.192	-0.075
Quebec	0.411	0.404	0.373	-0.038	0.294	0.244	0.203	-0.091
Ontario	0.355	0.342	0.348	-0.007	0.262	0.251	0.250	-0.012
Manitoba	0.331	0.333	0.301	-0.030	0.276	0.236	0.207	-0.069
Saskatchewan	0.380	0.367	0.326	-0.054	0.252	0.237	0.158	-0.094
Alberta	0.371	0.335	0.298	-0.073	0.240	0.219	0.212	-0.028
BC	0.264	0.262	0.240	-0.024	0.265	0.238	0.212	-0.053

	C. Gender gap				D. 90-10 gap			
	1998-2002	2003-2007	2008-2013	Change	1998-2002	2003-2007	2008-2013	Change
Canada	0.225	0.198	0.178	-0.047	1.339	1.372	1.357	0.018
Men					1.334	1.342	1.327	-0.007
Women					1.288	1.333	1.303	0.015
Provinces								
Nfld	0.279	0.246	0.211	-0.068	1.439	1.452	1.338	-0.101
PEI	0.133	0.107	0.087	-0.046	1.229	1.265	1.245	0.016
NS	0.230	0.203	0.162	-0.068	1.364	1.363	1.276	-0.088
NB	0.251	0.196	0.176	-0.075	1.342	1.324	1.268	-0.074
Quebec	0.204	0.172	0.153	-0.051	1.307	1.313	1.290	-0.017
Ontario	0.220	0.197	0.165	-0.055	1.361	1.423	1.410	0.049
Manitoba	0.236	0.169	0.149	-0.087	1.315	1.304	1.263	-0.052
Saskatchewan	0.259	0.220	0.210	-0.049	1.344	1.348	1.312	-0.032
Alberta	0.288	0.265	0.246	-0.042	1.369	1.365	1.332	-0.037
BC	0.207	0.195	0.201	-0.006	1.250	1.289	1.323	0.073

NOTE: The number of observations used are 2,75,9408 in 1998-2002, 2,844,461 in 2003-2007, and 3,467,374 in 2008-2013.

TABLE 2

Between-Within Variance Decomposition for all of Canada

	1998-2002	2003-2007	2008-2013	Change
A. Men and women				
Between	0.070	0.065	0.058	-0.012
Within	0.153	0.168	0.173	0.020
Total	0.223	0.233	0.230	0.007
B. Men only				
Between	0.061	0.056	0.050	-0.011
Within	0.156	0.171	0.177	0.021
Total	0.217	0.227	0.227	0.010
C. Women only				
Between	0.057	0.057	0.053	-0.004
Within	0.150	0.165	0.168	0.018
Total	0.207	0.222	0.221	0.014

NOTE: The decomposition is performed using a full set of interactions between education (7 categories) and age (9 categories) dummies (also fully interacted with gender when men and women are pooled together). Province and year (four year dummies in each pooled five-year period) effects have been partialled out and do not contribute to the total variance.

TABLE 3

Estimated Effect of Minimum Wages on Selected Wage Percentiles

Wage percentile:	5th	10th	15th	20th	25th
A. Linear specification					
Rel. min. wage	0.673	0.312	0.084	0.003	-0.041
	(0.071)	(0.045)	(0.033)	(0.077)	(0.042)
B. Quadratic specification					
Rel. min. wage	3.489	1.497	1.205	0.407	0.730
	(1.475)	(0.875)	(0.335)	(0.975)	(0.422)
Rel. mw squared	1.700	0.715	0.677	0.244	0.465
	(0.881)	(0.526)	(0.207)	(0.579)	(0.253)
Joint test (p-value)	0.0000	0.0001	0.0049	0.9146	0.1640

NOTE: The dependent variable in the regressions is the difference between the wage percentile and the median. The relative minimum wage is the difference between the minimum wage and the average of the 45th and 55th percentiles. The regression models are estimated separately for each quantile. Standard errors (clustered at the province level) are in parentheses. All models aslso include year dummies, province dummies, and province-specific linear trends. All regression models are weighted by the sum of LFS sample weights in each province and year. 160 observations (10 provinces in 16 years from 1997 to 2012) are used to estimated the models.

TABLE 4

Industry Wage Differentials

	Coefficient	Std error		Coefficient	Std error
Agriculture	-0.252	0.001	Transportation Equipment Manuf	0.133	0.001
Forestry and Logging	0.087	0.002	Furniture and Related Product Manuf	-0.157	0.002
Fishing, Hunting and Trapping	-0.126	0.005	Miscellaneous Manufacturing	-0.079	0.002
Mining and Oil & Gas Extraction	0.273	0.001	Wholesale Trade	—	
Utilities	0.312	0.001	Retail Trade	-0.216	0.001
Prime Contracting	0.104	0.001	Transportation	0.007	0.001
Trade Contracting	0.099	0.001	Wharehousing and Storage	-0.087	0.002
Food, Bever. and Tobacco Manuf	-0.058	0.001	Finance	0.142	0.001
Textile Mills & Textile Product Mills	-0.152	0.003	Insurance Carriers & Related Financial	0.157	0.001
Clothing Manufacturing & Leather	-0.268	0.002	Real Estate	-0.110	0.001
Wood Product Manufacturing	-0.005	0.001	Rental & Leasing Services	-0.138	0.002
Paper Manufacturing	0.179	0.002	Prof, Scientific and Tech Services	0.160	0.001
Printing and Related Support Activities	-0.019	0.002	Management & Administrative Support	-0.199	0.001
Petroleum and Coal Products Manuf	0.300	0.003	Educational Services	0.151	0.001
Chemical Manufacturing	0.133	0.001	Health Care and Social Assistance	0.096	0.001
Plastics and Rubber Products Manuf	-0.040	0.001	Information, Culture and Recreation	0.021	0.001
Non-Metallic Mineral Product Manuf	0.023	0.002	Accommodation and Food Services	-0.288	0.001
Primary Metal Manufacturing	0.170	0.002	Other Services	-0.145	0.001
Fabricated Metal Product Manuf	0.010	0.001	Federal Government	0.272	0.001
Machinery Manufacturing	0.048	0.001	Provincial and Territorial Govt	0.243	0.001
Computer & Electronic Product Manuf	0.110	0.002	Local, Municipal & Regional Govt	0.185	0.001
Electrical Equipment & Appliance Manuf	0.012	0.002			

NOTE: OLS estimates from a model that also includes provincial-specific year effects and a full set of age * education * gender dummies. Estimated using a sample of 9,186,717 observations from the 1999-2013 Labour Force Survey.

TABLE 5

Regression Models with Province-Level Industry Shares

	All		Men only			Women only		
	OLS	IV	HS and less	Some PS	University	HS and less	Some PS	University
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Industry Premium only								
Industry	4.748		5.362	4.744	3.073	5.418	4.113	4.112
Premium	(1.343)		(1.395)	(1.388)	(1.034)	(1.488)	(1.609)	(1.316)
B. Extractive Industries Share (scaled) only								
Extractive	18.450	22.858	20.020	19.070	15.256	18.430	18.021	13.684
Resources	(3.148)	(3.570)	(3.263)	(2.917)	(3.747)	(4.044)	(3.204)	(3.391)
Share								
F-test -1st stage		42.47						
DWH (p-value)		0.148						
C. Both Industry Premium and Extractive Share								
Industry	2.227	1.254	2.682	2.095	0.760	3.080	1.510	2.400
Premium	(1.130)	(0.697)	(0.947)	(0.964)	(1.216)	(1.351)	(1.427)	(1.284)
Extractive	15.551	21.227	16.528	16.343	14.265	14.420	16.055	10.559
Resources	(3.389)	(2.560)	(2.519)	(2.501)	(4.498)	(4.599)	(3.787)	(3.360)
Share								
F-test -1st stage		33.83						
DWH (p-value)		0.112						

NOTE: The dependent variable in all models is mean wages (by province and year) adjusted for demographics and industry composition (150 observations for 10 provinces over the 1999-2013 period). Standard errors (in parentheses) are clustered at the province level. The industry premium variable is the predicted wage based on estimated industry premia (from a pooled regression for all provinces and years) and the observed industry composition in the province-year. The (scaled) ER share is the fraction of workers in the extractive resources sector multiplied by the wage premium in that sector (0.27). The IV specification instruments the scaled ER share using a Bartik instrument based on the provincial ER share in 1999 accrued using yearly energy prices. All estimated models include a set of province and year dummies.

TABLE 6

Trend in Mean Wages Relative to Ontario, 1999 to 2013

	Unadjusted (1)	Adjusted for Demographics and Industry (2)	(2) plus Aggr. Ind. Premium (3)	(2) plus Share Extr. Resources (4)	(3) and (4) together (5)
Newfoundland	24.5	24.7	20.7	9.4	9.9
PEI	13.7	12.0	4.7	9.1	6.1
Nova Scotia	12.1	12.8	9.2	13.6	11.8
New Brunswick	9.9	9.5	4.2	7.2	5.1
Quebec	0.8	1.9	-0.5	1.4	0.4
Ontario	—	—	—	—	—
Manitoba	8.4	8.9	5.8	8.8	7.3
Saskatchewan	22.2	21.6	12.7	11.4	8.8
Alberta	23.2	22.6	16.6	8.2	7.7
British Columbia	-3.4	-2.0	-3.4	-5.8	-5.9

NOTE: The province-specific trends are estimated by running OLS models for mean wages (adjusted according to the column header) on province-specific linear trends. The models also include year and province effects, with Ontario as the excluded category. Estimates are then converted to percentage point changes over the whole 1999-2013 period.

TABLE 7

Trend in University-High School Wage Gap Relative to Ontario, 1999-2013

	Men		Women	
	Adjusted for Demographics and Industry	(1) plus Share Extr. Resources	Adjusted for Demographics and Industry	(3) plus Share Extr. Resources
	(1)	(2)	(3)	(4)
Newfoundland	0.3	4.2	-7.3	-3.3
PEI	-2.7	-2.0	0.9	1.6
Nova Scotia	-0.9	-1.1	-4.6	-4.8
New Brunswick	-4.4	-3.8	-4.0	-3.4
Quebec	-5.8	-5.6	-4.0	-3.9
Ontario	—	—	—	—
Manitoba	-7.3	-7.2	-3.4	-3.3
Saskatchewan	-9.6	-7.0	-1.2	1.4
Alberta	-11.7	-8.0	-7.2	-3.5
British Columbia	1.3	2.3	-1.1	-0.1

NOTE: The province-specific trends are estimated by running OLS models for mean wage gaps (adjusted according to the column header) on province-specific linear trends. The models also include year and province effects, with Ontario as the excluded category. Estimates are then converted to percentage point changes over the whole 1999-2013 period.

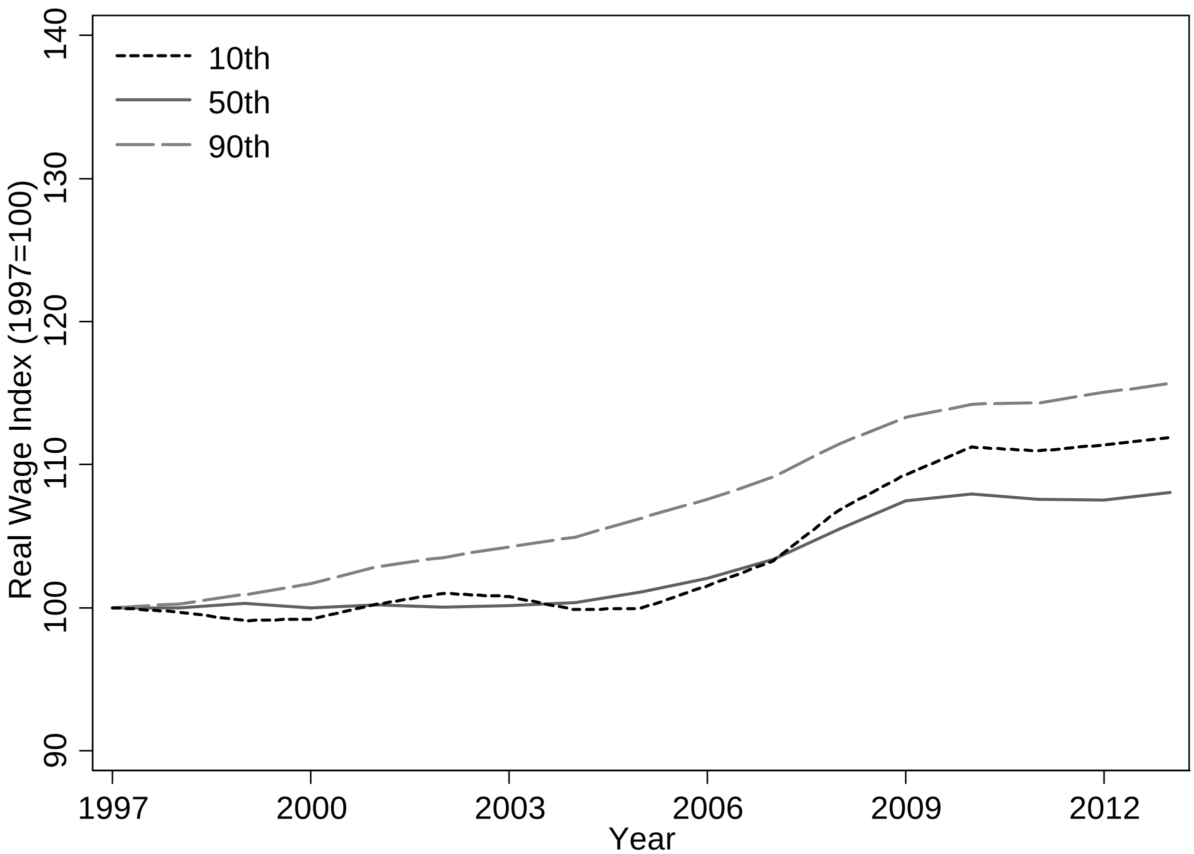
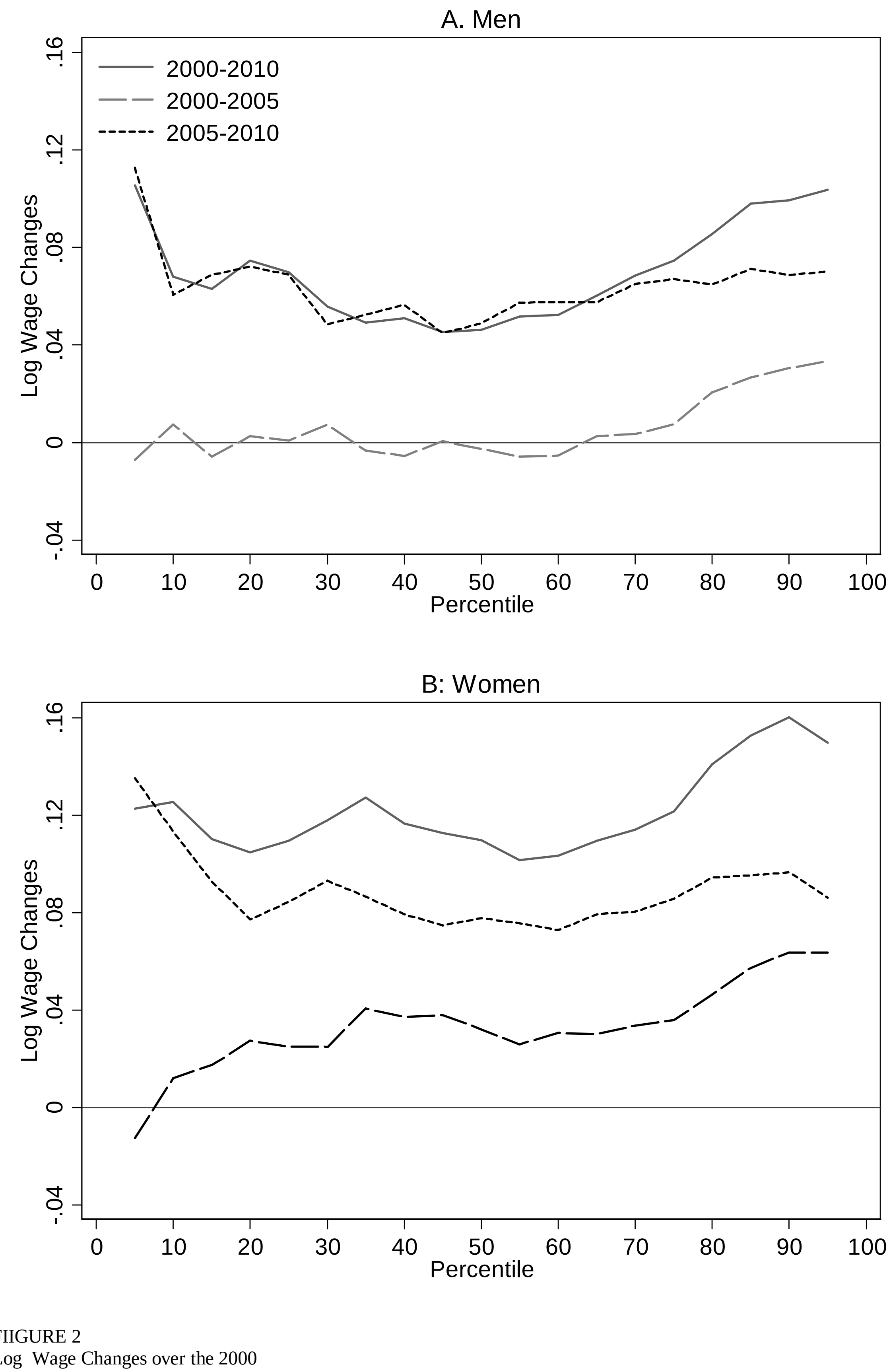


FIGURE 1
Relative Wage Changes at Selected Percentiles among Canadian Men and Women Combined



FIIGURE 2
Log Wage Changes over the 2000

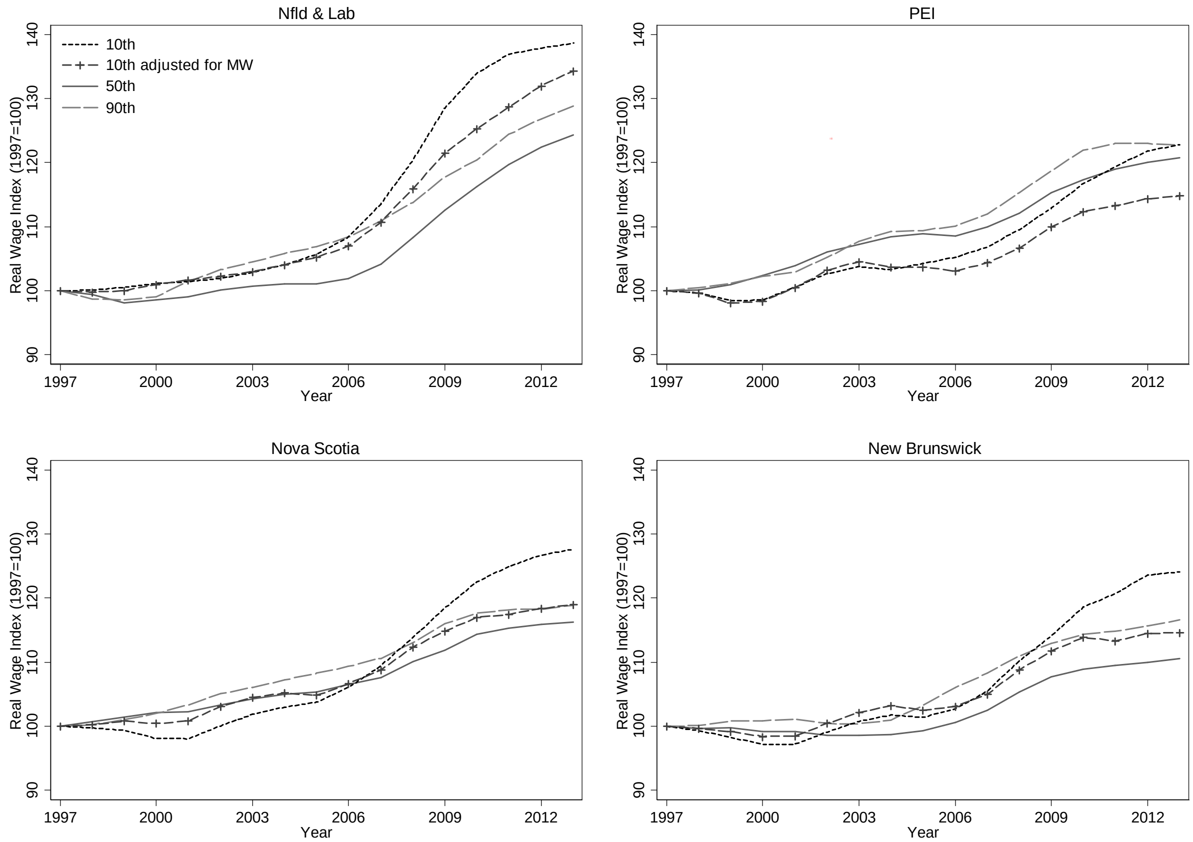


FIGURE 3a.
Relative Wage Changes by Provinces with Minimum Wage Adjustments

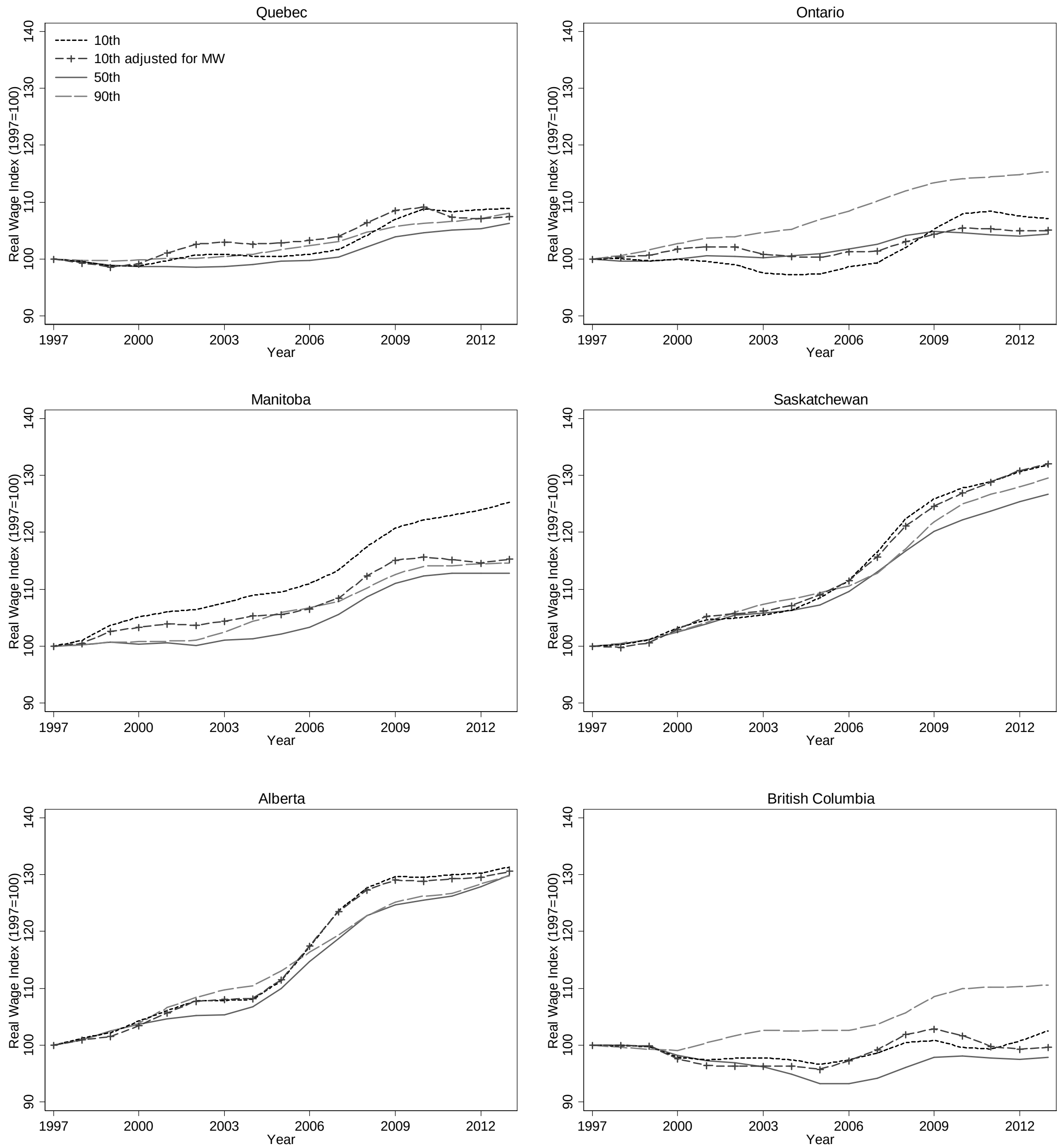


FIGURE 3b.
Relative Wage Changes by Provinces with Minimum Wage Adjustments

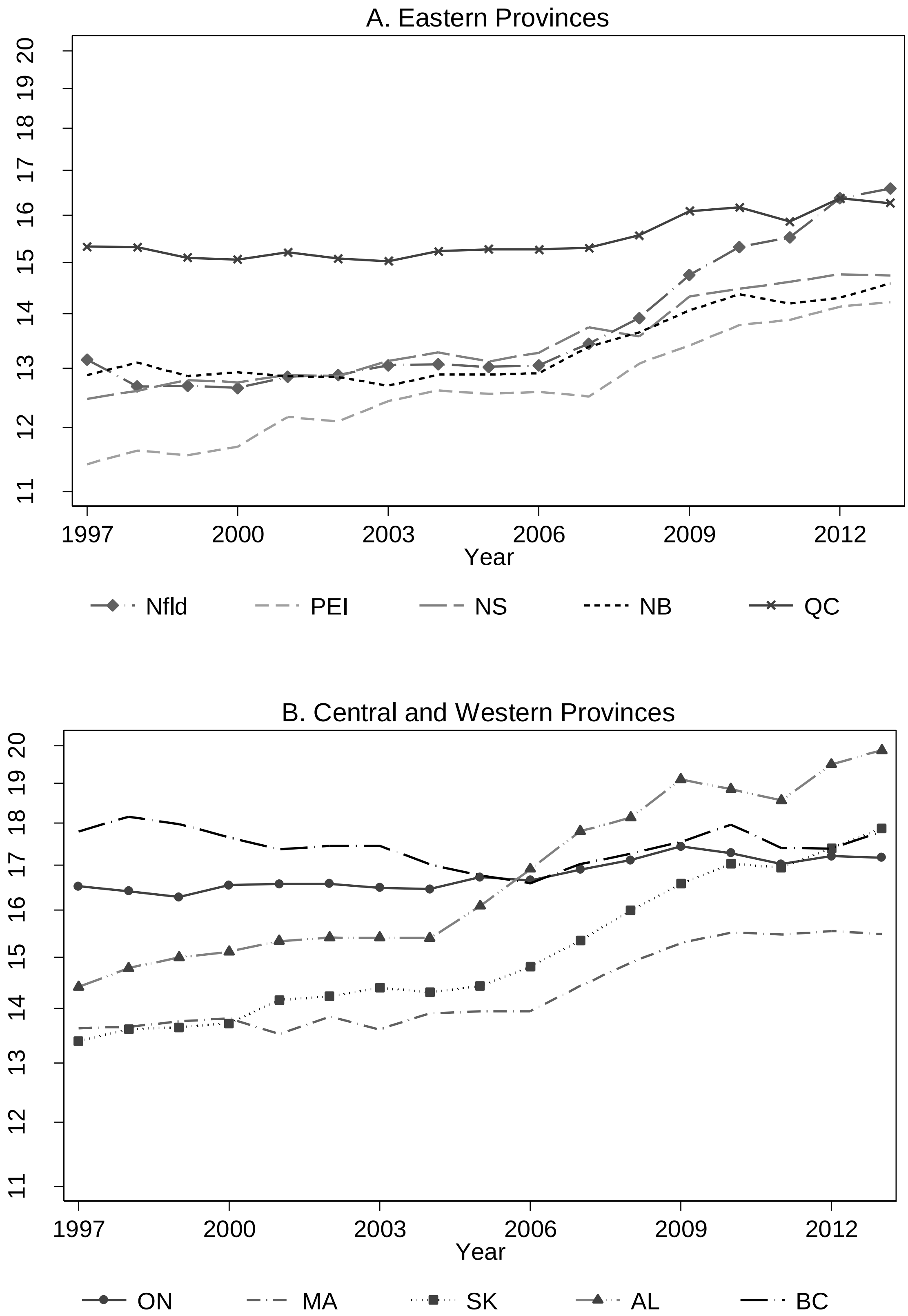


FIGURE 4
Median Hourly Wages by Provinces

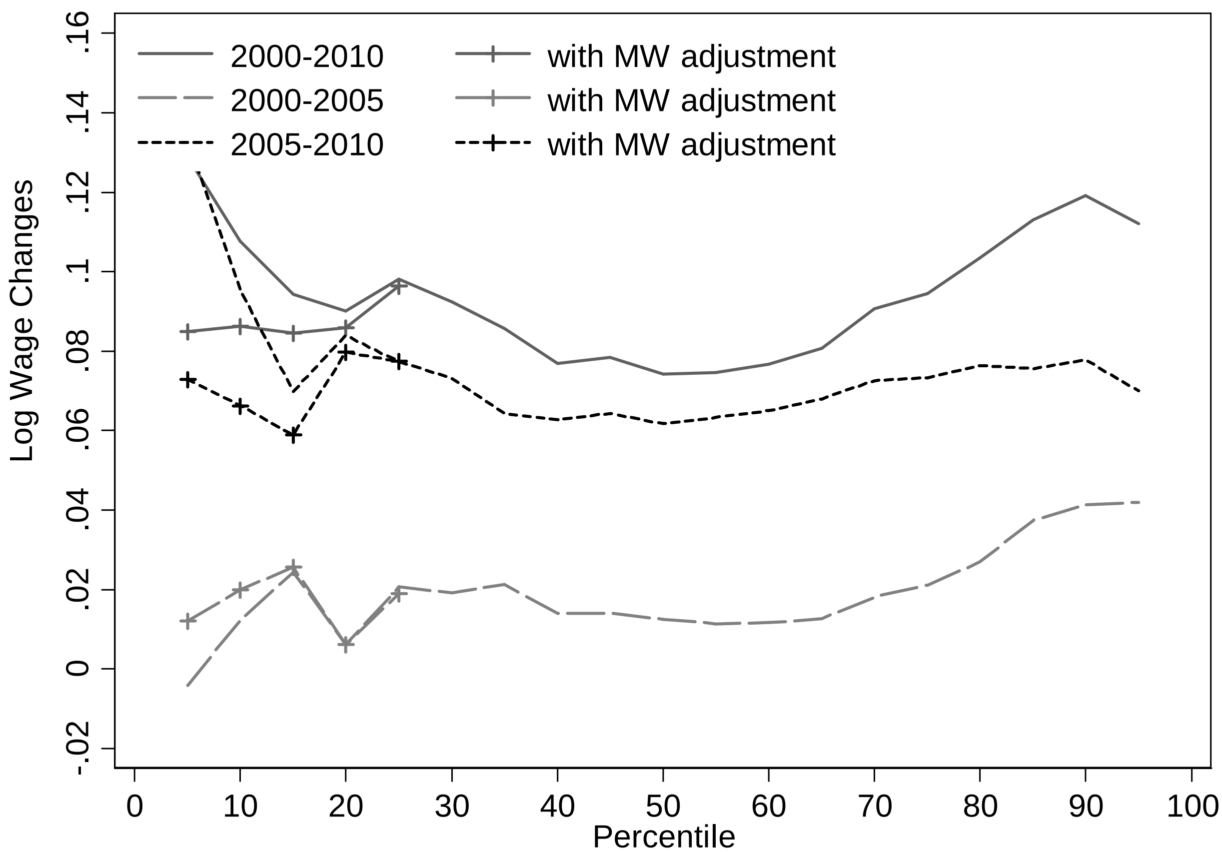


FIGURE 5
Log Wage Changes over the 2000s with Minimum Wage Adjustments mong Canadian Men and Women Combined

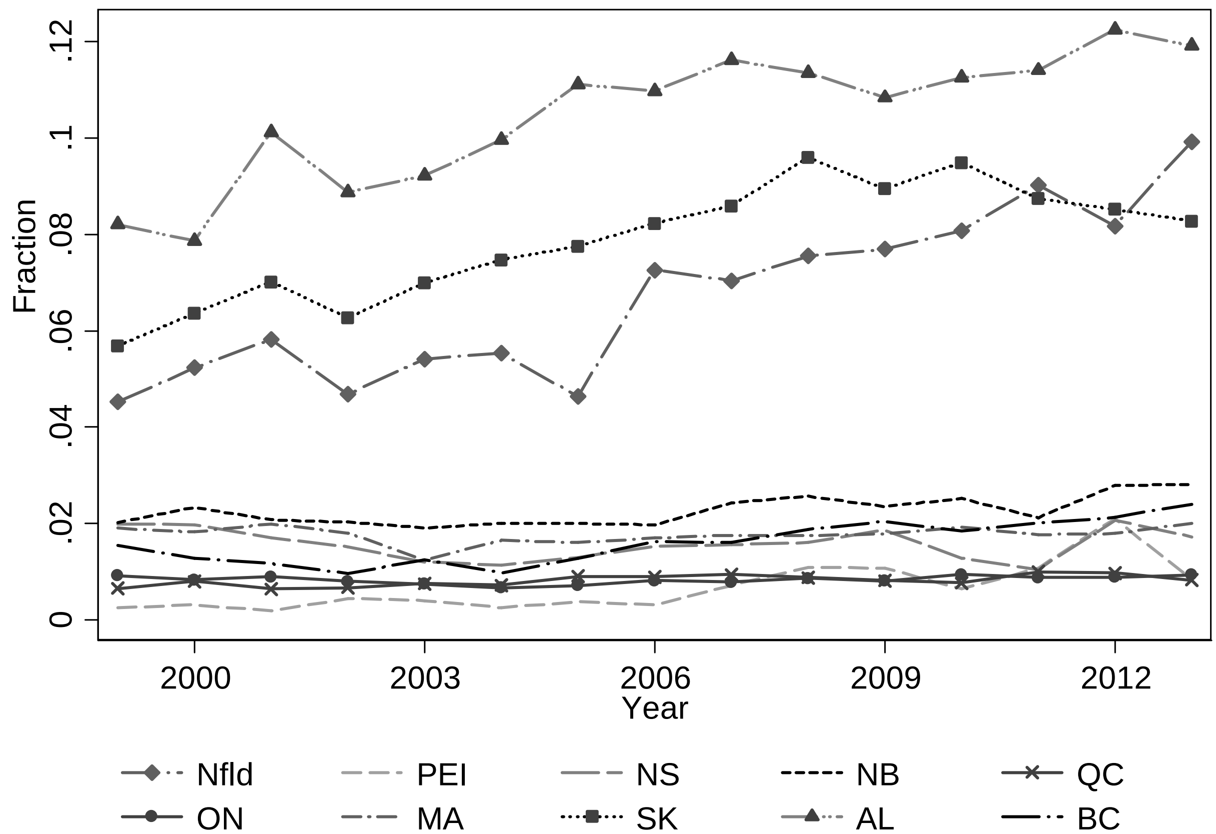


FIGURE 6
Fraction of Male Workers in Extractive Industries

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Footnotes

(Lead footnote) We would like to thank David Green and two anonymous referees for useful comments, and SSHRC and the Bank of Canada Fellowship Program for financial support.

1 Marchand (2014) finds that the energy boom has increased inequality within the energy sector, but reduced inequality in services (through spillover effects).

2 These questions are directly asked to respondents when they are first interviewed in the LFS (incoming rotation group). During subsequent months, respondents are only asked to update their answers in case they have changed job since the last interview.

3 This is also shown in Figure 5 which displays the same graph for men and women combined.

4 A more conventional approach in Mincer-type wage regressions consists of controlling for potential experience instead of age. We are unable to do so here since age is only reported in five-year categories in the public-use files of the LFS.

5 Consistent with the growing role of the resource extraction sector, the gender gap also declined less in Alberta that in all other provinces but British Columbia.

6 Detailed provincial-level results are reported in Table A2 in the on-line appendix.

7 We do so by running a regression with both province and year effects (dummies for each individual year within the five-year period) and the full set of interaction between gender, age, and education dummies included together. We then subtract the predicted effect of province and year dummies (only year dummies when running models at the provincial level) to get the "partialled out" wages. The within-group variance is then given by the variance of the regression residual, while the between-group variance is the variance of predicted wages.

8 Lemieux (2006a, and 2006b) reaches a similar conclusions when studying secular changes in the between and within-group dimensions of inequality in the United States.

9 Industries that are more "national" in nature (communications, transportation, etc.) are covered under the federal legislation. These industries typically employ few workers at the minimum wage.

10 Autor, Manning and Smith (2010) use a similar approach and find smaller, though still substantial, spillover effects than Lee (1999). Lemieux (2011) doesn't find much spillover effects in Canadian data, but his approach is different from what we do here as he jointly models the effect of the minimum wage on employment and the wage distribution.

11 The plots are presented in Figure A2 in the on-line appendix.

12 One key reason why some workers appear to be paid less than the minimum wage is that there is substantial heaping at integer values in the LFS wage data. Indeed, 37.5% of workers in our main sample report an integer value for their hourly wage. This means that, for example, when the minimum wage is equal to $10.25, many workers likely round off the reported wage to $10, which gives the false impression that these workers are paid less than the minimum wage.

13 See Tables A3a and A3b in the on-line appendix, which reports the percentage of workers at the minimum wage across demographic groups and provinces. The tables also show that, consistent with the recent trends in the real value of the minimum wage, the fraction of workers at or below the minimum wage increases from 4.3% in 2005-6 to 6.8% in 2013.

14 Using $\omega_{it}^{0.5}$ instead of $w_{it}^{0.5}$ is an imperfect fix for this problem since the sampling error is positively correlated for nearby percentiles. That said, the bias is likely very small since the variance of the sampling error in the estimate of $w_{it}^{0.5}$ is very small relative to the variance of $(MW_{it} - w_{it}^{0.5})$. The latter is equal to 0.0088 while the sampling error in $w_{it}^{0.5}$ ranges from 0.000005 in Ontario to 0.000037 in Prince Edward Island. Using the standard attenuation bias formula, the bias would be less than 0.5% even using the larger sampling variance of Prince Edward Island. The formula for the bias is slightly different when the same error ridden variable is on both sides of the regression, but it can be shown that the bias would still be in the order of 0.5 percent.

15 One concern in the literature (e.g. Bertrand et al., 2003, Cameron et al., 2008) is that clustering may have poor small sample properties when the number of clusters is small (ten provinces in our case). As a robustness check we have also computed the standard errors using a more parsimonious approach (Newey-West method) where the autocorrelation function is truncated to zero after four years. This yields slightly smaller, but otherwise comparable standard errors. We conclude from this exercise that having a small number of clusters does not appear to be a problem for the estimation of standard errors in our specific application.

16 Holding the real value of the minimum wage constant (instead of its relative value) yields qualitatively similar results.

17 As before, we use pooled data for 1998-2002, 2003-2007, and 2008-2013 but refer to years 2000, 2005, and 2010 to simplify the exposition. Note also that the (unadjusted) wage changes are qualitatively similar, though not identical to those based on a pooled sample of all provinces like Figure 2. The reason is that the average change in, say, the 10th percentile in the ten provinces is not equal to the change in the 10th percentile at the national level since the provincial 10th percentile falls at different points in the national wage distribution for different provinces.

18 While employment in petroleum and coal products manufacturing is concentrated in the same provinces as the ER sector, the on-line appendix Table A4 shows that it only accounts for a very small fraction of employment (0.19% compared to 2.1% for the ER sector over the entire period).

19 Specifically, in the case of demographics the provincial wages adjusted for composition effects are the set of province-year effects in a regression that also controls for a full set of province-year and gender-education-age interactions. Composition effects linked to industry and/or occupations are obtained by looking at how province-year effects change when industry and/or occupation effects are also included in the regression.

[20] This empirical model is similar to the approach used by Borjas and Ramey (1995) who were focusing on the effect of trade-impacted industries on regional wages.

[21] The energy prices were obtained using the Bank of Canada commodity price index (http://www.bankofcanada.ca/rates/price-indexes/bcpi/) deflated by the U.S. CPI. We also estimated models that removed the ER sector employment from the yearly provincial wage averages when constructing the dependent variables. This has imperceptible impact on the estimates.

[22] In appendix Figure A5, the ranking of industries on the x-axis corresponds to the list of industries in Table 4, a vertical line at x=4 indicating the ER sector (4th on the list in Table 4). Horizontal lines corresponding to the critical values for the null hypothesis that $\beta=0$ show which sectors have significant effects. Note that the critical value of 2.26 is larger than the standard critical value of 2 since there are only 10 clusters used to compute the standard errors.

[23] The effect of accommodation and food services (sector 39), the lowest paying of all 43 industries, becomes negative and significant when province-specific trends are included. Since the effect of this sector was not significant without provincial trends included, it is more likely to be a "fluke" than the ER sector which has a consistently positive and significant effect.

[24] This is consistent with the results reported in on-line appendix Figure A4.

[25] One small difference relative to Table 1 is that here we compare workers with a high school diploma or less to those with a university bachelor's or graduate degree, while in Table 1 we compare those with exactly a high school diploma to those with exactly a bachelor's degree. This has little impact on the results, so we use the broader groups here. The rationale for doing so is that we want to cover all workers in the analysis reported in columns 2-7 of Table 5 without having to report separate results for each of the seven education groups. Perhaps surprisingly, the university-high school gap declined for women (largest drop in all ten provinces) but did not change much for men in Newfoundland. This may be a consequence of relatively small LFS sample sizes in Newfoundland.