Testing the Robustness of Cross-Province Panel Studies Of The Minimum Wage Effect in Canada

Anthony E. Myatt and James Ted McDonald

October 2009

Department of Economics
University of New Brunswick
P. O. Box 4400
Fredericton
New Brunswick
E3B 5A3
CANADA

Email: tmyatt@unb.ca , tedmcdon@unb.ca
Phone: 506-447-3208

Acknowledgements: The authors would like to thank, without implicating, Michael Baker, Vaughan Dickson, and Morley Gunderson, for very helpful suggestions.

Testing the Robustness of Cross-Province Panel Studies Of The Minimum Wage Effect in Canada

ABSTRACT

A series of papers have established that minimum wages have negative employment effects on teenagers in Canada. All of these papers use panel data methodology, and assume that coefficients are constant across provinces and over time. However, when these assumptions are treated as testable constraints, they are soundly rejected. The impact of minimum wages seems to change over time, is cyclically dependent, and may be positive when unemployment is low.

I. Introduction

Surveys of economists consistently find a high degree of consensus on positive microeconomic issues. But on one particular issue – the effects of minimum wages on employment – the degree of consensus has significantly weakened over the 1990s (see table 1). This may well reflect the work of Card, Katz, and Krueger[1], who have attempted to show that minimum wage increases often have a zero or positive impact on employment. Their results have been the subject of a lively debate.

One interesting feature of the debate is the extent to which the empirical evidence appears to conflict. Neumark and Wascher (2004) point out that conflicting empirical evidence can be found for nearly every country in the world, with two notable exceptions: Spain and Canada. The most often cited explanation for the Canadian exception is Hammermesh's (2002) observation that Canada is "a desirable laboratory" for testing minimum wage effects because minimum wages are set provincially, which gives more identifying variation.

Another interesting feature of the debate is the recognition that conscious or unconscious biases in searching for a "robust" equation may explain "author effects" – where one team of authors consistently finds different results to another team. In an attempt to cut through these biases Levine (2001) committed the journal *Industrial Relations* to a "pre-specified" research design where opposing teams would use the same econometric model to be agreed before the data became available. This "pre-specified" econometric specification has since been used in several empirical papers, including Neumark (2001) and more recently by Campolieti, Gunderson and Riddell (2004).

The purpose of this paper is to explore the robustness of the Canadian results using variations of the same "pre-specified" econometric model. The core issue is the implicit assumptions made by nearly all Canadian studies that regression coefficients are stable both over time and across provinces. Our main finding is that when these assumptions are treated as imposed constraints and tested for validity, they are soundly rejected. The marked non-robustness of the results to the relaxation of these assumptions calls into question the validity of the negative employment effect of minimum wages that has been found in most of the Canadian literature.

II. The Canadian Evidence

The list of studies yielding significant negative employment effects in Canada includes Swidinsky (1980), Schaafsma and Walsh (1983), Grenier and Seguin (1991), Baker, Benjamin and Stanger (1999), Baker (2003), Yuen (2003), Campolieti, Fang, and Gunderson (2004), and Campolieti, Gunderson and Riddell (2004)[2]. On balance, this evidence suggests that minimum wages are having *increasingly important* negative effects on youth employment. Apparently, the minimum wage/employment elasticity has increased from -0.17 for the period 1956-75 (Swidinsky, 1980), to –0.25 for the period 1975-93 (Baker, Benjamin and Stanger, 1999), to –0.49 for the period 1983-2000 (Baker, 2003).

The only paper to have found no significant minimum wage effect is that by Goldberg and Green (1999). However, Baker, Benjamin and Stanger (hereafter referred to as BBS) have shown that this anomalous result is entirely because Goldberg and Green used a logarithmic specification and empirical results are sensitive to the choice of functional form. They conjecture that this sensitivity arises because of "heterogeneity in the cyclical effects of various control variables across provinces that are accommodated differently in the linear and log-linear specifications" (p. 328). When BBS allow for interactions between the province effects and the other control variables they find that both linear and log-linear models have similar negative minimum wage effects. Furthermore, Box-Cox models suggest the linear model is best.

All but two of the Canadian studies combine aggregate time-series provincial data into panel-data sets[3]. The advantage of provincially-aggregated panel data is that they are available for a long time span. In contrast, panel data on individuals are typically available only for relatively short periods of time – for example, a maximum of six years for the Survey of Labor Income Dynamics. For these reasons we choose aggregate provincial time-series data for nine Canadian provinces, spanning the years 1976-2004.[4]

III. The Econometric Specification

The "standard model" that has evolved in the Canadian minimum wage literature has the teenage employment-population ratio, E, as the dependent variable. The key explanatory variable is the ratio of the adult minimum wage to the average hourly wage in manufacturing, MINW [5]. The control variables are the prime-aged male unemployment rate and the level of real GDP (both used to control for aggregate economic activity), and the population share of teenagers relative to the working age population 15-64 (used to control for supply variation). A set of time-invariant provincial dummies, $PROV_i$, is typically included to capture province-specific effects. Time effects are either captured parsimoniously by a quadratic in time, or by a set of year dummy variables, $YEAR_i$.

The "pre-specified" model of Neumark (2001) and others is essentially the standard model, with year dummies instead of a quadratic in time (because of their greater flexibility), and with the addition of a lagged minimum wage term (because of the accumulation of evidence that minimum wage effects occur with a time lag). Thus, the "pre-specified model" can be written:

$$E_{it} = \alpha + \beta_1 \cdot MINW_{it} + \beta_2 \cdot MINW_{it-1} + \varphi \cdot X_{it} + \sum_{i=1}^{N-1} \pi_i \cdot PROV_i + \sum_{t=1}^{T-1} \phi_t \cdot YEAR_t + \varepsilon_{it}$$

where X is a vector of control variables that includes the prime-aged male unemployment rate, the level of real GDP, and the population share of teenagers relative to the working age population 15-64. One variation of this model is to use a logarithmic specification making the coefficients on the continuous explanatory variables elasticities. We consider both level and log versions of the various specifications in our analysis.

This panel-data model assumes that the control variables have identical coefficients, both across provinces and over time. A key question is whether these homogeneity assumptions are valid. Clearly, if the economic structures of the provinces were sufficiently heterogeneous, and if significant structural changes occurred during the estimating period, both assumptions might be violated. The usual argument is that the cross-province homogeneity assumption is necessary to allow panel-data models to fully exploit variation across provinces, not just across time; and that without this assumption there may not be enough variation to statistically identify the true minimum wage effects. However, a fundamental question is whether these assumptions should be regarded as necessary restrictions, or as testable (and potentially rejected) constraints? And following on from that, what validity can any identified effects have if they result from the imposition of statistically invalid constraints?

IV. Benchmarking and Choice of Functional Form

We begin by replicating key results in the literature to benchmark our data to that used in other studies.

We focus on three models at this stage: the one we have labelled the "standard model", the "pre-specified research design model" (which adds a lagged minimum wage term), and a third (we label the "full model") which also includes province-specific time trends as explained below.
The rationale for adding province-specific time trends is that BBS speculated that there may be heterogeneity in the cyclical effects of the various control variables across provinces. Cyclical effects are captured both through the prime-aged male unemployment rate, and through the level of real GDP. The inclusion of common year dummies implies that the real GDP coefficient will reflect divergences from trend. However, these year dummies would remove only the common trend (and common year shocks) for all provinces. If each province has a different trend (as is the case in Canada) this variable will not well capture the business cycle that each province experiences. So, including province-specific year dummies may help to alleviate this heterogeneity of cyclical effects across provinces. Furthermore, Neumark and Wascher (2004) provide a precedent: in their international study of twenty OECD countries they allow for country-specific time trends.

Columns (1) to (3) of Table 2A show the results for the linear version of the standard model for three time periods – chosen so as to benchmark our data to the literature. As shown in column 1, we find a minimum wage elasticity of –0.249 for the 1976-93 time period, which is almost identical to the –0.242 reported by BBS[6]; in column 2 we find an elasticity of –0.485 for the 1983-2000 period, which is almost identical to the –0.488 reported by Baker (2003). These results are the basis for the view that minimum wages are having *increasingly important* negative effects on youth employment in Canada. In column (3) we see that the elasticity for the whole period using the standard model is –0.267. As expected, adding a lagged minimum wage term in column (4) increases the absolute value of the minimum wage coefficient by about 20% from –0.267 to –0.3299. However, the inclusion of a province-specific time trend in column (5) reduces the coefficient to –0.2164.

Given the focus in some of the recent literature on whether the correct functional form for the

employment equation is linear or logarithmic, Table 2B repeats the exercise for the logarithmic version of the model. Column (1) corroborates the Goldberg and Green (1999) result that minimum wages have no significant effect using data from 1976-93. However, columns (2) through (5) reveal that this result does not carry over to the other periods; in every other sub-period, and in the whole period, the log version shows significant negative minimum wages effects, though with a smaller elasticity than the linear functional form. Thus the apparent sensitivity of the minimum wage effects to functional form is itself apparently sensitive to the time period considered.

To help choose between the linear and logarithmic functional forms we ran a RESET test (using a quadratic and cubic transformation) on all the regressions reported in Tables 2A and 2B. For the 1976-93 period the linear version of the standard model (in column (1) of Table 2A) passed the test with a p-value of 0.1271, but the logarithmic version failed it with a p-value of 0.0014. This supports BBS's preference for the linear functional form for their time period. However, all the other regressions reported in Tables 2A and 2B failed the RESET test. In particular, all three models failed the RESET test for the entire period 1976-2004 in both the linear and logarithmic functional forms. To further address the question of whether the linear or logarithmic functional form is more appropriate, we follow the same procedure as BBS and run a series of Box-Cox tests comparing the linear and log versions of our models for the three time periods. Before continuing further, we drop the standard model from further consideration. It has served its purpose in allowing us to benchmark our data to the literature. But Tables 2A and 2B have shown that lagged minimum wages are significant – both on their own and when province-specific time trends are included. Furthermore, the standard model's estimate of the minimum wage elasticity is bounded by those from the pre-specified and full models, so there is little point in retaining it.[7]

The results of the Box-Cox tests are presented in Table 3. As expected, the linear function is preferred in the 1976-93 sub-period. Indeed, as we move from the pre-specified model to the full model (which includes province-specific time trends) the preference for the linear functional form becomes overwhelming, with lambda increasing from 0.76 to 0.98. On the other hand, in the later sub-period (1983-2000) the logarithmic functional form is favoured: lambda decreases from 0.4082 to 0.3554 as we move from the pre-specified to the full model. And in the whole period (1976-2004) the Box-Cox test is indecisive with lambda changing from 0.5077 in the pre-specified model, to 0.6390 in the full model.

To summarize, while the linear function is superior to the logarithmic for the earlier sub-period 1976-93 (as BBS concluded), the logarithmic function is superior for the later sub-period 1983-2000. For the whole period 1976-2004, the Box-Cox test yields no clear answer. This suggests the possibility of a structural break – before which the linear function is better and after which the logarithmic function is better. Therefore, using the entire sample 1976-2004 we searched for such a break. However, regardless of the model specification, and regardless of functional form, the standard F-test suggested there was a structural break before and after every year in the entire sample period, suggesting a more

general model instability across time than could be captured by a structural change at a single point of time. In the interests of brevity, from here on we report only the results from the linear functional form.

V. Province-Specific Interaction Terms

A generalization of the specification that includes province-specific time trends is one that also allows the impact of other explanatory variables including the minimum wage terms to vary by province. There is precedent in the literature for minimum wage effects to be allowed to vary by province. For example, Grenier and Seguin (1991) and Williams (1993) both allow for regionally specific minimum wage effects. BBS allowed for provincial interaction terms for all their control variables but retained the restriction that minimum wages must have the same effect across provinces. More recently, Neumark and Wascher (2004) allow for interaction terms between minimum wages and other labour market indicator variables. Our strategy (given what is already found in BBS) is to have four specifications: (1) a specification without any restrictions, where all independent variables (the control variables and the minimum wage) are allowed to have province-specific effects; (2) a specification where the controls have province-specific effects but the minimum wage does not (as in BBS); (3) a specification where the minimum wage has province-specific effects but the controls do not; and finally (4) a specification where both the controls and the minimum wage are restricted to have the same effect across provinces (the standard panel data model). Specification (4) has already been reported in Table 2A but is repeated here for convenience. Table 4 contains the estimates for the linear functional form, for both the pre-specified and full models, for the entire data period (1976-2004). [8]

Is allowing the minimum wage effect to vary across provinces important? Comparing (3) with (4) allows us to see whether this is important in a context where the controls are restricted to have the same effect across provinces; while comparing (1) with (2) does the same thing in a context where the controls are allowed to have province-specific effects. Either way, allowing minimum wages to have province-specific effects significantly weakens the case that minimum wages have adverse employment effects. For example, with a linear functional form in the full model only two provinces have significant minimum wage effects.

Which of the regressions reported in Table 4 are preferred? Since specification (1) is the completely unconstrained version of the system we can test the validity of the different sets of constraints implied by specifications (2), (3), and (4) by comparing them with specification (1) using standard F-tests. In all cases, the constraints are rejected in favour of the unconstrained specification. (We can see that the adjusted R^2 with everything province-specific is higher than any other specification.)

Where does this leave us? The RESET test eliminates all but 3 linear regressions; and since the constraints imposed in specifications (2) to (4) are rejected, we are left with just two reasonably performing regressions: rows 1A and 1B in Table 4. In specification 1A (the pre-specified model) five of the nine provinces exhibit significant minimum wage effects, with the size of minimum wage

elasticity varying from a low (in absolute terms) of –0.21 in British Columbia to a high of –0.66 in Ontario. In specification 1B (the full model) minimum wages are significant in only two of the nine provinces (Alberta and Ontario). Is the full model better than the pre-specified model? At issue is the appropriateness of including province-specific time trends. While an F-test that the province-specific time trends are insignificantly different from zero rejects the null hypothesis, the resulting equation does have a very slightly lower Akaike Information Criterion score than the regression that omits them. (The difference in absolute terms is 0.03.) It seems there is very little basis to prefer one specification over another; yet they have quite different implications for minimum wage effects.[9]

Do these results support the view that the across-province homogeneity assumptions are necessary restrictions, and that without them there would not be enough variation to statistically identify the true minimum wage effects? A partial answer is that even without these restrictions we can get significant minimum wage effects (in the pre-specified model, row 1A of Table 4) in 5 out of 9 provinces. (Of course, this begs the question of whether these are the *true* minimum wage effects.) A more complete answer is provided by Figure 1, which shows, for each province, the within-province variation of two key variables in our data: the dependent variable, the employment-population ratio; and the minimum wage ratio. Alberta and Ontario are the two provinces that record significant minimum wage effects in both the unconstrained pre-specified model (row 1A of Table 4) and the unconstrained full model (row 1B of Table 4). Figure 1 shows that Ontario has relatively low variation in its minimum wage ratio, but relatively high variation in the employment/population ratio. More surprisingly, Alberta is sitting close to the middle of the pack with less than average variation in both key variables. If finding significant minimum wage effects without the across-province homogeneity assumptions depends on having sufficient within-province variation, then since there are significant minimum wage effects for Alberta, one would expect them also for New Brunswick, Newfoundland, Quebec, and BC. Yet, in the unconstrained full model such effects are not found.

Could it be that provincial minimum wages are relatively high in Alberta, and that explains why significant minimum wage effects are found there? Figure 2 plots minimum wages over time, while Figure 3 plots minimum wages relative to average hourly earnings in manufacturing, for all nine provinces. It is clear from these Figures that Alberta has low minimum wages relative to the other provinces and one of the lowest minimum wage ratios of any province.

To conclude this section, it seems that the argument that the across-province homogeneity assumptions are necessary to find significant minimum wage effects does not receive much empirical support. Furthermore, when we treat these assumptions as testable restrictions, they are always soundly rejected. Finally, when the across-province homogeneity assumptions are imposed, the equations invariably fail Ramsey's specification error test. The fact that all Canadian studies up to this point have routinely assumed that regression coefficients are homogenous across provinces may be a weakness in the literature.

Having thus tested the robustness of the standard result *across space*, we proceed to test it *across time*.

VI. Robustness over Time

In Table 2 we showed a lack of consistency in the minimum wage coefficient to changes in the time period. Furthermore, when we test for structural breaks the standard F-test indicated a structural break before and after every year in the entire sample period, regardless of the model specification. In view of this, we decided to estimate rolling regressions through time using moving "windows". The length of the window is a compromise between the need for a period short enough to reveal structural change, but long enough that the model not only has enough degrees of freedom, but can also capture the low-frequency effects emphasized by BBS. On balance, we decided to use both 7-year and 9-year windows and to focus on the linear functional form.[10]

Table 5 reports the results for the 7-year window for both the pre-specified and full model, imposing the across-province homogeneity assumptions. Regardless of the model, the minimum wage coefficient is not initially significantly different from zero. It begins to increase in absolute size and significance in the period whose midpoint is 1990, eventually peaking in absolute size around 1994, after which it gradually declines.[11] This suggests that minimum wages are not having *increasingly important* negative effects on youth employment. Rather, their effects peaked around 1994 and have subsequently declined. Comparing the pre-specified with the full model, there is not a big difference between their estimates. Minimum wages are significantly negative in 10 (out of 22) rolling windows (midpoints 1990 to 1999) using the pre-specified model, whereas they are only significantly negative in 6 (out of 22) rolling windows using the full model (midpoints 1993 to 1998). In addition, larger negative estimates are generally obtained using the pre-specified model. But both models suggest no significant effect in the two most recent rolling windows (midpoints 2000 and 2001). The pre-specified model has more regressions fail the RESET test (at the 5% level of significance) than the full model: 7 out of 22 regressions fail for the pre-specified model and 4 out of 22 for the full model.

Figures 4 and 5 plot, for each model, the minimum wage coefficients obtained using the seven-year window (at the midpoint year of each window) against the seven-year moving average of the prime-aged male unemployment rate. The plots are very similar; in both figures the inverse relation is striking, suggesting that the adverse effects of minimum wages on teenage employment are much worse when the prime-aged male unemployment rate is high, but negligible when it is low (7 percent or less). In other words, it appears from these figures that adverse minimum wage effects in Canada are a cyclical phenomena.

Table 6 repeats the exercise using 9-year rolling windows. As expected, the longer window increases the number of regressions showing significant minimum wage effects: using the pre-specified model, significant minimum wage effects are found in 12 out of 20 regressions (instead of 10 out of 22 using the shorter window); using the full model, significant minimum wage effects are found in 8 out of 20

regressions (instead of 6 out of 22 using the shorter window). On the other hand, the longer window increases the number of regressions failing the RESET test in the pre-specified model: 9 out of 20 regressions fail at the 5% level of significance (instead of 7 out of 22 for the shorter window). But the longer window is kinder to the full model: the number of regressions that fail the RESET test actually falls to 3 out of 20 (instead of 4 out of 22). To the extent to which the RESET test is telling us something meaningful, it appears that the full model is preferable. Nevertheless, there is clear instability in the estimated effect of minimum wages on teenage employment over the time period.

Figures 6 and 7 plot the 9-year rolling-window minimum wage coefficients against the 9-year moving average of the prime-aged male unemployment rate. In contrast to the 7-year results, the minimum wage coefficient no longer appears cyclical during the early period (1976-1988), though the cyclicality still seems to be there for the later period (1989-99). During the early period, minimum wage coefficients are small and insignificant. But after 1989, they move inversely to the unemployment rate, so that by 1999 they are again small and insignificant. This raises the possibility that there was something different about the recession of 1991-94. Indeed, perhaps there was a combination of effects: the recession may have sped up ongoing structural changes that may have been occurring as a result of globalisation and the Canada/US Free Trade Agreement (1989). For example, the increasing casualization of jobs, with more workers losing full-time employment who are forced to accept part-time jobs at lower pay and lower benefits, may have increased the competition for low-wage jobs during this recessionary period.

Overall, the regressions from the rolling windows suggest that coefficient estimates from the panel data model are not stable over time: specifically, that adverse minimum wage effects are associated with high unemployment; and minimum wages have negligible effects providing the unemployment rate is relatively low (7% or less). The next section explores possible explanations.

VI. Possible Explanations for Sensitivity over Time

Our main result is that the impact of minimum wages seems to change over time, is cyclically dependent, and may be zero when unemployment is low. However, it is possible that these results are an anomaly of statistical identification. In particular, if the variation in provincial minimum wage ratios was particularly high in the early 1990s, that would be the period when minimum wage effects would be picked up and correctly identified. If this were true, the appearance of cyclical dependence of minimum wage effects might be an illusion, and the high minimum wage effects found during the early 1990s might not be an ‘abnormality’ but rather may reflect their true influence over the whole time period.

To investigate this possibility, we plot in Figure 8 the coefficient of variation of the minimum wage ratio against the minimum wage coefficients obtained from regressions of the pre-specified model using rolling 9-year moving windows. If our results were an anomaly of statistical identification, we

would expect a negative correlation: a high coefficient of variation in the early 1990s when minimum wages were having large negative effects. However, it is apparent that the two series are positively correlated (with a simple correlation coefficient of 0.75). This suggests our results are not an artefact of statistical identification.

However, before ruling out statistical identification as a possible explanation, we should recall that variation in the dependent variable might be just as important as variation in the minimum wage ratio. Recall that Ontario is one province where minimum wage effects are found in the unrestricted regressions of Table 4A, and Figure 1 showed that Ontario has relatively low variation in the minimum wage ratio, but high variation in the employment-population ratio. Therefore, Figure 9 plots the coefficient of variation of the teen employment-population ratio against the minimum wage estimates obtained from the 9-year rolling regressions of the pre-specified model. Again, there is no spike in the coefficient of variation of the teen employment-population ratio in the early 1990s; if anything the coefficient of variation of is relatively stable throughout the estimating period.

It appears that neither of our two key variables have more statistical variation in the early 1990s when adverse minimum wage effects are found to be strongest. Thus, there appears to be no evidence suggesting that our results are an anomaly of statistical identification.

A second possible explanation is that the changing impact of minimum wages could be due to changes in the extent to which the minimum wage constraint is binding over time. The minimum wage is a wage floor, but if this floor is non-binding during some periods, we would expect to find no adverse employment effect during those periods. To check this possibility we obtained data on the proportion of employed teenagers with hourly wages less than 25 cents above the minimum wage.[12] If the minimum wage was non-binding during the 1980s, but became binding during the early 1990s, we would expect to see the proportion of teenagers who worked at the minimum wage increase in the early 1990s. But Figure 10 (which shows only the 5 provinces for which significant minimum wage effects were found in row 1A of Table 4) shows no discernable trend at all. It seems not to be the case that the minimum wage was non-binding for much of the period but became binding in the early 1990s.

A third possible explanation is that the apparent changing impact of minimum wages might be due to missing variable bias: the omission of key determinants of teenage employment from the model that have changed over time. In other results not reported here, we have incorporated many different likely candidates including: a measure of employment insurance generosity (and eligibility); unionization rates; industrial composition; the proportion of the workforce that works part-time. None of these variables (either alone or collectively) explain the apparent instability of the minimum wage effect over our time period.

VII. Conclusions

In contrast to most other countries, there is a consensus that minimum wages have adverse employment effects in Canada, and these effects are increasing in magnitude in recent years. This consensus result is based on a model that imposes constant coefficients across provinces and over time. But when we treat the across-province restrictions as testable constraints they are overwhelmingly rejected. In addition, we find evidence of temporal instability of coefficients, particularly after 1989.

Canada's provinces are remarkably heterogeneous: BC is heavily reliant on forestry and Saskatchewan on wheat production; Alberta is an energy exporter, while Ontario and Quebec are the industrial heartland. It may be reasonable, therefore, to allow for differences in sensitivity to minimum wage effects (as did Grenier and Seguin (1991) and Williams (1993)). We could go further and allow the control variables to have province-specific effects. BBS (1999) allowed for such sensitivity (while restricting minimum wages to have the same effect across provinces) when exploring why the linear and logarithmic functional forms yielded different signs for the minimum wage coefficient. Our procedure was to estimate four permutations: (1) a specification where all the independent variables (the control variables and the minimum wage) have province-specific effects; (2) a specification where the controls have province-specific effects but the minimum wage does not (as in BBS); (3) a specification where the minimum wage has province-specific effects but the controls do not; and finally (4) a specification where both the controls and the minimum wage are restricted to have the same effect across provinces (the standard panel data model). Beginning with specification (1) where all the independent variables have province-specific effects, we tested the restrictions implied by the other three. In all cases the restrictions were overwhelmingly rejected. Furthermore, the specifications that constrain coefficients to be equal across provinces generally failed Ramsey's RESET test for specification error.

It is often argued that the across-province homogeneity assumptions are necessary because without them there would not be enough variation in the data to estimate true minimum wage effects. While we remain ignorant of the *true* minimum wage effects, there is enough variation in the data to estimate *significant* effects in five of the nine provinces, even allowing all the independent variables to have province-specific effects. Furthermore, significant effects are estimated for Alberta, even though it has below average variation in the minimum wage ratio and in the dependent variable. There seems to be little evidence supporting the view that the across-province homogeneity assumptions are statistically necessary.

Do our unrestricted estimates support the view that minimum wages adversely affect teenage employment in Canada? On the whole, the pre-specified model supports this view: five of the nine provinces exhibit significant minimum wage effects, with the size of minimum wage elasticity varying from a low (in absolute terms) of –0.21 in British Columbia to a high of –0.66 in Ontario. But if we add province-specific time trends to the model, minimum wages are significant in only two of the nine

provinces (Alberta and Ontario). A key issue is the appropriateness of including province-specific time trends. While an F-test that the province-specific time trends are insignificantly different from zero rejects the null hypothesis, the resulting equation does have a very slightly lower Akaike Information Criterion score than the regression that omits them. (The difference in absolute terms is 0.03.) It seems there is very little basis to prefer one specification over another; yet they have quite different implications for minimum wage effects.

As far as temporal instability is concerned, we show that minimum wages are not having *increasingly important* negative effects on youth employment. Rather, their effects peaked around 1993 and have subsequently declined. Using rolling 7-year windows it appears that coefficient estimates from the panel data model are not stable over time; that adverse minimum wage effects are associated with high unemployment; and minimum wages have negligible effects providing the unemployment rate is relatively low (7% or less). Using rolling 9-year windows the cyclical effect becomes very muted pre-1989. In this early period, minimum wages effects are small and insignificantly different to zero. However, after 1989 estimated minimum wage coefficients move inversely to the unemployment rate in a fairly dramatic way. This suggests that there may have been a structural shift around 1989, which may have compounded the effects of the deep recession in the early 1990s. While definitive answers are outside the scope of the present paper, we note that these temporal instability results have two important implications.

First, it suggests caution when reading the results of existing Canadian individual panel data studies, such as Yuen (2003) and Campolieti, Fang, and Gunderson (2004). Yuen uses Statistics Canada's Labour Market Activity Survey data for the years 1988 to 1990, while Campolieti, Fang, and Gunderson use Statistics Canada's Survey of Labour and Income Dynamics for the years 1993 to 1999. Figures 4 and 5 suggest there is temporal instability for both these periods. It is not clear that the results of these studies can be extrapolated outside their time periods, especially since our results show a return in the magnitude of the minimum wage effect to pre-1990 levels in recent years.

Second, if minimum wages only have negative employment effects when unemployment is high, then there is an interesting policy implication. Fortin and Lemieux (2004) argue that minimum wages are a useful redistributive tool. If so, reducing minimum wages may adversely affect one of the economy's automatic stabilizers, making the economy more vulnerable to unemployment, and more (rather than less) susceptible to adverse minimum wage effects.

While our results are suggestive, we recognize that they raise many other questions. We need to know why some provinces are more susceptible to adverse minimum wage effects than others. If there was a structural shift around 1989, we need to know more about its cause and whether it is possible to model it. And if it is true that minimum wage effects move inversely with unemployment, then we need to know why. These questions define the lines of our future research.

References

Alston, R. M., Kearl J. R., and M. B. Vaughan. 1992. "Is There a Consensus Among Economists in the 1990s?" *American Economic Review, Papers and Proceedings*, 82, May, 203-209.

Baker, Michael. 2003. "Minimum Wages and Human Capital Investments of Young Workers: Work Related Training and School Enrollment." mimeograph, University of Toronto.

Baker, M., D. Benjamin, and S. Stanger. 1999. "The Highs and Lows of Minimum Wage Effects: A Time-Series Cross-Section Study of the Canadian Law." *Journal of Labor Economics*, 17, 318-350.

Card, David. 1992. "Using the Regional Variation in Wages to Measure the Effects of the Federal Minimum Wage." *Industrial and Labor Relations Review*, 46, 22-37.

Card, David. 1992. "Do Minimum Wages Reduce Employment? A Case Study of California 1987-89." *Industrial and Labor Relations Review*, 46, 38-54.

Card, David, Katz, Lawrence, and Alan Krueger. 1994. "Comment on David Neumark and William Wascher, 'Employment Effects of Minimum Wages and Subminimum Wages: Panel Data on State Minimum Wage Laws.' " *Industrial and Labor Relations Review*, 47, 487-96.

Card, David, and Alan Krueger. 1994. "Minimum Wages and Employment: A Case Study of the Fast Food Industry in New Jersey and Pennsylvania." *American Economic Review*, 84, September, 772-93.

Card, David, and Alan Krueger. 1995. "*Myth and Measurement: The New Economics of the Minimum Wage*." Princeton NJ: Princeton University Press.

Card, David, and Alan Krueger. 2000. "Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania: A Reply." *American Economic Review*, 90, December, 1396-1420.

Campolieti, Michele, Fang, Tony and Morley Gunderson. 2005. "Minimum Wage Impacts on Youth Employment Transitions, 1993-99." *Canadian Journal of Economics*, vol 38, No. 1, 81-104.

Campolieti, Michele, Morley Gunderson, and Chris Riddell. 2004. "Minimum Wage Impacts From a Pre-Specified Research Design: Canada 1981-97", mimeograph, University of Toronto.

Drost, Helmar, and H. Richard Hird. 2006. "*An Introduction to the Canadian Labour Market*" 2nd Edition, Thomson Publishers.

Fortin, N. M., and Thomas Lemieux. 2005. "Income Redistribution in Canada: Minimum Wages Versus Other Policy Instruments." *Adapting Public Policies to a Labour Market in Transition*, edited by W. C. Riddell and F. St-Hilaire, McGill-Queen's University Press.

Fuller, D., and Doris Geide-Stevenson. 2003. "Consensus Among Economists: Revisited." *Journal of Economic Education*, Fall, 369-387.

Goldberg, Michael, and David Green. 1999. "Raising the Floor: The Social and Economic Benefits of Minimum Wages in Canada." Canadian Centre for Policy Alternatives, September.

Grenier, G. and M. Seguin. 1991. "L'incidence du salaire minimum sur le march travail des adolescents au Canada: une reconsideration des resultats empiriques" *L'Actualité Economique*, 67, 123-143.

Hamermesh, Daniel. 2002. "International Labor Economics." *Journal of Labor Economics*, vol. 20, 709-732.

Katz, Lawrence and Alan Krueger. 1992. "The Effect of the Minimum Wage in the Fast Food Industry." *Industrial and Labor Relations Review*, 46, October, 6-21.

Kearl J. R., Pope C. L., Whiting G. C., and L. T. Whimmer. 1979. "A confusion of economists." *American Economic Review, Papers and Proceedings*, 69, May, 28-37.

Levine, David, "Editor's Introduction to "The Employment Effects of Minimum Wages: Evidence from a Prespecified Research Design", *Industrial Relations*, 40, April 2001, 161-162.

Manning, Alan. 2003. "*Monopsony in Motion: Imperfect Competition in Labor Markets*" (Princeton: Princeton University Press.)

Neumark, David. 2001. "The Employment Effects of Minimum Wages: Evidence from a Prespecified Research Design." *Industrial Relations*, 40(1), January, 121-144.

Neumark, David, and William Wascher. 2004. "Minimum Wages, Labor Market Institutions, and Youth Employment: A Cross-National Analysis." *Industrial and Labor Relations Review*, 57, 223-248.

Osberg, Lars, F. Wien and J. Grude. 1995. "*Vanishing Jobs: Canada's Changing Workplaces*", James Lorimer Publishers, Toronto,

Garnett Picot, Zhengxi Lin, and Wendy Pyper. 1997. "Permanent Layoffs In Canada: Overview and Longitudinal Analysis", Statistics Canada Research Paper Series, No. 103, September.

Schaafsma, J., and W. Walsh. 1983. “Employment and Labor Supply Effects of the Minimum Wage: Some Pooled Time-Series Estimates from Canadian Provincial Data.” *Canadian Journal of Economics*, 16, 86-97.

Swidinsky, R. 1980. “Minimum Wages and Teenage Unemployment.” *Canadian Journal of Economics*, 13, 158-171.

Yuen, Terence. 2003. “The Effect of Minimum Wages on Youth Employment in Canada: A Panel Study”, *Journal of Human Resources*, 78, 647-672.

Williams, Nicolas. 1993. “Regional Effects of the Minimum Wage on Teenage Employment.” *Applied Economics*, 25, 1517-28.

Data Appendix:

Our full dataset spans the years 1976-2004 and includes all Canadian provinces except Prince Edward Island and Nunavut. While the final dataset is annual, the minimum wage ratio is an average of monthly data, obtained from the following sources.

The minimum wage ratio:
Minimum wages for Canadian adult workers since 1965 are to be obtained from the Human Resources Development Canada website: http://www110.hrdc-drhc.gc.ca/psait_spila/lmnec_eslc/eslc/salaire_minwage/index.cfm/doc/english
This data set gives the exact date when changes occurred, allowing us to construct monthly data on the adult minimum wage.
This was deflated by average hourly earnings (including overtime) of workers paid by the hour, in manufacturing industries. (The frequency of this data was also monthly.)

- The 1983 to 2000 data was obtained from Cansim II, Table 2810004, series numbers (for B.C., Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia and Newfoundland respectively) are as follows: V312117, V305588, V299343, V293744, V287442, V279936, V273156, V268142, V259846.
- The above series are the same as that used by Baker, Benjamin and Stanger (1999). They obtained data prior to 1983 from special tabulations performed by Stats Canada. We are grateful to them for sharing their data with us.
- Since the series in Table 281004 were discontinued in 2000, we updated our series using Table 2810030. The series used (from B.C. to Newfoundland) were: V1807323, V1807171, V1807060, V1806904, V1806717, V1806534, V1806455, V1806369, V1806255.

Employment, unemployment, and population data:
Data on employment, population, and unemployment were all obtained from Table Number 2820001. Series numbers (for B.C., Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia and Newfoundland respectively) are as follows:

- Teenage population, both sexes, 15 to 19 years: V2097397, V2096717, V2096087, V2095457, V2094827, V2094197, V2093567, V2092937, V2091668.
- Total population, both sexes, 15 to 64 years: V2097396, V2096716, V2096086, V2095456, V2094826, V2094196, V2093566, V2092936, V2091667.
- Teenaged employment, both sexes, 15 to 19 years: V2097439, V2096759, V2096129, V2095499, V2094869, V2094239, V2093609, V2092979, V2091710.
- Prime-aged male employment rate (employed/population), 25-54 years: V2097793, V2097113, V2096483, V2095853, V2095223, V2094593, V2093963, V2093333, V2092064.
- Prime-aged male unemployment rate, 25 to 54 years (unemployed/labor force): V2097751, V2097071, V2096441, V2095811, V2095181, V2094551, V2093921, V2093291, V2092022.
- Aggregate unemployment rate, 15 years and over (used to construct EI generosity series):

V2097536, V2096856, V2096226, V2095596, V2094966, V2094336, V2093706, V2093076, V2091807.

Real GDP:

Statistics Canada has only published provincial real GDP data since 1981. One option, the one chosen by Baker, Benjamin and Stanger (1999), is to deflate provincial nominal GDP by the provincial CPI's. The option we chose was to use Statistics Canada's official data post-1981, and to use the Conference Board of Canada's estimates prior to 1981. We obtained a consistent series by calculating GDP growth rates from the Conference Board data, and "backcasting" from the 1981 estimate provided by Stats Canada.

The Stats Canada real provincial GDP data is to found in Cansim II, Table 3840002. The series numbers (from B.C. to Newfoundland) are: V3840347, V3840301, V3840255, V3840209, V3840163, V3840117, V3840071, V3840025, V3839933.

TABLES and FIGURES

Table 1: Percent in Agreement with the proposition: "Minimum wages increase unemployment amongst young and unskilled workers."

	1979*	1990†	2000‡
Generally Agreed	68%	62.4%	45.6%
Agreed with provisos	22%	19.5%	27.9%
Disagreed	10%	17.5%	26.5%

* Kearl et. al. 1979; † Alston et. al. 1992; ‡ Fuller et. al. 2003

Table 2A: Benchmarking to the Existing Literature
The LINEAR MODEL

	(1) 1976-93	(2) 1983-2000	(3) 1976-2004	(4) 1976-2004	(5) 1976-2004
MINW	-0.2992** (-3.41)	-0.5069** (7.95)	-0.3091** (-6.24)	0.0743 (0.67)	0.1163 (1.08)
MINW(-1)				-0.4452 (-3.96)	-0.3664 (-3.62)
Unemployment Rate	-1.664** (-13.9)	-1.3222** (-10.0)	-1.7636** (-13.0)	-1.7756** (13.66)	-1.786** (-13.86)
Teenage Population	-0.2529 (-0.54)	-0.5354 (-1.28)	-2.2554** (-6.47)	-2.3768** (-7.03)	-0.9127** (-2.22)
Real GDP	0.4349** (4.11)	-0.3975** (-5.64)	-0.2028 (-4.85)	-0.2035 (-4.9)	-0.2005** (-1.05)
Province dummies	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES
Province-specific time trend	NO	NO	NO	NO	YES
Minimum wage elasticity	**-0.2501** (-3.41)	**-0.4255** (-7.95)	**-0.2675** (-6.24)	**-0.3299** (-7.6)	**-0.2164** (-3.27)
RESET TEST (p-value)	0.1271	0.000	0.000	0.0001	0.0014
AIC	-5.325	-5.145	-4.906	-5.003	-5.238
Adjusted R^2	0.968	0.9600	0.935	0.942	0.955
Sample size	162	162	261	252	252

Note: ** denotes significance at the 5% level and * denotes significance at the 10% level. Regressions are weighted by province and year-specific population. All regressions throughout are weighted by province and year specific population.

Table 2B: Benchmarking to the Existing Literature
The LOG MODEL

	(1) 1976-93	(2) 1983-2000	(3) 1976-2004	(4) 1976-2004	(5) 1976-2004
MINW	0.0046 (0.06)	-0.3256 (-6.26)	-0.2427 (-5.68)	0.0641 (0.66)	0.0999 (1.13)
MINW(-1)				-0.3529 (-3.55)	-0.2629 (-3.05)
Unemployment Rate	-0.2005 (10.9)	-0.29322 (-9.98)	-0.24067 (-11.94)	-0.25124 (-12.54)	-0.18867 (-9.33)
Teenage Population	-0.6216 (-4.83)	-0.40485 (-3.53)	-0.78908 (-8.34)	-0.84382 (-9.02)	-0.87611 (-8.72)
Real GDP	-0.04542 (-0.44)	-0.29871 (-2.4)	-0.18288 (-2.5)	-0.17261 (-2.28)	0.518742 (4.01)
Province dummies	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES
Province-specific time trend	NO	NO	NO	NO	YES
Minimum wage elasticity	**0.0046** (0.06)	**-0.3256** (-6.26)	**-0.2427** (-5.68)	**-0.2888** (-6.69)	**-0.1630** (-3.17)
RESET TEST (p-value)	0.0014	0.0185	0.0025	0.0002	0.0000
AIC	-3.332	-3.43	-3.151	-3.213	-3.501
Adjusted R^2	0.96	0.964	0.937	0.942	0.958
Sample size	162	162	261	252	252

Note: ** denotes significance at the 5% level and * denotes significance at the 10% level. Regressions are weighted by province and year-specific population. All regressions throughout are weighted by province and year specific population.

Table 3: Box-Cox Test of Linear versus Logarithmic Specifications

A: PRE-SPECIFIED RESEARCH DESIGN (MINW + MINW(-1))			
	1976-93	1983-2000	1976-2004
Minimum Wage Elasticity	– 0.2801	– 0.4013	– 0.2903
Lambda	0.7518	0.4082	0.5077
Likelihood Ratio ($\lambda = 1$)	14.25	43.17	47.07
Likelihood Ratio ($\lambda = 0$)	70.14	46.34	75.98
B: PRE-SPECIFIED RESEARCH DESIGN + PROV SPECIFIC TRENDS			
	1976-93	1983-2000	1976-2004
Minimum Wage Elasticity	-0.21918	-0.44945	-0.18547
Lambda	0.9800	0.3554	0.6390
Likelihood Ratio ($\lambda = 1$)	5.83	35.99	23.62
Likelihood Ratio ($\lambda = 0$)	106.25	11.21	39.27

Table 4: Minimum Wage Elasticity Allowing for Interactions, 1976-2004

THE LINEAR FUNCTIONAL FORM

		BC	AB	SK	MN	ON	PQ	NB	NS	NF	adj. R^2	AIC	RESET
	Province-Specific Variables	PRE-SPECIFIED RESEARCH DESIGN											
1A	Everything	-0.2113**	-0.3162**	-0.4399	-0.3478*	-0.6578**	-0.555**	-0.0315	-0.0622	0.42267	0.981	-6.005	0.2698
		-2.4	-2.6	-1.64	-1.99	-9.33	-3.01	-0.11	-0.27	1.04			
2A	Everything Except MINW & MINW(-1)	-0.5077**	-0.5077**	-0.5077**	-0.5077**	-0.5077**	-0.5077**	-0.5077**	-0.5077**	-0.5077**	0.973	-5.711	0.0024
		-7.21	-7.21	-7.21	-7.21	-7.21	-7.21	-7.21	-7.21	-7.21			
3A	Only MINW & MINW(-1)	-0.4456**	0.1172	0.0715	-0.0910	-0.6414**	-0.1647*	-0.1910	-0.0049	0.1645	0.963	-5.417	0.0019
		-10.62	1.73	0.62	-0.85	-8.67	-2.12	-1.22	-0.03	0.64			
4A	None	-0.3299**	-0.3299**	-0.3299**	-0.3299**	-0.3299**	-0.3299**	-0.3299**	-0.3299**	-0.3299**	0.942	-5.003	0.0001
		-7.6	-7.6	-7.6	-7.6	-7.6	-7.6	-7.6	-7.6	-7.6			
	Number of regressions where minimum wages have significant negative effects	4/4	3/4	2/4	3/4	4/4	4/4	2/4	2/4	2/4			
	Province-Specific Variables	THE FULL MODEL = PRE-SPECIFIED RESEARCH DESIGN + A PROVINCE SPECIFIC TREND											
1B	Everything	-0.1043	-0.4080**	-0.3798	-0.3606	-0.6244**	-0.3725	-0.0808	-0.0356	0.5381	0.981	-5.975	0.3871
		-0.87	-2.73	-1.31	-1.57	-6.22	-1.65	-0.24	-0.15	1.1			
2B	Everything Except MINW & MINW(-1)	-0.5256**	-0.5256**	-0.5256**	-0.5256**	-0.5256**	-0.5256**	-0.5256**	-0.5256**	-0.5256**	0.974	-5.729	0.1520
		-5.11	-5.11	-5.11	-5.11	-5.11	-5.11	-5.11	-5.11	-5.11			
3B	Only MINW & MINW(-1)	-0.3152**	0.0888	0.1893	-0.0043	-0.5280**	-0.0605	0.1118	0.0606	0.2786	0.969	-5.547	0.0779
		-4.63	0.86	1.38	-0.03	-5.95	-0.66	0.55	0.25	0.81			
4B	None	-0.2164**	-0.2164**	-0.2164**	-0.2164**	-0.2164**	-0.2164**	-0.2164**	-0.2164**	-0.2164**	0.955	-5.238	0.0014
		-3.27	-3.27	-3.27	-3.27	-3.27	-3.27	-3.27	-3.27	-3.27			
	Number of regressions where minimum wages have significant negative effects	3/4	3/4	2/4	2/4	4/4	2/4	2/4	2/4	2/4			

Note: ** denotes significance at the 1% level and * denotes significance at the 5% level.

Figure 1: Within Province Variation of the Teenage Employment Population Ratio, and the Minimum Wage Ratio

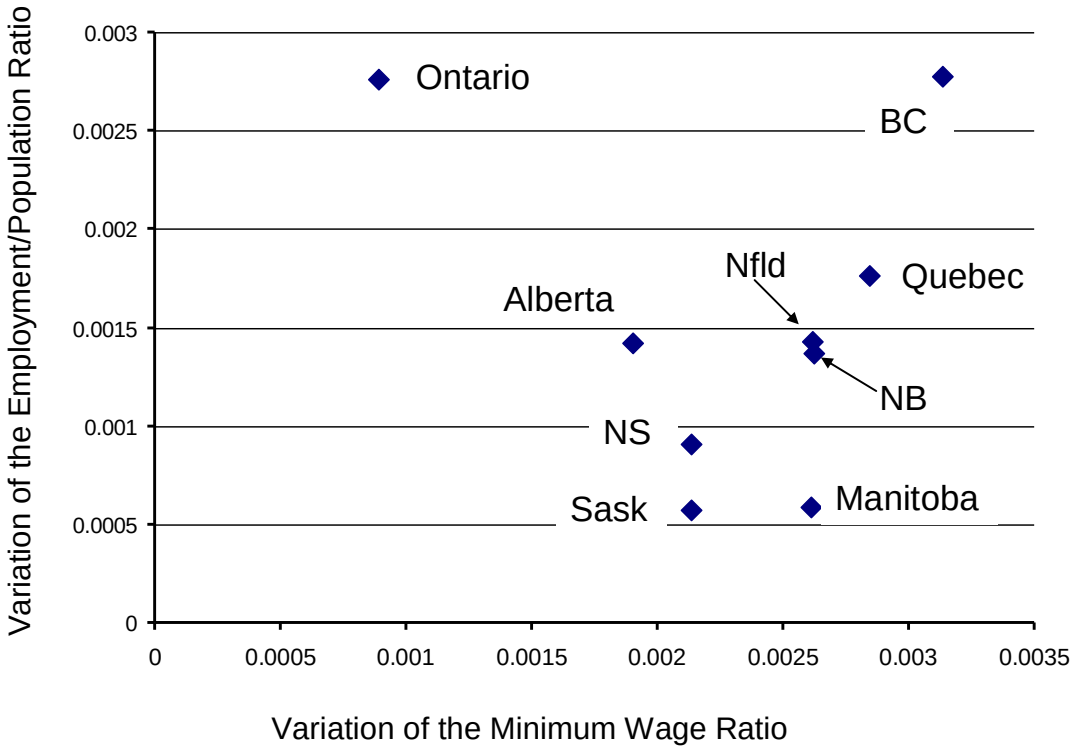


Figure 2: Provincial Minimum Wages

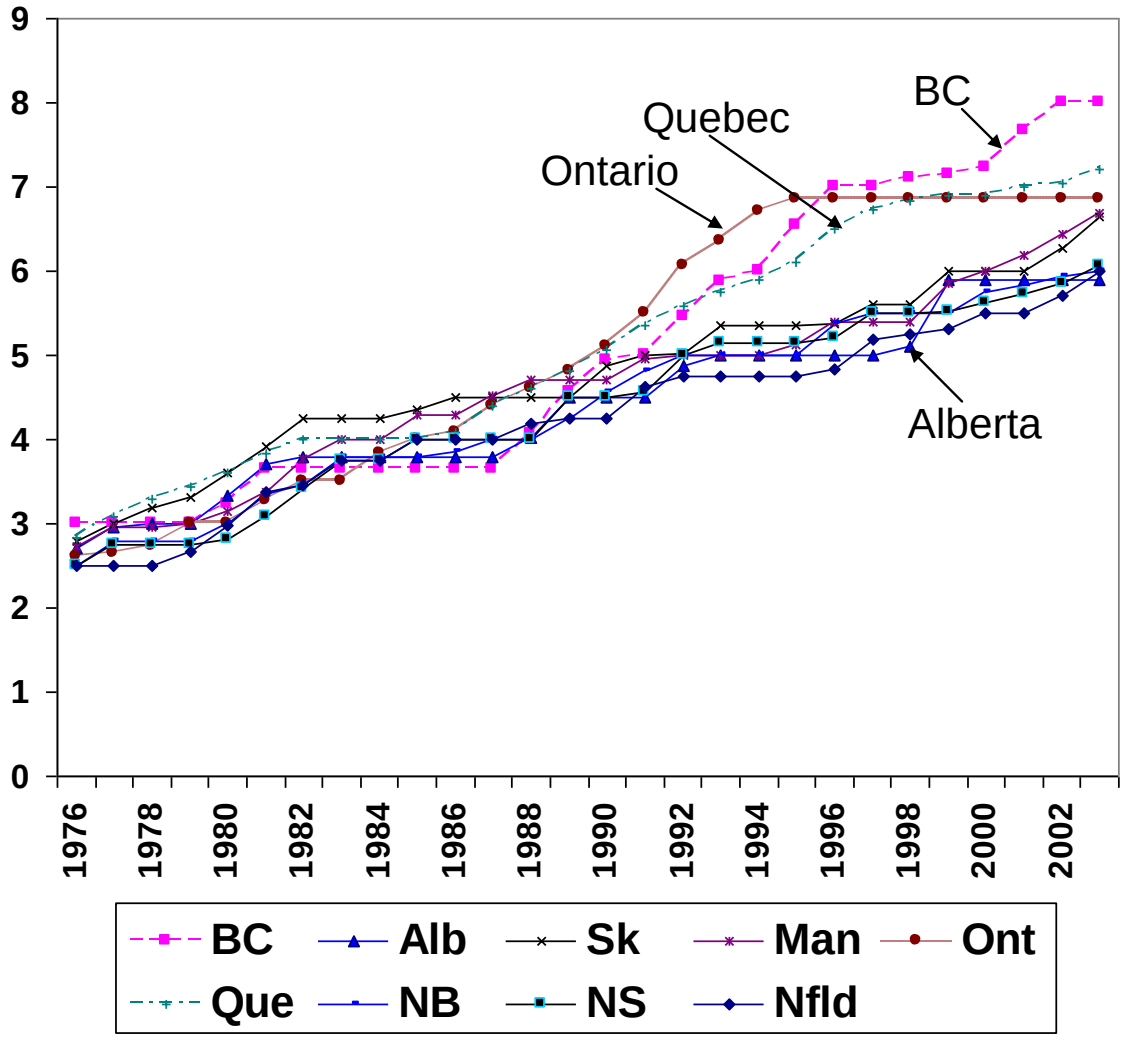


Figure 3: Provincial Minimum Wage Ratios

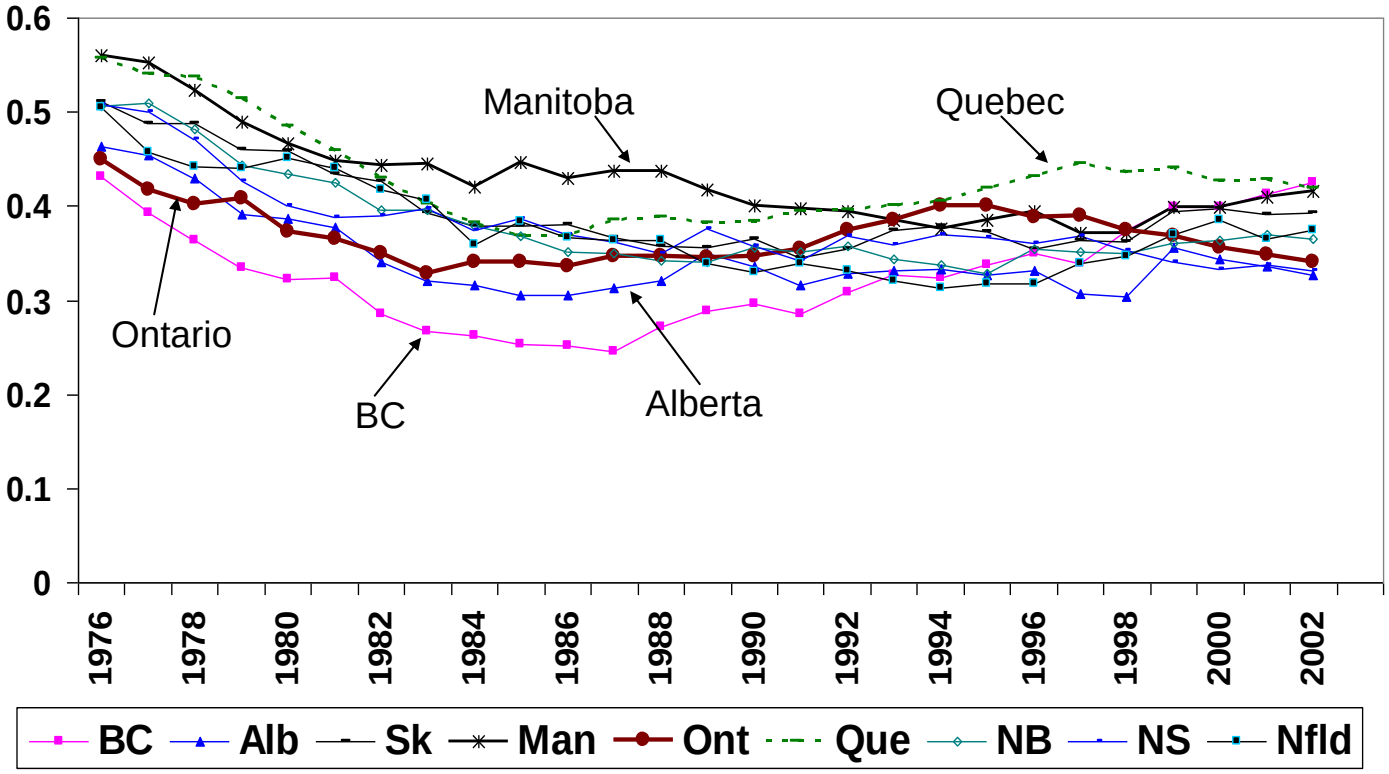


Table 5: 7-YEAR Rolling Regressions of the Linear Model

		The "Pre-Specified" Model				The "Full" Model			
Period	Mid-point	MINW elasticity	t-value	RESET	Adj R^2	MINW elasticity	t-value	RESET	Adj R^2
1976-82	1979								
1977-83	1980	-0.1949	-1.43	0.5330	0.989	0.0015	0.01	0.2560	0.993
1978-84	1981	-0.1158	-0.84	0.3926	0.987	-0.0288	-0.17	0.1397	0.991
1979-85	1982	-0.2624	-2.22	0.0800	0.988	-0.2707	-1.28	0.0818	0.993
1980-86	1983	-0.1690	-1.42	0.2637	0.987	0.0077	0.03	0.3013	0.990
1981-87	1984	-0.2267	-1.57	0.8532	0.984	-0.0003	0	0.1088	0.992
1982-88	1985	-0.3173	-1.79	0.0416	0.983	-0.0670	-0.41	0.0451	0.992
1983-89	1986	0.0550	0.35	0.0084	0.985	0.0041	0.03	0.5389	0.992
1984-90	1987	0.0355	0.26	0.0075	0.985	-0.0468	-0.34	0.1123	0.991
1985-91	1988	0.0256	0.21	0.1403	0.983	0.1080	0.66	0.0005	0.991
1986-92	1989	-0.1216	-1.08	0.1794	0.981	-0.0144	-0.1	0.0066	0.993
1987-93	1990	-0.4370	-4.34	0.0028	0.984	-0.0770	-0.4	0.9750	0.990
1988-94	1991	-0.6259	-5.64	0.0007	0.980	-0.2643	-1.23	0.7066	0.989
1989-95	1992	-0.8300	-7.43	0.0025	0.982	-0.3036	-1.13	0.1336	0.989
1990-96	1993	-0.9823	-8.84	0.0337	0.985	-0.7219	-3.03	0.1795	0.986
1991-97	1994	-1.1638	-10.66	0.3247	0.986	-0.8523	-4.78	0.1897	0.988
1992-98	1995	-1.0656	-8.38	0.0206	0.975	-0.7909	-4.36	0.0014	0.985
1993-99	1996	-0.8319	-7.19	0.8483	0.978	-0.7475	-3.72	0.0866	0.980
1994-00	1997	-0.8407	-6.79	0.9926	0.978	-0.7098	-3.33	0.5950	0.980
1995-01	1998	-0.6282	-4.94	0.7465	0.979	-0.6118	-3.14	0.5898	0.984
1996-02	1999	-0.2915	-2.07	0.7300	0.974	-0.3216	-1.31	0.6165	0.980
1997-03	2000	-0.1235	-0.71	0.4603	0.965	0.0786	0.25	0.3403	0.977
1998-04	2001	-0.0777	-0.42	0.4596	0.960	0.2905	1.12	0.4352	0.970

Figure 4: Minimum Wage Coefficient Estimates Using
The Pre-Specified Model and Rolling 7-Year Windows

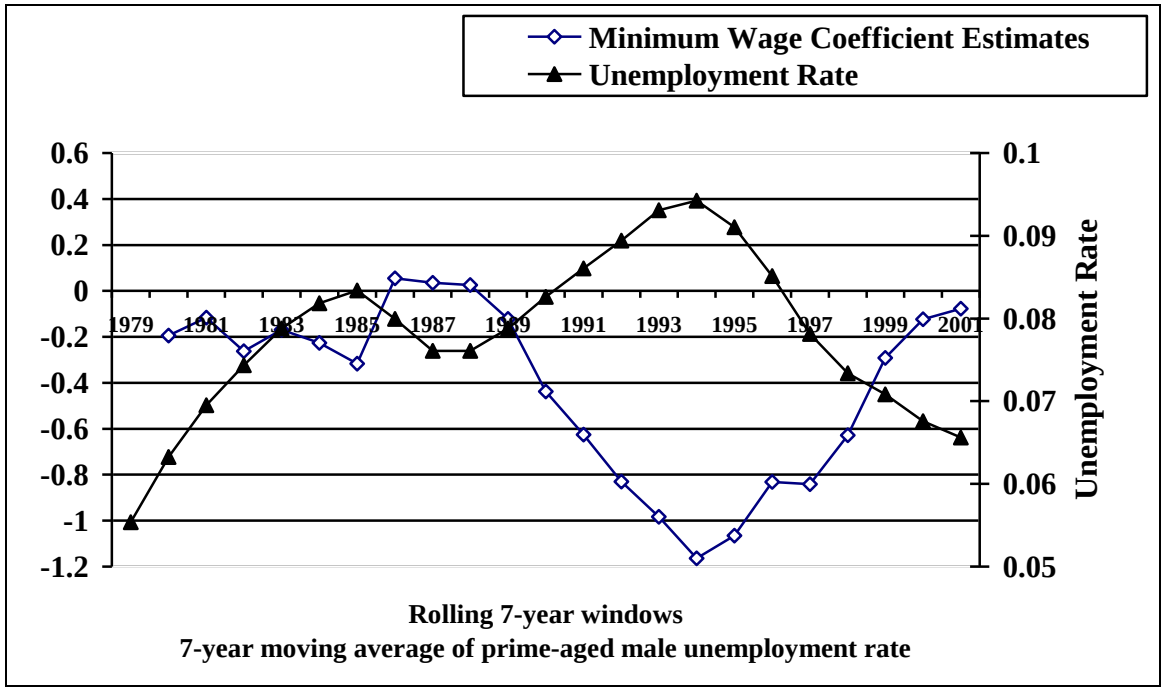


Figure 5: Minimum Wage Coefficient Estimates Using
The Full Model and Rolling 7-Year Windows

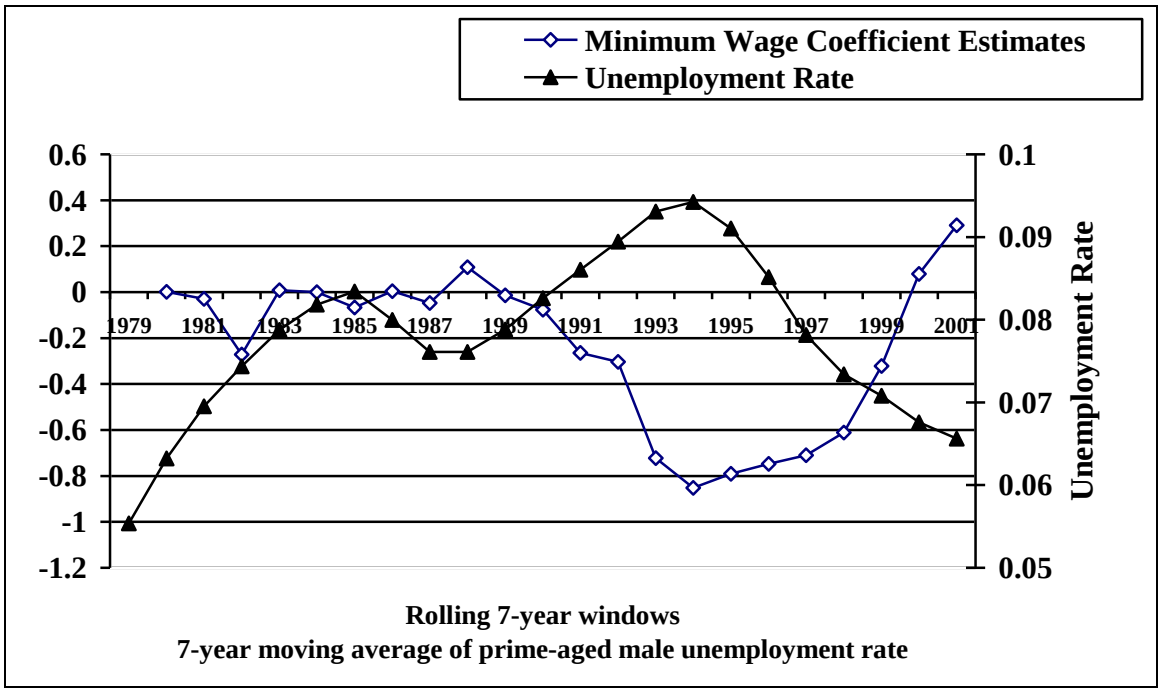


Table 6: 9-YEAR Rolling Regressions of the Linear Model

		The "Pre-Specified" Model				The "Full" Model			
Period	Mid-point	MINW elasticity	t-value	RESET	Adj R^2	MINW elasticity	t-value	RESET	Adj R^2
1977-85	1981	-0.2987	-2.48	0.2111	0.984	-0.2103	-1.74	0.2211	0.991
1978-86	1982	-0.1849	-1.64	0.1202	0.984	-0.0869	-0.56	0.1355	0.99
1979-87	1983	-0.2170	-1.98	0.4652	0.984	0.0878	0.53	0.1362	0.99
1980-88	1984	-0.1662	-1.37	0.8558	0.983	0.1617	1.2	0.5477	0.99
1981-89	1985	-0.1692	-1.33	0.1472	0.982	0.0388	0.36	0.2519	0.991
1982-90	1986	-0.1625	-1.28	0.0075	0.982	-0.1787	-1.74	0.0387	0.992
1983-91	1987	-0.0668	-0.59	0.0458	0.982	-0.1482	-1.53	0.6363	0.992
1984-92	1988	-0.1115	-1.09	0.0389	0.981	-0.0519	-0.47	0.0087	0.991
1985-93	1989	-0.2784	-2.73	0.0029	0.977	0.0135	0.08	0.0405	0.987
1986-94	1990	-0.4309	-3.9	0.0004	0.968	-0.2328	-1.22	0.9566	0.984
1987-95	1991	-0.5568	-5.64	0.0001	0.975	-0.2861	-1.37	0.8779	0.985
1988-96	1992	-0.7297	-7.71	0	0.98	-0.4875	-2.8	0.3022	0.987
1989-97	1993	-0.9714	-9.96	0.0008	0.982	-0.7901	-4.88	0.1597	0.989
1990-98	1994	-1.0087	-10.8	0.0018	0.98	-0.7930	-5.01	0.1638	0.987
1991-99	1995	-0.9476	-10.82	0.0973	0.978	-0.6497	-4.21	0.3352	0.983
1992-00	1996	-0.8811	-9.27	0.2677	0.973	-0.7644	-5.11	0.2363	0.978
1993-01	1997	-0.7343	-8.19	0.8058	0.978	-0.7862	-5.55	0.5825	0.98
1994-02	1998	-0.5878	-5.31	0.6893	0.968	-0.6066	-3.14	0.1611	0.975
1995-03	1999	-0.4526	-3.49	0.9120	0.961	-0.4673	-2.09	0.3279	0.97
1996-04	2000	-0.3592	-3.02	0.5535	0.967	-0.0794	-0.41	0.9271	0.976

.

Figure 6: Minimum Wage Coefficient Estimates Using
The Pre-Specified Model and Rolling 9-Year Windows

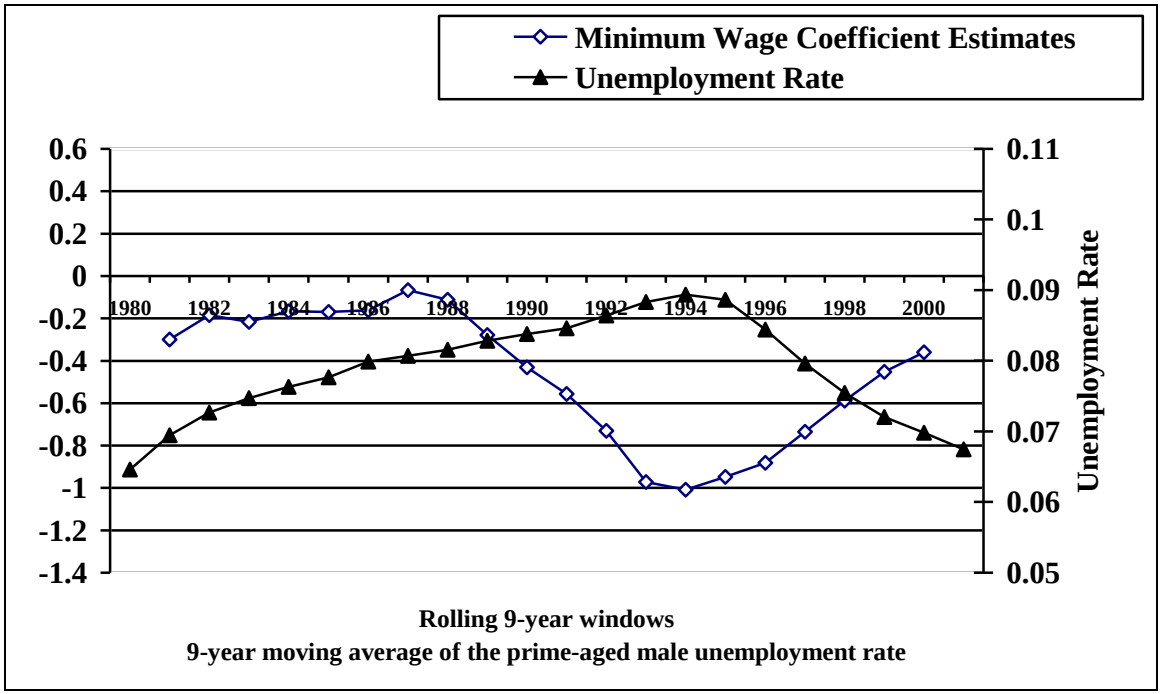


Figure 7: Minimum Wage Coefficient Estimates Using
The Full Model and Rolling 9-Year Windows

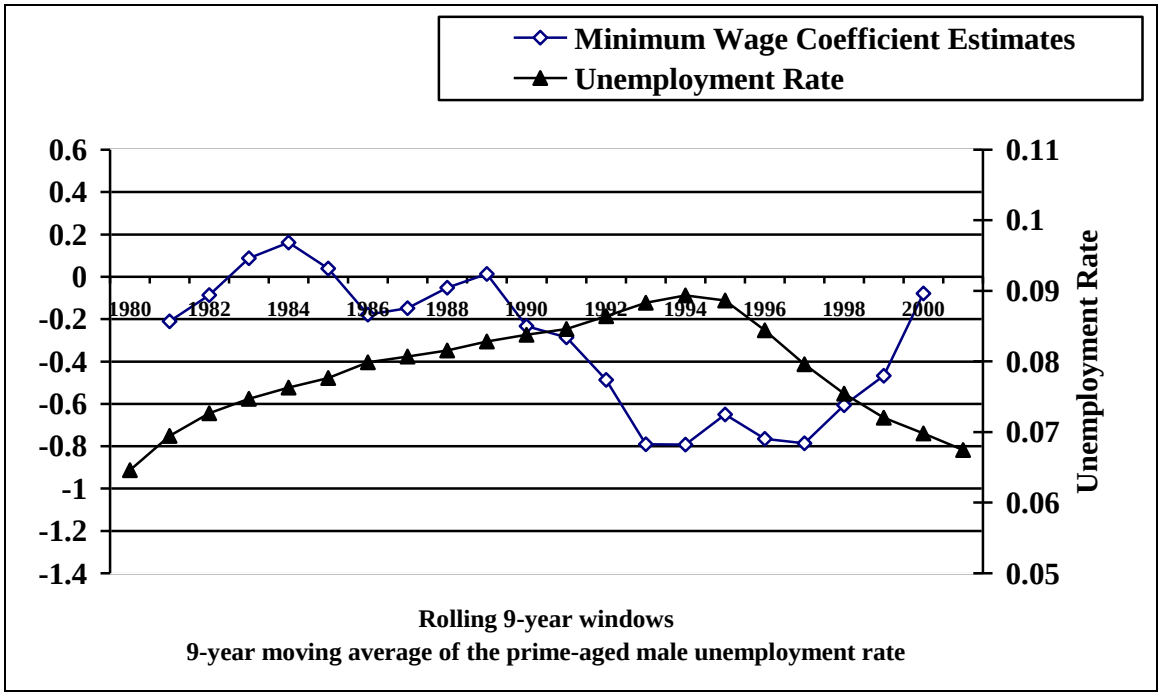


Figure 8: Coefficient of Variation in Provincial Minimum Wage Ratios
And Minimum Wage Coefficients from Rolling 9-Year Window Estimates of the Pre-Specified Model

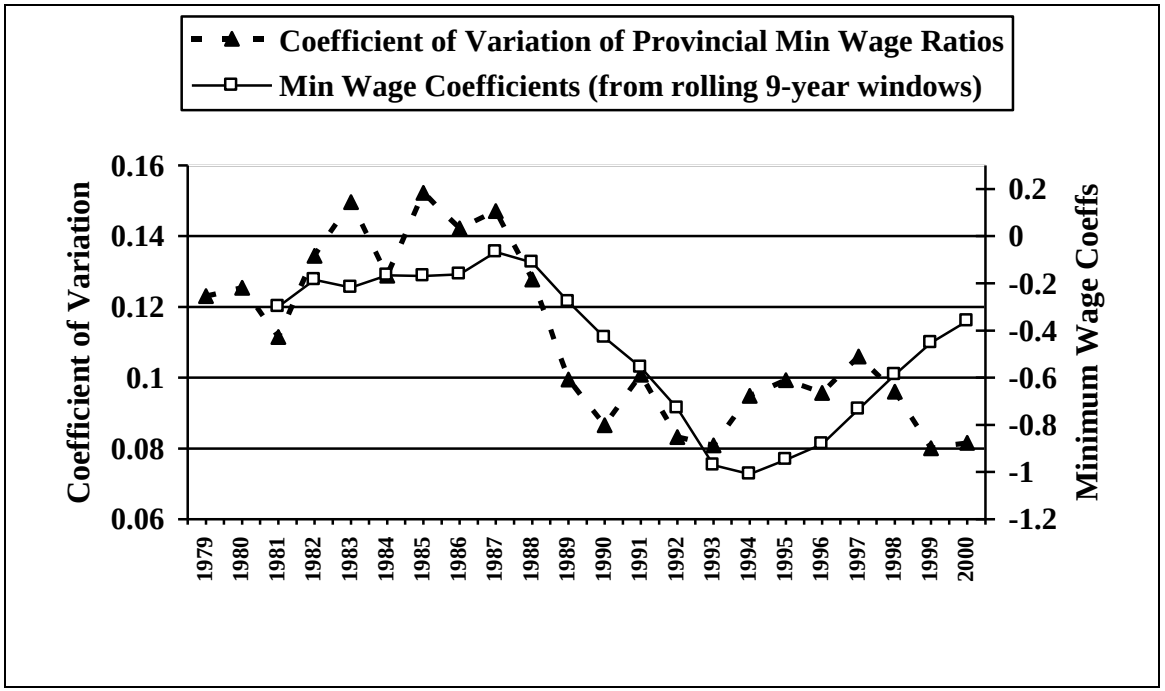


Figure 9: Coefficient of Variation in Provincial Teen Employment Population Ratios
And Minimum Wage Coefficients from Rolling 9-Year Window Estimates of the Pre-Specified Model

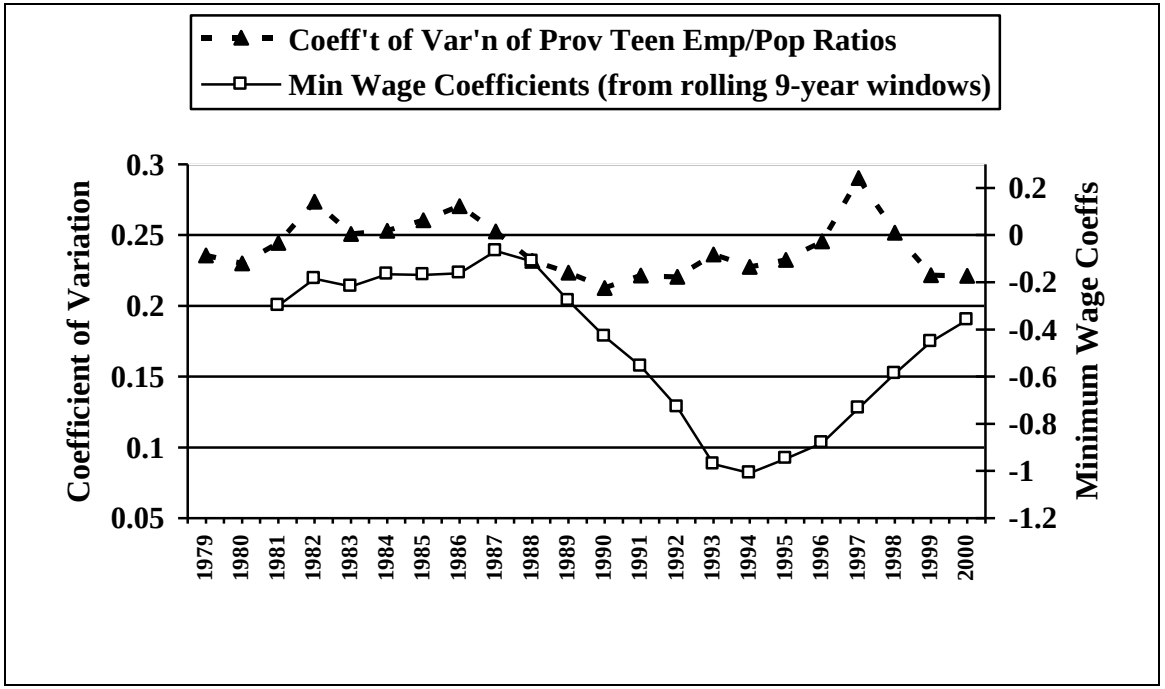
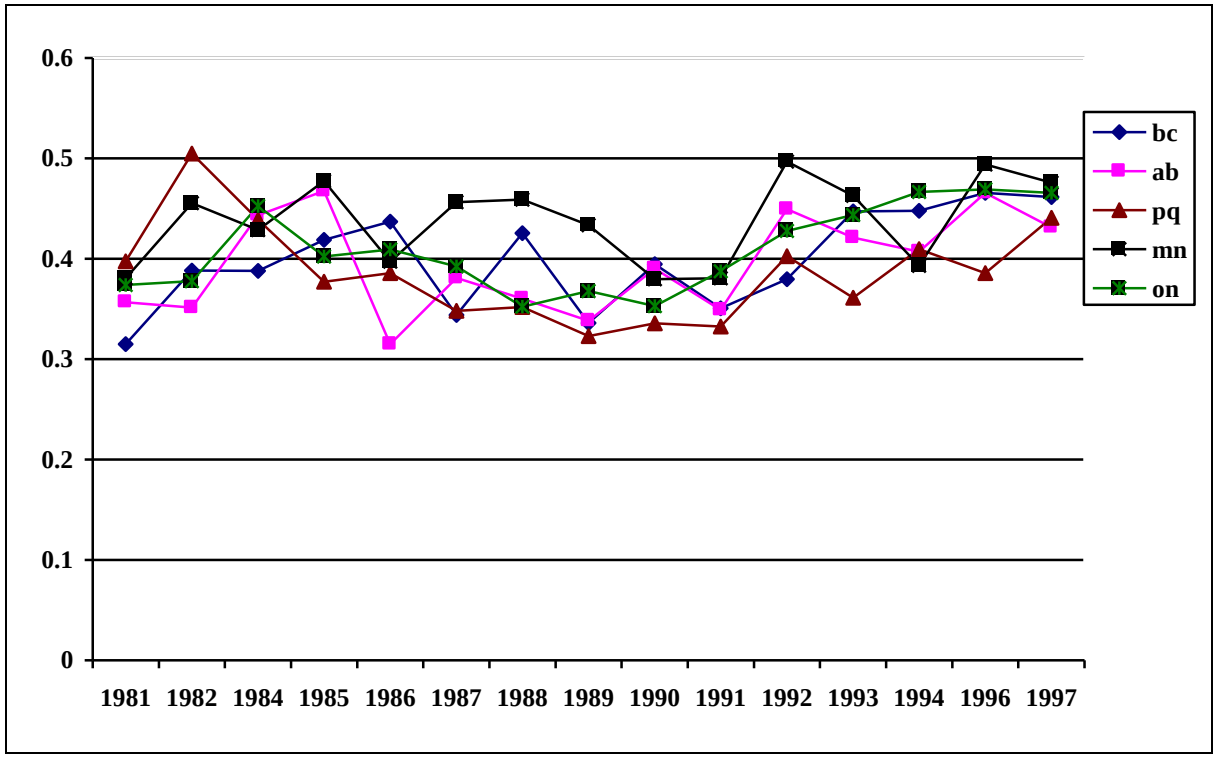


Figure 10: The Proportion of Teenagers earning less than the minwage + 25c



Notes: Data drawn from Statistics Canada's Survey of Consumer Finances.
All regressions weighted by province and year specific population.

ENDNOTES

[1] Card (1992a, 1992b), Katz and Krueger (1992), Card, Katz and Krueger (1994), Card and Krueger (1994, 1995, 2000).

[2] Yuen (2003) found sensitivity of the results to the definition of the control group. Excluding high-wage workers from the control group eliminated the minimum wage effect for teenage workers overall; but focusing on only "longer term" low-wage workers, the minimum wage effect reappeared.

[3] The exceptions – by Yuen (2003), and Campolieti et. al. (2004) – both use individual panel data sets.
[4] Because of small sample size, we follow the literature in omitting Prince Edward Island and Canada's Territories from our provincial panel dataset.
[5] Over the years, several provinces have allowed sub-minimum wages for individuals under 18 years of age, or for individuals in specific occupations (such as farming). However, Baker et al (1999) show that the wage distribution for teens has a prominent spike at the adult minimum wage. They conclude: "Overall, the [adult] minimum wage appears to have a substantial impact on the distribution of wages in the jobs held by teens (1999, page 324). As a result, they use the adult minimum wage throughout their paper.
[6] However, we obtain different coefficient estimates for the teenage population share and real GDP. The former arises because BBS deflate teenage population by total population 15 years of age and over, rather than total population of working age. The latter arises from different provincial real GDP data. See the data appendix for further discussion.

[7] It turns out that the standard model performs almost identically to the pre-specified model on the Box-Cox tests.
[8] BBS show that allowing interaction terms for the control variables did not affect the estimated minimum wage elasticity in the linear formulation; but the same exercise in the logarithmic specification did affect the estimated minimum wage elasticity. In fact, interactions brought the log estimates into line with the linear estimates. This is not the case for the longer 1976-2004 period: the minimum wage elasticity is substantially increased by allowing the control variables to have province-specific effects in the linear model. For example, comparing rows (2A) and (4A) of Table 4 we see an increase of around 50% in the pre-specified model estimates, and comparing rows (2B) and (4B) of Table 4 we see an increase of around 135% for the full model. (This comparison mirrors the procedure of BSS, page 328). However, this sensitivity exists irrespective of whether we use the linear or logarithmic functional forms, for both the pre-specified and full models.
[9] We also ran the province-specific interaction exercise using the logarithmic functional form. However, the logarithmic equations had significantly lower absolute values on the Akaike Information Criterion than the corresponding linear equations. Furthermore, every single logarithmic equation failed the RESET test, often resoundingly; whereas, three of the eight regressions with the linear functional form passed the RESET test: rows 1A, 1B and 2B of Table 4. On balance, therefore, it seems the linear functional form is better.
[10] The results for the logarithmic functional form are very similar to those of the linear form reported in this section.
[11] At their peak, the magnitude of the minimum wage effect seems implausibly large.
[12] We obtain these data from successive waves of the Statistics Canada Survey of Consumer Finances. See the data appendix for further details.