# Assessing What We Know about Employment Effects of Minimum Wage Increases: Technical Appendix

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In this appendix, I will discuss estimates of minimum wage impacts on employment, with particular reference to the estimates in Compolietti, Gunderson and Riddell(2006) (hereafter CGR). CGR is the most recent minimum wage study published in a peer reviewed journal for Canada and many public policy pieces use the estimates from this study in their discussion. It also uses a very standard methodology. For that reason, it serves as a useful place to focus. I will discuss empirical specifications used in the minimum wage literature in general as well as the one used in CGR in particular, and I will investigate the robustness of estimates to different ways of handling the deflation of the minimum wage variable, handling province specific trends, and to extending the period to something closer to the present. Much of the debate over minimum wage effects is based on estimated impacts on teenage employment rates. Even a quick glance at the extensive literature that exists (particularly in the US) estimating teenage employment impacts indicates that such estimates cover a wide range. But it is important to keep in mind that estimates of impacts on young adults (20 to 24 year olds) and on older adults are uniformly small. There is little disagreement that minimum wage impacts on overall employment rates are tiny. Moreover, there is good reason to question whether estimates obtained for teenagers can be used to provide useful evidence of impacts on other low wage workers. This is particularly the case since teenagers are considering trade-offs between employment and education that are not being made by older workers. Using Canadian provincial data, I find the same patterns: negligible impacts on the overall employment rate and the young adult employment rates of a minimum wage increase even as large as 10%. Further, when I both recreate CGRs estimates for a longer period and use what I consider

to be more plausible specifications, the implied elasticity for teenagers falls between -0.2 and -0.3. This implies impacts on the employment rate that are small relative to regular variability in this market. The main conclusion is that claims that an increase in the minimum wage on the order of 10% would create substantial efficiency problems for the economy are simply not credible. Such an increase would have only marginal effects on overall employment. One can argue for effects on teenage employment that are somewhat larger but even here the actual size of the impact is not large and there is little reason to think that it provides a particularly useful guide to what the minimum wage would do to other low wage workers.

# 1 The Empirical Specification

CGR make a point out of specifying a particular form for the regression determining age-specific employment rates, choosing a form that is common in the minimum wage literature. Since many different specifications have been employed in this literature - many with a plausible justification - it is worth investigating the robustness of their results to switching to other common specifications.

The specification they employ is given as follows (their equation 1)):

$$E_{it} = \quad + \quad _1 MW_{it} + \quad _2 MW_{it \ 1} + \quad _3 X_{it} + \quad _4 Region_i + \quad _5 Year_t + \quad _{it} \qquad (1)$$

where E is the employment-population ratio for a given age group in province i in year t; MW is the ratio of the nominal minimum wage to the average wage of workers aged 16 to 64 in region i in year t; X is a vector of other covariates; Region corresponds to a complete set of province dummies; and Year corresponds to a complete set of year dummies.

In purely empirical terms, one can pose the problem of what researchers are trying to accomplish with a regression such as 1) in quasi-experimental terms. Specifically, one would like to know how much the employment rate in a jurisdiction would change if the minimum wage changed by some amount (say, 10%) compared to a counterfactual scenario in which the minimum wage remained unchanged in the same jurisdiction. One could imagine simply examining the correlation between the employment rate and the nominal minimum wage but several factors suggest this will not provide a useful answer. First, such a simple correlation using all available data for all provinces and years will reflect systematic differences in the employment rate across provinces that are due to factors other than the minimum wage. Thus, if Alberta tends to have a higher employment rate and a lower minimum wage than other provinces, a simple correlation will suggest a strong impact of minimum wages on

employment rates. Part of the higher employment rate in Alberta may have to do with the minimum wage but much of it will not (since minimum wages are not the main determinant of employment rates) and so we would prefer not to use permanent cross-province differences in employment rates to identify the minimum wage effect. For this reason, researchers control for these differences by including a set of province dummy variables whose coefficients do not change with time. Similarly, we do not want to attribute high employment periods in general solely to minimum wages and so control for aggregate trends at the national level by including a set of year dummies.

With the inclusion of the province and year dummies, researchers identify minimum wage impacts by comparing movements in the minimum wage in a province over time to movements in the employment rate in that province relative to the national trend. In other words, we look to see if the employment rate, say, rose less in a boom in provinces that increased their minimum wage relative to provinces that did not.

A second type of complication involves the need to deflate the minimum wage variable. If one used the nominal minimum wage on the right hand side, one would see higher values of this variable in later years in a sample just because of inflation

25-54 year old workers in the province. This is an attempt to control for province specific labour demand shifts and is a standard variable to include. Second, they also include the share of the overall population that is in the age group being studied in an attempt to control for supply shifts. This is also a standard control. Finally, CGR include a lag of the minimum wage variable in order to try to pick up longer term effects of the minimum wage.

# 2 Theoretical Considerations

As the discussion in section 1) suggests, the specification in equation 1) has a certain common sense plausibility. The difficulty is that the inclusion or exclusion of a few variables in a regression can often have a substantial impact on the key parameters we are focusing on (the coefficients on the minimum wage variables in this case). This is particularly evident in the minimum wage literature where estimates range from large and negative all the way to small and positive. In this circumstance, the standard in economics is to turn to theory to guide our decisions on what to control for and on other specification decisions such as how to deflate the minimum wage variable. In the case of minimum wage effects, most discussions suggest that we are concerned with firm labour demand effects and so a natural place to turn for theoretical guidance is labour demand models. But as Hamermesh notes in his classic book on labour demand, there is no theoretically defensible way to get to equation 1) using any standard production function (Hamermesh(1993), p.187). In estimating a labour demand elasticity, we are interested in what happens to the demand for, say, unskilled labour when the wage of unskilled labour goes up, holding constant the prices of all other inputs (i.e., other types of labour, capital, energy, etc.). Moreover, these prices should be deflated by the price of the firms output since that is the price the firm is using in its calculations - whether the price of food has risen or fallen is immaterial to the production decisions of a firm that produces cars. There are very few empirical studies which take the structure of labour demand seriously in their estimation.

If equation 1) is not intended to be an estimate of something derived from labour demand, what is it? Minimum wages affect employment levels for a group to an extent that depends upon: a) how elastic is the demand for the group (i.e., if the group were all being paid the minimum wage and that wage increased, how much would demand for them go down); and b) the extent to which the group is exposed to the minimum wage (i.e., the proportion whose wages actually change when the minimum wage changes). Equation 1) could be seen as an attempt to estimate the

combination of these two effects because the total impact on employment is viewed as policy relevant. However, this means that equation 1) is a reduced form summary of the data and, by its nature, ad hoc. This is the reason so many different specifications have been tried in the literature (and so many different answers obtained). CGR try to make the best out of this by promising they will stick to one particular specification and not be tempted to try out others. But what is the virtue in binding oneself to the mast of this specification when the defense of any specification is ad hoc?

One key place this difficulty arises is in the decision on how to deflate the minimum wage variable. Deflating by the average wage in an economy seems to rely on the theory of labour demand for its justification since, as weve seen, that theory indicates that one should control for the prices of other inputs. But if one controls for this input price, why not control for others? Moreover, at the provincial economy level, the average wage is clearly an endogenous variable, implying that estimates will be biased. A positive demand shock will increase both the dependent variable (the employment rate) and the average wage, generating an automatic negative correlation between the dependent variable and the minimum wage variable. CGR (following others) argue they can address this by using a specification in which the minimum wage and the average wage are entered separately (instead of in ratio). But this still results in a specification that includes the endogenous variable on the right hand side and, as is well known, when a clearly endogenous variable is included in a regression not only its own coefficient but all other coefficient estimates are biased. One could imagine bringing in the average wage separately and then instrumenting for it to handle the endogeneity issues but they do not do this. In their defense, neither does anyone else in the literature but this just emphasizes exactly how ad hoc this literature is.

Probably the best that can be done in the face of these difficulties is to include as many controls as one can in order to reduce the possibility that one is really just capturing general macro movements in an economy rather than actual minimum wage effects. As discussed earlier, the year dummy variables do this for national level macro trends but do not control for province specific growth patterns. The prime age unemployment rate, since it varies by province and over time, is intended to do this at least to some extent. However, if labour supply elasticities are small (as they are for prime age males) then demand shifts will tend to show up in wage changes rather than employment changes. This would imply that something like the prime age unemployment or employment rate will be an imperfect measure of growth effects. For this reason, many authors also include province specific time trends (Dube et al(2010), for example, include specifications with time trends as do Neumark and

Wascher in some of their papers). I will investigate the robustness of estimates to this added control below.

# 3 More Specification Issues - Weighting and Logs

Two more specification issues require discussion before turning to the actual estimates. First, there is some disagreement in the literature on whether and how to

tions. To make this point clearer, if the LFS drew the exact same sample size in each province then there would be no need to re-weight at all. Baker et al(1996) find that re-weighting makes little difference to estimates in the Canada for the data period they examine (1979-1992). I will present estimates both with and without weights

in each year simply because that is the data I had already pulled. As we will see, in spite of these differences, my estimates of minimum wage effects for their period and specification are very similar to theirs.

# 6 Estimates

I begin by replicating CGRs estimates of equation 1) using data from their same time

check using an alternative, and possibly more plausible, minimum wage definition.

we present results using only the post-1997 data. This has the advantage of being based on one consistent data source. The estimates in this table are, again, widely varied. They are often less negative than the CGR estimates from the earlier period and some are, again, positive. But there are also some larger, negative estimates. Overall, the estimates suggest that results are time period dependent with the larger negative estimates in CGR's own specification being replaced with smaller negative or positive estimates in the post-1997 estimates. But it is also worth pointing out that few of the estimates are statistically significantly different from zero, implying that there is not enough minimum wage variation in the post-1997 period to provide well defined estimates of minimum wage effects, especially when lags are included.

How big are these implied effects? For teenagers, an elasticity of -0.3 (a number that roughly represents the set of estimates in these tables) implies a decline in the employment rate from 40% to 39%. To provide some context, from 2000 to 2016, the teenage employment rate in BC had an average of 40% but ranged from a low of 37% to a high of 49% and had a standard deviation of 4.5%. Thus, relative to the regular variability in the employment rate, the implied minimum wage impact is small indeed. In terms of absolute employment numbers, there were 111,000 employed teenagers in BC in 2016. Reducing the employment rate by 1 percentage point would imply a loss of approximately 2,900 positions. It is worth repeating, though, that this is dwarfed by the type of regular variability we observe in employment for youth. A one standard deviation decline in the employment rate would imply a loss of approximately 13,000 jobs. For the total age range (15-64), an elasticity of -0.055 means that a 10% increase in the minimum wage implies a decline from an employment rate of 64% (our sample average) to an employment rate of 63.6%. For BC, from 2000 to 2016, this employment rate average 70.7% and ranged from a low of 68.9% to a high of 73.9% with a standard deviation of 2.1%. Thus, implied minimum wage effects are even more completely dwarfed by regular variability.

It is not entirely clear what these estimated elasticities imply about the actual elasticity of the demand curve. CGRs attempts to address this question yield a set of estimates that are extremely poorly defined and span a range from positive and small to negative and very large. Dube et al(2010), which is probably the most plausible set of minimum wage estimates currently available for the US, generate an implied demand elasticity for teenagers of approximately -0.7. This would imply that an increase in the minimum wage would lead to an increase in total wages going to teenagers. Hamermesh(1993) argues that the consensus estimate for the elasticity of demand for all workers is -0.3 and in recent work on this (Beaudry, Green and Sand(2016)), we we also obtain an estimate of this size. This would, again, imply an

overall increase in the wage bill as a result of a minimum wage increase. One would expect this to provide a lower bound on the elasticity for groups truly directly affected by the minimum wage, however.

# 7 Conclusion

This discussion leads to a set of clear conclusions. First, the overall impact of a minimum wage increase of even 10% on overall employment levels is very small indeed. There is no disagreement on this point in the literature. Second, the impact for 20 to 24 year olds is also very small and, again, there is no disagreement on this point either. Third, it is well known that estimated impacts for teenagers cover a wider range. I have argued that this stems, ultimately, from the ad hoc nature of estimation in this area. CGR's attempt to redress this by choosing one of many plausible specifications is not a real answer to this issue. Fourth, teenagers likely constitute a poor stand-in for understanding the impact of minimum wages on other low skilled workers. Estimated results for them should be seen as only relevant for them. Fifth, when I both recreate CGR's estimates for a longer period and use what I consider to be more plausible specifications, the implied elasticity for teenagers falls between -0.2 and -0.3. This implies impacts on the employment rate that are small relative to

Belman, Dale and Paul J. Wolfson (2014). What Does the Minimum Wage Do?

Table 2: Minimum Wage Effects on Employment Rate by Age Group
CGR Sample (1981-1997), Weighted

| | Wage Ratio | | | Real Min Wage | | | Wage Ratio | | | Real Min Wage | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15-19 | 20-24 | 15-64 | 15-19 | 20-24 | 15-64 | 15-19 | 20-24 | 15-64 | 15-19 | 20-24 | 15-64 |
| Min wage | -19.2 | -16.4 | -8.70 | 0.13 | -1.37 | -0.54 | -20.5 | -18.4 | -6.55 | -0.81 | -2.60 | -0.39 |
| | (5.82) | (5.49) | (2.26) | (0.91) | (0.84) | (0.37) | (6.08) | (5.73) | (2.10) | (0.92) | (0.86) | (0.33) |
| Lag | -7.06 | -4.47 | -4.77 | -1.96 | -0.91 | -0.44 | -3.92 | -2.24 | 0.60 | -1.76 | -0.63 | 0.10 |
| | (5.60) | (5.24) | (2.16) | (0.94) | (0.86) | (0.37) | (5.78) | (5.37) | (1.97) | (0.88) | (0.79) | (0.31) |
| Total | -26.2 | -20.9 | -13.5 | -1.83 | -2.29 | -0.97 | -24.4 | -20.7 | -5.95 | -2.56 | -3.22 | -0.29 |
| Elast | -0.31 | -0.15 | -0.098 | -0.25 | -0.19 | -0.082 | -0.29 | -0.15 | -0.043 | -0.35 | -0.27 | -0.024 |
| Prov. Trend | No | No | No | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes |

Standard Errors in parentheses

All regressions include the prime age unemployment rate, the proportion of the age 15-64 population in the given age group, province and year fixed effects.

Table 3: Minimum Wage Effects on Employment Rate by Age Group
1981-2016 Sample, Unweighted

| | Wage Ratio | | | Real Min Wage | | | Wage Ratio | | | Real Min Wage | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15-19 | 20-24 | 15-64 | 15-19 | 20-24 | 15-64 | 15-19 | 20-24 | 15-64 | 15-19 | 20-24 | 15-6 |
| Min wage | 1.84 (5.28) | -7.25 (5.35) | 1.68 (3.47) | -0.72 (0.84) | -1.00 (0.88) | -0.24 (0.57) | -11.9 (4.97) | -10.5 (5.22) | -3.19 (2.45) | -0.64 (0.75) | -1.10 (0.80) | -0.4 (0.37 |
| Lag | 1.63 (5.09) | 6.66 (5.15) | -0.38 (3.33) | -1.37 (0.83) | 0.70 (0.86) | 0.14 (0.56) | -6.21 (4.75) | 5.23 (5.00) | 0.049 (2.34) | -1.51 (0.74) | 0.37 (0.79) | 0.09 (0.37 |
| Total | 3.47 | -0.59 | 1.30 | -2.09 | -0.30 | -0.11 | -18.1 | -5.27 | -3.14 | -2.15 | -0.73 | -0.3 |
| Elast | 0.059 | -0.0066 | 0.013 | -0.38 | -0.033 | -0.012 | -0.31 | -0.055 | -0.032 | -0.39 | -0.080 | -0.03 |
| Prov. Trend | No | No | No | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes |

Standard Errors in parentheses
All regressions include the prime age unemployment rate, the proportion of the age 15-64 population in the given age group, province and year fixed effects.
denotes significance at the 5% level,

Table 4: Minimum Wage Effects on Employment Rate by Age Group
1997-2016 Sample, Unweighted

| | Wage Ratio | | | Real Min Wage | | | Wage Ratio | | | Real Min Wage | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15-19 | 20-24 | 15-64 | 15-19 | 20-24 | 15-64 | 15-19 | 20-24 | 15-64 | 15-19 | 20-24 | 15-64 |
| Min wage | 5.10 (7.54) | -5.85 (7.79) | 4.76 (3.84) | -1.42 (1.18) | -1.81 (1.27) | 0.071 (0.64) | -5.00 (5.75) | -10.2 (7.25) | -2.44 (2.47) | -1.25 (0.86) | -1.61 (1.11) | -0.14 (0.38) |
| Lag | 9.10 (7.45) | 19.3 (7.87) | 6.44 (3.84) | -1.00 (1.18) | 1.38 (1.26) | 0.060 (0.63) | -0.76 (5.71) | 12.5 (7.39) | 0.47 (2.47) | -0.11 (0.87) | 1.20 (1.12) | 0.13 (0.38) |
| Total | 14.2 | 13.4 | 11.2 | -2.41 | -0.44 | 0.13 | -5.76 | 2.31 | -1.96 | -1.36 | -0.41 | -0.017 |
| Elast | 0.32 | 0.18 | 0.14 | -0.56 | -0.064 | 0.017 | -0.13 | 0.030 | -0.025 | -0.32 | -0.060 | -0.0024 |
| Prov. Trend | No | No | No | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes |

Standard Errors in parentheses
All regressions include the prime age unemployment rate, the proportion of the age 15-64 population in the given age group, province and year fixed effects.
denotes significance at the 5% level,