

Staff Analytical Note/Note analytique du personnel 2017-26

# The Impacts of Minimum Wage Increases on the Canadian Economy



by Dany Brouillette,<sup>1</sup> Calista Cheung,<sup>1</sup> Daniel Gao<sup>2</sup> and Olivier Gervais<sup>1</sup>

<sup>1</sup> Canadian Economic Analysis Department

<sup>2</sup> Funds Management and Banking Department

Bank of Canada

Ottawa, Ontario, Canada K1A 0G9

[dbrouillette@bankofcanada.ca](mailto:dbrouillette@bankofcanada.ca)

[ccheung@bankofcanada.ca](mailto:ccheung@bankofcanada.ca)

[danielgao@bankofcanada.ca](mailto:danielgao@bankofcanada.ca)

[ogervais@bankofcanada.ca](mailto:ogervais@bankofcanada.ca)

Bank of Canada staff analytical notes are short articles that focus on topical issues relevant to the current economic and financial context, produced independently from the Bank's Governing Council. This work may support or challenge prevailing policy orthodoxy. Therefore, the views expressed in this note are solely those of the authors and may differ from official Bank of Canada views. No responsibility for them should be attributed to the Bank.

## **Acknowledgements**

We would like to highlight the contribution from Madeline Hanson, Madigan Dockrill, Patrick Rizzetto, Stephanie Calhoun and Andrew Agopsowicz in drafting this note. We would thank Eric Santor, Robert Fay, Patrick Sabourin, Laurent Martin and Jane Voll for their helpful comments and suggestions. Finally, we would also thank Nicole van de Wolfshaar for her editorial assistance.

## Abstract

This note reviews the channels through which scheduled minimum wage increases over the coming years may affect Canadian economic activity and inflation and assesses their macroeconomic impacts. From reduced-form estimates of direct minimum wage pass-through, we find that consumer price index (CPI) inflation could be boosted by about 0.1 percentage point (pp) on average in 2018. A structural general equilibrium simulation suggests that minimum wage increases would reduce the level of gross domestic product by roughly 0.1 per cent by early 2019 and boost CPI inflation by about 0.1 pp. While the net impact on labour income would be positive, employment would fall by 60,000—a number that lies in the lower part of a range obtained from an accounting exercise (30,000 to 140,000). Consumption would decline because higher inflation would elicit a slight interest rate increase, which would more than offset the higher labour income. Potential output should remain unchanged in the short run. Longer-term effects are possible through automation, productivity gains or participation in the labour force, but the signs of these longer-term effects are ambiguous.

*Bank topics: Labour markets; Recent economic and financial developments*

*JEL codes: E, E2, E24, J, J2, J21, J22, J23*

## Résumé

Dans cette note, nous examinons les canaux par lesquels les hausses du salaire minimum prévues dans les années à venir pourraient influencer sur l'activité économique et l'inflation au Canada, et nous évaluons l'incidence macroéconomique de ces augmentations. À partir d'estimations de la transmission directe des variations du salaire minimum dans un modèle de forme réduite, nous constatons que l'inflation mesurée par l'indice des prix à la consommation (IPC) pourrait progresser d'environ 0,1 point de pourcentage en moyenne en 2018. Selon une simulation réalisée dans un modèle d'équilibre général de forme structurelle, les hausses du salaire minimum sont susceptibles de retrancher environ 0,1 % du niveau du produit intérieur brut (PIB) d'ici le début de 2019, et de faire augmenter d'environ 0,1 point de pourcentage l'inflation mesurée par l'IPC. L'incidence nette sur le revenu du travail serait positive, mais il en résulterait une perte de 60 000 emplois, un nombre qui s'inscrit dans le bas d'une fourchette obtenue dans le cadre d'un exercice comptable (de 30 000 à 140 000). La consommation diminuerait parce qu'une montée de l'inflation se traduirait par une légère hausse du taux d'intérêt, ce qui contrebalancerait amplement l'augmentation du revenu du travail. La production potentielle devrait rester inchangée à court terme. Les hausses du salaire minimum pourraient avoir des effets à long terme du fait de l'automatisation, des gains de productivité ou de l'évolution du taux d'activité, mais ces effets peuvent être aussi bien positifs que négatifs.

*Sujets : Marchés du travail; Évolution économique et financière récente*

*Codes JEL : E, E2, E24, J, J2, J21, J22, J23*

# 1 Summary

This note reviews the channels through which minimum wage increases can affect Canadian economic activity and inflation and assesses the macroeconomic impacts of the scheduled provincial minimum wage increases in the coming years. The key results are as follows:

- The macroeconomic impacts of these measures may be significant because about 8 per cent of employees in Canada work at the minimum wage, and estimates in the literature suggest that changes in the statutory rate have historically affected the wages of up to 15 per cent of employees with lowest wages.
- The direct pass-through from a simple reduced-form approach suggests that minimum wages could modestly boost consumer price index (CPI) inflation in 2017, ranging from 0.0 to 0.1 percentage point (pp) and by about 0.1 pp on average in 2018, ranging from 0.0 pp to 0.2 pp. The impact for CPI inflation in 2019 is also likely to be modest, ranging from 0.0 to 0.1 pp.
- Simulations using a structural general equilibrium model suggest that the scheduled increases would reduce the level of real gross domestic product (GDP) by roughly 0.1 per cent by early 2019, while boosting CPI inflation by about 0.1 pp. This reflects the following main effects:
  - The increases in the minimum wage lead to higher real wages, which push up firms' marginal costs, and thus inflation increases accordingly as a fraction of firms adjust their prices in the short term.
  - Weaker labour demand leads to reduced employment and lower hours worked, although the net impact on labour income is positive. Employment losses amount to about 60,000 workers (hours worked decline by 0.3 per cent), a number that lies in the lower part of the range obtained from a simple accounting exercise (30,000 to 140,000).
  - Consumption would be reduced slightly as the higher inflation would elicit a slight interest rate increase, which would more than offset the higher labour income.
- Potential output should remain unchanged in the short run. Longer-term effects are possible through automation, productivity changes or changes in labour force participation. The sign of these longer-term effects is, however, ambiguous.

## 2 What are the proposed changes to the minimum wage?

**Table 1** provides details on scheduled minimum wage increases by province. Overall in Canada, about 8 per cent of all employees currently work at minimum wage, a proportion that increases to 11 per cent if a threshold of 5 per cent above minimum wage is used.

Table 1: Scheduled changes in minimum wage				
	2016	2017	2018	2019
<b>Newfoundland and Labrador</b>	\$10.50 (October 2015)	\$10.75 (April 2017) \$11.00 (Oct. 2017)	Future changes indexed to CPI	Future changes indexed to CPI
<b>Prince Edward Island</b>	\$11.00 (October 2016)	\$11.25 (April 2017)	\$11.55 (April 2018)	Future changes based on annual review
<b>New Brunswick</b>	\$10.65 (April 2016)	\$11.00 (April 2017)	Future changes indexed to CPI	Future changes indexed to CPI
<b>Nova Scotia</b>	\$10.70 (April 2016)	\$10.85 (April 2017)	Future changes indexed to CPI	Future changes indexed to CPI
<b>Quebec</b>	\$10.75 (May 2016)	\$11.25 (May 2017)	\$11.75 (May 2018)	\$12.10 (May 2019)
<b>Ontario</b>	\$11.40 (October 2016)	\$11.60 (October 2017)	\$14.00 (January 2018)	\$15.00 (January 2019)
<b>Manitoba</b>	\$11.00 (October 2015)	\$11.15 (October 2017)	No announced changes	No announced changes
<b>Saskatchewan</b>	\$10.72 (October 2016)	\$10.96 (October 2017)	Adjusted annually based on average % change in CPI and average hourly wage	Adjusted annually based on average % change in CPI and average hourly wage
<b>Alberta</b>	\$12.20 (October 2016)	\$13.60 (October 2017)	\$15.00 (October 2018)	No announced change
<b>British Columbia</b>	\$10.85 (September 2016)	\$11.35 (September 2017)	Future changes indexed to CPI	Future changes indexed to CPI

CPI: consumer price index.

There are several channels through which increases in the minimum wage could affect Canadian economic activity and inflation. These channels are reviewed and quantified in

this note. In a first step, we estimate the direct pass-through of minimum wage into CPI inflation using a simple-reduced form equation (**Section 3**). Next, we look at how the resulting boost to real wages would propagate into economic activity (GDP, consumption) and inflation using a structural general equilibrium model, ToTEM III (**Section 4**). Last, we discuss the possible implications for potential output through, for example, substitution of labour for capital and labour force participation. Potential effects on income distribution and poverty are beyond the scope of this note.

### 3 Direct pass-through impact on CPI inflation

Since a higher minimum wage raises production costs for firms, it is likely that part of the increase will be passed on to consumers. The extent of this pass-through, however, depends on firms' ability to substitute away from the higher-cost labour inputs and preserve their margins, as well as the competitive landscape they face. To assess the direct impact of the pass-through from minimum wage to CPI inflation, we use reduced-form regressions with monthly provincial CPI inflation as the dependent variable and provincial minimum wage changes as the main explanatory variable. See **Annex 1** for details.

Our results (**Table A1** in Annex 1) indicate a small but significant contemporaneous direct pass-through from minimum wages to CPI inflation that is broadly consistent with the international evidence. Arpaia et al. (2017) report, for example, that the sum of pass-through coefficients is between 0.0 and 0.1 pp for goods and services components likely to be affected by minimum wage legislation (20 European Union countries). Lemos (2008) also finds a small pass-through impact in the United States, albeit higher than our results: a 0.4 per cent increase in overall prices following a 10 per cent increase in the US minimum wage.

Direct impacts of the pass-through from minimum wages to CPI inflation are presented in **Table 2**. The annualized impacts for 2017–19 are calculated for each province by converting the provincial monthly impact on a year-over-year basis and then by taking the average. Aggregation of the provincial impact is performed using the weights of each province in the CPI basket. This approach suggests that the scheduled changes in minimum wages could modestly boost CPI inflation in 2017, ranging from 0.0 pp to 0.1 pp, and by about 0.1 pp on average in 2018, ranging from 0.0 pp to 0.2 pp. The impact for CPI inflation in 2019 is also likely to be modest, ranging from 0.0 pp to 0.1 pp. The impact of the pass-through in 2017 and 2019 is lower than in 2018 given the smaller increases in minimum wages in those years.

Table 2: Pass-through of minimum wage to CPI inflation (pp)	
	Range
2017	0.0–0.1
2018	0.0–0.2
2019	0.0–0.1

## 4 Overall impact on real activity and inflation: A general equilibrium approach

The direct pass-through impacts presented in the previous section may not capture the possible general equilibrium and policy reaction effects. Therefore, we use a structural model (ToTEM III) to simulate the real wage increase in a general equilibrium framework setting.<sup>1</sup> The advantage of using a general equilibrium model is that it accounts for the different channels simultaneously. The impact of minimum wage increases is estimated in ToTEM III through a shock to labour supply that boosts aggregate real wages.<sup>2</sup>

It is therefore necessary, as a first step, to assess the impact of minimum wage increases on aggregate wages. Minimum wage increases can boost aggregate wages through direct cost-push effects and through potential spillover effects to workers earning just above the minimum wage (Brown 1999). In theory, the higher minimum wage raises the relative price of low-skilled workers, so employers substitute toward higher-skilled workers and bid up their wages. In addition, employers may adjust wages throughout the distribution to restore former wage differentials for reasons related to recruiting, retention and morale (Gunderson 2005). However, the literature suggests that effects on wages tend to taper off further up the distribution. Evidence for Canada is provided by Fortin and Lemieux (2015) who find, based on panel regressions on provincial annual data, that a 1 per cent minimum wage increase leads to a 0.67 per cent increase in the 5th percentile of the wage distribution that year, a 0.31 per cent increase in the 10th percentile, and a 0.08 per cent rise in the 15th percentile. Above the 15th percentile, the impact is statistically insignificant.

---

<sup>1</sup> A brief description of the changes incorporated into ToTEM III can be found in the appendix to the Bank of Canada *Monetary Policy Report* (October 2017).

<sup>2</sup> Because minimum wages do not enter ToTEM III, it is impossible to directly estimate the impact of changes to minimum wage on inflation. Therefore, the reduced-form analysis of Section 2 remains relevant as a cross-reference.

To calculate the impact of upcoming provincial minimum wage increases on aggregate wages, the elasticities from Fortin and Lemieux (2015) are applied to adjust each province's wage distribution by age group.<sup>3</sup> Based on these calculations, the minimum wage increases are expected to boost the national level of real wages by roughly 0.7 per cent by 2019.

### Net impact on inflation

The first channel of importance is the direct impact of higher minimum wages on CPI inflation. In the model, an increase in aggregate wages raises firms' marginal costs, which triggers an increase in prices in the economy. Simulation results suggest that a 0.7 per cent increase in real wages induced by the minimum wage changes will ultimately boost CPI inflation by about 0.1 percentage points.

### Labour market adjustments

The most widely studied aspect in the minimum wage literature is the impact on employment. Traditional competitive models suggest that an increase in a binding minimum wage will reduce employment, as firms substitute toward other inputs, such as capital or, perhaps, other more productive labour. Although empirical evidence is mixed on the magnitude of minimum wage effects, most studies for Canada find that the reduction in employment is statistically significant, especially for younger workers (Ngo, Rhodes and West 2017; Sen, Van de Waal and Rybczynski 2011; Fortin 2010; Campolieti, Gunderson and Riddell 2006; and Gunderson 2005). Fortin (2010), for example, uses a panel of annual provincial data to regress employment rates by age on the ratio of minimum wage to average wages. He finds that the negative effects are larger for youth and have increased in the 1995–2008 period compared with 1981–94.

In the structural model simulation, the increase in the minimum wage is captured as a negative labour supply shock that raises wages by 0.7 per cent. This shock reduces the demand for labour, leading to a decline in total hours worked of 0.3 per cent. If average hours worked remain unchanged, this would represent a loss of about 60,000 jobs by 2019.<sup>4</sup> On net, however, real labour income should be higher following the implementation of these measures relative to otherwise. This is because the 0.7 per cent

---

<sup>3</sup> The weights of each age group are then adjusted by assuming employment rates respond in accordance to the estimated elasticities shown in **Table B2** (see **Annex 2**).

<sup>4</sup> Note that if the average working hours decline following the increase in the minimum wage, the number of jobs lost would also be lower than 60,000.

increase in the level of aggregate real wages more than offsets the 0.3 per cent decrease in total hours worked.

The impact on employment from this general equilibrium simulation is comparable in magnitude with the lower range of estimates derived from a simple accounting exercise applying employment rate elasticities from a reduced-form approach (described in **Annex 2**) to the planned minimum wage changes.<sup>5</sup> A range of elasticities is estimated based on the following:

- re-estimating the employment rate elasticities obtained in Fortin (2010) to include more recent data, up to 2016;
- substituting the wage data of hourly workers from the Survey of Employment, Payrolls and Hours (SEPH) used in Fortin (2010) with wage data for all workers (both hourly paid and salaried) from SEPH and from the Labour Force Survey;
- extending the analyses to further control for education level and sex, following the approach of Sen, Van de Waal and Rybczynski (2011) and Baker, Benjamin and Staker (1999);
- testing for non-linear effects at higher relative minimum wage levels and at different parts of the economic cycle.<sup>6</sup>

Applying the range of elasticities obtained suggests that the announced minimum wage increases could reduce employment in Canada by 30,000 to 136,000 relative to otherwise by 2019 (see **Annex 2** for details of the calculations).<sup>7</sup>

### Implications on consumption

As noted by Arpaia et al. (2017), the impact of a higher minimum wage on consumption is ambiguous because it depends “on the interaction between the employment, wage and price effects of a minimum wage increase as well as the interaction with the tax and

---

<sup>5</sup> These elasticities allow us to estimate the response in employment rates to prospective minimum wage increases and calculate the effect on employment by applying these new employment rates on working-age population projections.

<sup>6</sup> Non-linear employment effects are found in the literature. For example, some studies on increases to the minimum wage in the United States find that employment effects for youth and low-skilled workers are significantly smaller during economic expansions than during recessions (Sabia 2014; Addison, Blackburn and Cotti 2009). Meanwhile, Grenier and Séguin (1991) and Jardim et al. (2017) propose that employment effects may be minimal when the ratio of minimum wage to average wage is low, but negative once the ratio rises beyond some threshold. This is because minimum wage rates may be more binding for employers when they are relatively high, so even small changes would induce significant employment cuts, although such effects do not appear to have been formally tested.

<sup>7</sup> Impact for Canada includes Ontario, Alberta, British Columbia and Quebec. For other provinces, the prospective minimum wage increases are negligible relative to historical average wage increases, so the effects on employment are assumed to be nil.

benefit system” (Arpaia et al. 2017, p. 28). There is some evidence in the literature that an increase in minimum wage boosts labour income (Campolieti, Gunderson and Lee 2012) and spending (Aaronsson, Agarwal and French 2012), especially for low-income households.

In the general equilibrium model simulations, disposable income is revised up as wages increase by more than hours worked decline. Nevertheless, the impact on consumption is negative, although modest, because the higher income is more than offset by slightly higher interest rates. While consumers at the lower end of the income distribution spend all their extra resources, their share is small in the model (they represent about 4 per cent of all consumers) and is not enough to offset the negative impact of higher interest rates on consumption.<sup>8</sup>

### Implications on potential output

We assume that potential output does not change in the short run in our simulations. However, it is possible that changes in the minimum wage may affect long-run employment and investment. In fact, Sorkin (2015) and Aaronsson et al. (forthcoming) recently argue that these long-run effects may be substantially larger than the short-run effects. As the minimum wage increases, firms may decide to substitute labour for capital by investing more heavily in automation, and this may even affect what types of firms enter and exit the market.<sup>9</sup> But firms may also opt to increase on-the-job training for their lower-productivity workers instead of replacing them with machines (Acemoglu and Pischke 1999). Both these channels are likely to increase labour productivity, but the former is at a cost of lower employment for displaced workers. The net effect on potential output from these channels is therefore ambiguous.

An increase in the minimum wage may also affect labour supply and demand in the long run. Under standard models with perfectly competitive labour markets, higher wages would induce more workers into the labour force. However, the presence of search frictions creates two opposing effects: higher wages raise the payoff from searching for work but weaken firms’ incentives to create jobs, making it more difficult to find work and thus discouraging search efforts (Rocheteau and Tasci 2007). As Mincer (1976) argues, changes in labour force participation indicate how the minimum wage affects the *value* of being in the labour market. If wages increase by more than the employment

---

<sup>8</sup> Higher interest rates also lead to an appreciation of the Canadian dollar, which puts negative pressure on household spending and exports.

<sup>9</sup> There are also several such anecdotes in the news. See, for example, R. Marowits, “Metro Grocery Chain Looking at Automation to Offset Higher Ontario Minimum Wage,” *The Star*, August 15, 2017.

declines, the net value of being in the labour force rises and “pulls” more workers in. By contrast, if the employment decline is very large, workers may see less value in searching for work and withdraw from the labour force, perhaps opting for further education (e.g., youth) or retirement (e.g., older workers). Meanwhile, a loss of a minimum wage job by a family member may draw other household members into the labour market, raising participation through an “added worker” effect (Gunderson 2005). However, evidence of these channels is mixed.<sup>10</sup> Previous studies by Greubel and Maki (1981) and Schaafsma and Walsh (1983) find that minimum wage hikes have a negative effect on participation rates in Canada, and more recent estimates (see **Annex 2**) show similar results.

Again, this leads us to conclude that the net effect on potential output from these channels is ambiguous and that at least over the short- to medium-run our assumption that potential output remains the same is reasonable.

### **Overall net impact on real activity and inflation**

In ToTEM III, the marginal cost channel is expected to dominate the effect of lower output and to boost CPI inflation by about 0.1 percentage points. For real activity, the scheduled increases in minimum wages are expected to reduce the level of GDP by about 0.1 per cent by early 2019.

---

<sup>10</sup> For example, Neumark and Wascher (2003) find in fact that school enrollment rates of high school students in the United States fall in response to minimum wage increases and argue this leads to less human capital accumulation.

## References

- Addison, J. T., M. L. Blackburn and C. D. Cotti. 2009. "Do Minimum Wages Raise Employment? Evidence from the US Retail Trade Sector." *Labor Economics* 16 (4): 397–408.
- Aaronsson, D. 2001. "Price Pass-Through and the Minimum Wage." *The Review of Economics and Statistics* 83 (1): 158–169.
- Aaronsson, D., S. Agarwal and E. French. 2012. "The Spending and Debt Response to Minimum Wage Hikes." *American Economic Review* 102 (7): 1–31.
- Aaronson, D., E. French, I. Sorkin and T. To. Forthcoming. "Industry Dynamics and the Minimum Wage: A Putty-Clay Approach."
- Acemoglu, D. and J.-S. Pischke. 1999. "The Structure of Wages and Investment in General Training." *Journal of Political Economy* 107 (3): 539–572.
- Arpaia, A., P. Cardoso, A. Kiss, K. van Herck and A. Vandeplass. 2017. "Statutory Minimum Wages in the EU: Institutional Settings and Macroeconomic Implications." IZA Institute of Labour Economics Policy Paper No. 124.
- Baker, M., D. Benjamin and S. Staker. 1999. "The Highs and Lows of the Minimum Wage Effect: A Time-Series Cross-Section Study of the Canadian Law." *Journal of Labor Economics* 17 (2): 318–350.
- Brown, C. 1999. "Minimum Wages, Employment, and the Distribution of Income." In *Handbook of Labor Economics*, Volume 3B, Chapter 32, edited by O. Ashenfelter and D. Card, 2101–2163. Elsevier.
- Brown, C., C. Gilroy and A. Kohen. 1982. "The Effect of the Minimum Wage on Employment and Unemployment." *Journal of Economic Literature* 20 (2): 487–528.
- Campolieti, M., M. Gunderson and B. Lee. 2012. "The (Non) Impact of Minimum Wages on Poverty: Regression and Simulation Evidence for Canada." *Journal of Labor Research* 33 (3): 287–302.
- Campolieti, M., M. Gunderson and C. Riddell. 2006. "Minimum Wage Impacts from a Prespecified Research Design: Canada 1981–1997." *Industrial Relations* 45 (2): 195–216.
- Card, D. and A. Krueger. 1995. "Time-Series Minimum-Wage Studies: A Meta-Analysis." *The American Economic Review* 85 (2): 238–243.
- Fortin, N. and T. Lemieux. 2015. "Changes in Wage Inequality in Canada: An Interprovincial Perspective." *Canadian Journal of Economics* 48 (2): 682–713.

Fortin, P. 2010. "Salaire minimum, pauvreté et emploi : à la recherche du compromis idéal." *Regards sur le travail* 7 (1): 1–14.

Grenier, G. and M. Séguin. 1991. "L'incidence du salaire minimum sur le marché du travail des adolescents au Canada : une reconsidération des résultats empiriques." *L'Actualité économique* 67 (2): 123–143.

Gruebel, H. and D. Maki. 1981. "A Note on the Effects of Unemployment Insurance, Minimum Wage Legislation and Trade Union Growth on Reported Unemployment Rates in Canada, 1950–75." *Industrial Relations* 36 (1981): 922–927.

Gunderson, M. 2005. "Minimum Wages in Canada: Theory, Evidence and Policy." *Federal Labour Standards Review Commission*.

Jardim, E., M. C. Long, R. Plotnick, E. van Inwegen, J. Vigdor and H. Wething. 2017. "Minimum Wage Increases, Wages, and Low-Wage Employment: Evidence from Seattle." National Bureau of Economic Research Working Paper No. 23532.

Lemos, S. 2008. "A Survey of the Effects of the Minimum Wage on Prices." *Journal of Economic Surveys* 22 (1): 187–212.

Mincer, J. 1976. "Unemployment Effects of Minimum Wages." *Journal of Political Economy* 84 (4): S87–S104.

Neumark, D. and W. Washer. 2003. "Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania: Comment." *The American Economic Review* 90 (5): 1362–1396.

Ngo, L., N. Rhodes and D. West 2017. "Assessing the Economic Impact of Ontario's Proposed Minimum Wage Increase." Financial Accountability Office of Ontario Commentary.

OECD. 1998. "Making the Most of the Minimum: Statutory Minimum Wages, Employment and Poverty." *OECD Employment Outlook*, Chapter 2.

Rocheteau, G. and M. Tasci. 2007. "Minimum Wage and the Labor Market." Federal Reserve Bank of Cleveland.

Sabia, J. J. 2014. "The Effects of Minimum Wage Over the Business Cycle." *Journal of Labor Research* 35 (2014): 227–245.

Schaafsma, J. and W. D. Walsh. 1983. "Employment and Labour Supply Effects of the Minimum Wage: Some Pooled Time-Series Estimates from Canadian Provincial Data." *Canadian Journal of Economics* 16 (1): 86–97.

Sen, A., C. Van de Waal and K. Rybczynski. 2011. "Teen Employment, Poverty and the Minimum Wage: Evidence from Canada." *Labour Economics* 18 (1): 36–47.

Sorkin, I. 2015. "Are There Long-Run Effects of the Minimum Wage?" *Review of Economic Dynamics* 18 (2): 306–333.

Wessels, W. J. 2001. "The Effect of Minimum Wages on the Labor Force Participation Rates of Teenagers." Employment Policies Institute.

———. 2005. "Does the Minimum Wage Drive Teenagers out of the Labor Force?" *Journal of Labor Research* 26 (1): 169–176.

Williams, N. and J. Mills. 2001. "The Minimum Wage and Teenage Employment: Evidence from Time Series." *Applied Economics* 33 (3): 285–300.

## Annex 1: Reduced-form estimates of the direct pass-through of minimum wage

We adopt a similar framework as in Aaronsson (2001) and estimate the following reduced-form equation:

$$\Delta CPI_t^p = \sum_{i=0}^4 \eta_i \Delta MW_{t-i} + \alpha_1 \Delta CPI_{t-1}^p + \alpha_2 \Delta UR_t^p + \mu^m + \mu^y + \mu^p + \varepsilon_t \quad [A1]$$

where  $\Delta CPI_t^p$  represents CPI inflation for province  $p$ , in month  $t$ ;  $\Delta MW_t$  is the change in the minimum in province  $p$ ; and  $\Delta UR_t^p$  the change in unemployment rate in province  $p$ . We also control for monthly ( $\mu^m$ ), yearly ( $\mu^y$ ) and provincial ( $\mu^p$ ) fixed effects. Estimations are done with pooled provincial data over the period from January 1991 to August 2017.<sup>11</sup> Lagged inflation is added to capture persistence, if any, while the provincial unemployment rate controls for economic conditions.

The coefficients of interest are the  $\eta_i$  because they capture the dynamics of the direct pass-through from minimum wage increases to inflation. We allow for these measures to affect CPI inflation contemporaneously and with lags but not with leads. Overall, we find little evidence of persistence in the direct pass-through as the sum of the estimated coefficients is significant only for the specification with contemporary minimum wage (**Table A1**).

Table A1: Estimated pass-through coefficients		
Dependent variable in equation [A1]	Dynamic structure	$\sum \eta_i$
Provincial CPI	T only	0.014**
	T to T-1	0.007
	T to T-2	0.003
	T to T-3	0.007
	T to T-4	0.020
** Significant at 0.05 level.		

<sup>11</sup> Although data are available further back in time, at least from January 1980, we prefer to report the regression results starting in 1991 to avoid the results being affected by the change the in monetary policy regime.

## Annex 2: Reduced-form estimates of employment rate and participation rate elasticities

### Employment rate elasticities

As a first step, we update the employment elasticities estimated in Fortin (2010) to include more recent data. Fortin (2010) applied a panel estimation approach using annual provincial data to regress employment rates by age and province on the ratio of the minimum wages to average wages, with various controls:

$$\log ER_{\alpha,p,t} = \beta \log \left( \frac{MW}{AW} \right)_{p,t} + \rho \sum PROV_p + \gamma \sum YEAR_t + \tau \sum TREND + \pi \log(GDP_{p,t}) + \delta YOUTHPOP_{p,t} + \varepsilon \quad [B1]$$

The dependent variable is the logarithm of the employment rate for a given age group  $\alpha$ , in province  $p$  and year  $t$ . The primary measure for the minimum wage is the logarithmic value of the ratio of nominal minimum wage to average wage for a given province. The dummy variables  $PROV$  and  $YEAR$  control for province-specific and time fixed effects, and the  $TREND$  variable is an interaction between  $PROV$  and  $YEAR$ , following the approach used in the Organisation for Economic Co-operation and Development (OECD 1998) and Baker, Benjamin and Staker (1999), to control for provincial time trends. The log of real provincial GDP is included to control for cyclical changes, and the share of 15 to 24 year olds in the provincial population ( $YOUTHPOP$ ) is included to control for demographic shifts that may affect employment rates by age group.

The regressions are run for three age groups (15–19, 20–24 and 25–54) over the sample periods 1981–94 and 1995–2008 and are shown in the first set of columns of **Table B1**. While Fortin (2010) used average wages for workers *paid by the hour* from the Survey of Employment, Payrolls and Hours (SEPH) as the denominator in the relative minimum wage variable, we first depart from his work by substituting with SEPH average wages for *all paid workers* (including hourly paid and salaried) in these regressions over the same 1995–2008 period and then by extending the sample up to 2016.<sup>12</sup> These results are shown in the second set of columns of **Table B1**. The third set of columns shows the results when we substitute with the Labour Force Survey (LFS) wages.<sup>13</sup>

---

<sup>12</sup> SEPH wage data for all paid workers is only available from 1991. Whereas Fortin (2010) used 2002 constant-dollar GDP at market prices data to control for provincial GDP, we use 2007 chain-weighted GDP at market prices up to 2015 and apply the growth rate for GDP at basic prices for 2016.

<sup>13</sup> There are several methodological differences between LFS and SEPH wages, including the exclusion of agricultural and self-employed workers from SEPH.

**Table B1: Updated Fortin (2010) elasticities—impact of change in relative minimum wage on employment rates**

Age group:	Fortin (2010)			Update using SEPH wages			Update using LFS wages		
	15–19	20–24	25–54	15–19	20–24	25–54	15–19	20–24	25–54
<b>Sample</b>									
<b>1981–94</b>	-0.21**	-0.02	0.08***						
<b>1995–2008</b>	-0.53***	-0.22***	-0.06**	-0.45***	-0.26***	-0.03	-0.11	-0.15*	0.00
<b>1995–2016</b>				-0.40**	-0.29***	-0.03	-0.06	-0.15**	-0.00

\*, \*\*, \*\*\* denotes statistical significance at the 0.10, 0.05, and 0.01 level.

These results using the more comprehensive SEPH wage data up to 2016 show slightly smaller disemployment effects for 15 to 19 year olds and prime-age workers compared with Fortin (2010) and slightly larger effects for 20 to 24 year olds. When we substitute with LFS wage data (which begins only in 1997), the effects are even smaller and only significant for 20 to 24 year olds.

#### Employment rate elasticities: robustness test

To test the robustness of these elasticity estimates, we next extend the analyses to further control for education level and sex, following the approach of Sen, Van de Waal and Rybczynski (2011) and Baker, Benjamin and Staker (1999). The baseline model is similar to equation [B1], with some differences. First, the dependent variable is now the logarithm of the employment rate for a given age group, sex and education level in province  $p$  and year  $t$ . Second, the lagged value of the relative minimum wage is also included, given evidence presented in Williams and Mills (2001) and Card and Kreuger (1995), that minimum wage changes take effect with some lag. Third, we include a dummy variable for gender and a set of dummy variables corresponding to various levels of education: (1) high school or lower; (2) some post-secondary (3) university degree or higher. Fourth, we add the provincial prime-age male unemployment rate ( $UNEMP$ ) to control for cyclical changes. These variables are all standard in the literature. For average wage data, we use wages for all paid workers taken from the SEPH database because of the longer time series. For ease of comparison with the elasticities in **Table B1**, we estimate these panel regressions over the same 1995–2016 period, and the results are shown in **Table B2**.

Compared with the above results in **Table B1** based on the Fortin (2010) approach, we find that employment elasticities are smaller for most age groups and only statistically significant for the 15–19 and 20–24 age groups (**Table B2**). When all age groups are grouped together, the impact on employment rates is negative but insignificant.

**Table B2: Impact of change in relative minimum wage on employment rates, with controls for sex and education**

	Age 15–19	Age 20–24	Age 25–54	Age 55+	Age 15+
<b>Elasticity</b>	-0.33***	-0.22***	-0.03	-0.06	-0.07
<b>R-Squared</b>	0.87	0.64	0.81	0.90	0.88

\*, \*\*, \*\*\* denotes statistical significance at the 0.10, 0.05, and 0.01 level.

We also find support for some non-linear effects, in line with arguments by Grenier and Séguin (1991) and Jardim et al. (2017) that employment effects may be larger at higher minimum wage levels. To test for such non-linearities, we added a variable that is an interaction of the relative minimum wage variable with a dummy variable that took the value of one for various thresholds of the relative minimum wage to average wage ratio: 0.30, 0.35, and 0.40. The results are fairly mixed but suggest that when the minimum wage is above 40 per cent of the average wage level, there may be an additional (small) negative impact on employment rates for 15 to 19 year olds (**Table B3**).<sup>14</sup>

**Table B3: Non-linear employment effects when minimum wage is above 40% of the average wage level**

	Age 15–19	Age 20–24	Age 25–54	Age 55+	Age 15+
<b>Elasticity</b>	-0.36***	-0.23***	-0.02	-0.01	-0.06
<b>Additional impact when MW/AVGW &gt; 0.40</b>	-0.04*	-0.01	0.01	0.03	0.01
<b>R-Squared</b>	0.87	0.63	0.81	0.90	0.88

\*, \*\*, \*\*\* denotes statistical significance at the 0.10, 0.05, and 0.01 level.

### Impacts on employment

The elasticities in **Table B1** and **Table B2** allow us to estimate the response in employment rates to prospective minimum wage increases and then calculate the impact on employment by applying these new employment rates on working-age population projections. If we apply the updated elasticities from **Table B1** to the planned minimum wage increases, the estimated reduction to national employment would be 136,000 jobs by 2019 using the SEPH wage measure and only 30,000 jobs using the LFS wage measure.

<sup>14</sup> We also tested whether the impact on employment rates differ when the economy is contracting versus expanding by interacting the relative minimum wage variable with a dummy variable that would equal one if the unemployment rate had risen compared with the previous year. Results are mostly insignificant.

Meanwhile, applying the elasticities from **Table B2** to the employment rates of the 15 to 19 and 20 to 24 age groups, the planned minimum wage increases would reduce national employment by about 75,000 jobs relative to otherwise by 2019, or about 0.4 per cent of 2016 levels.<sup>15</sup> Incorporating non-linear effects (**Table B3**) would slightly augment the estimated reduction in national employment to 80,000 jobs by 2019.

While the results in **Table B2** show the average impact across all education levels, we generally find that the disemployment effects diminish at higher levels of educational attainment. For example, for 20 to 24 year olds, a 10 per cent relative minimum wage increase would reduce employment rates by 2.4 per cent for those with high school or less but would have no significant effects for those with a university degree or higher. Meanwhile, even prime-age workers with high school or less education are not significantly affected by minimum wage increases.

### Participation rate elasticities

Next, we estimate the relationship between minimum wages and participation rates, using the same equation as for the employment rate, simply replacing the dependent variable of employment rates with participation rates. For ease of comparison with the employment rate elasticities, we use the same sample period of 1995–2016.

**Table B4** shows that the baseline estimates reveal no significant impact of minimum wage increases on participation rates for workers aged 25 and above, but they do show a significant *negative* effect for younger workers. Specifically, a 10 per cent increase in the minimum wage relative to average wages is estimated to *decrease* participation rates by 2.6 per cent for 15 to 19 year olds and by 1.5 per cent for 20 to 24 year olds. This negative relationship is consistent with previous findings for Canada (Greubel and Maki 1981; Schaafsma and Walsh 1983) and for the United States by Wessels (2001, 2005). The result that these participation rate responses are close in magnitude to those estimated above for employment rates suggests that there would be a limited change in *unemployment* rate in response to an increase in minimum wage.<sup>16</sup>

---

<sup>15</sup> Employment rates are assumed to respond to minimum wage changes with one year lag and are assumed to be zero if the minimum wage rate is rising less than the increase in average wage rates. Average wage rates are assumed to increase over 2017–19 at their historical mean annual growth rates. Employment effects are incorporated only for Ontario, Quebec, Alberta and British Columbia; for most other provinces, prospective minimum wage increases are close to assumed average wage increases, so employment effects are assumed to be nil.

<sup>16</sup> This finding is supported by the literature; for example, Brown, Gilroy and Kohen (1982) finds that a 10 per cent increase in minimum wages decreases employment levels for white males aged 16 to 19 by 1.21 per cent but only increases their unemployment rates by 0.19 per cent.

Table B4: Impact of change in relative minimum wage on participation rates					
	Age 15–19	Age 20–24	Age 25–54	Age 55+	Age 15+
<b>Elasticity</b>	-0.264 <sup>***</sup>	-0.150 <sup>**</sup>	-0.029	-0.021	-0.060
<b>R-Squared</b>	0.835	0.466	0.813	0.893	0.873

<sup>\*</sup>, <sup>\*\*</sup>, <sup>\*\*\*</sup> denotes statistical significance at the 0.10, 0.05, and 0.01 level.