Impact of Basic Income and other Programs on Wages and Inequality

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1 Introduction

Reducing poverty and redistributing income are arguably fundamental goals of a Universal Basic Income scheme. Two fundamental characteristics of any Basic Income program is to provide a guaranteed income to all individuals, and pay for it through higher taxes higher up in the income distribution. While the extent of taxation at the top depends on whether the Basic Income transfer is phased out as income increases, or remains untaxed, the distributional consequences are clear. By increasing transfers at the bottom and raising taxes at the top, inequality and poverty are bound to decrease.

There are two important reasons, however, why a simple accounting approach like the one we just described would likely yield inaccurate impacts of Basic Income on inequality and poverty. First, Basic Income and taxes likely have behavioural impacts on work decisions and tax avoidance efforts. A very large literature in public economics and labour economics has explored the consequences of income support programs on labour supply. Potential labour supply responses are also a first order concern in the growing literature on the possible impacts of Basic Income schemes (see, e.g., Hoynes and Rothstein, 2019). If low-income workers reduce their work effort in response to the introduction of Basic Income, their total income –Basic Income plus labour earnings– will increase by less than the amount of the Basic Income grant, thus mitigating the distribution impact of Basic Income.

The second reason why the impact of Basic Income likely goes above and beyond what would be predicted by a simple accounting framework is that Basic Income may also affect equilibrium wages in the labour market. If Basic Income substantially reduces the labour supply of low-income workers, equilibrium wages in this segment of the labour market would likely increase as employers need to compete to hire among a reduced pool of available workers. As such, incentive effects and equilibrium wage effects of Basic Income may have offsetting impacts on income inequality, making it challenging to predict the full effect of Basic Income on poverty and inequality. One further complication is that different individuals may be differently affected by Basic Income depending on their skill level, their baseline labour supply, and how they respond to changing incentives linked to the introduction of a Basic Income.

Unlike the labour supply impacts of income support programs that have been extensively studied in the literature, a much more limited set of studies has looked at the effect of these programs on equilibrium wages. Most notably, Rothstein (2008, 2010) studies the equilibrium, or wage incidence, effects of the Earned Income Tax Credit (EITC) program in the United States. More recently, Hoynes and Rothstein (2019) and Kasy (2018) discuss the equilibrium effects of Basic Income. However, the U.S. context they consider is very different from the situation that currently prevails in British Columbia. Most importantly, key U.S. transfer programs like the earned income tax credit (EITC) have important work requirements, while comparable programs in British Columbia don't. In particular, the Canada Child Benefit (CCB) –the largest transfer program for prime-age individuals– has no income requirement and is only clawed back at relatively high income levels.

The goal of this paper is to evaluate the equilibrium labour market effects of Basic Income and transfer programs more broadly, focusing on their consequences for wage and earnings inequality. To do so, we use a tax incidence framework similar to Rothstein (2008, 2010) to simulate the effects of transfers on wages, earnings, hours and employment. Implementing the approach requires knowledge of how the labour supply and demand system responds to changes in effective marginal and average tax rates for different groups of workers. Once available, we will use rich data from the master files of the 2016 Canadian Census to look at equilibrium effects at the local labour market level, and consider rich patterns of heterogeneity in the impacts. The same Census data will then be used to conduct a welfare analysis for the full population of British Columbia under Basic Income and other counterfactual transfer schemes.

The rest of the paper proceeds as follows. In Section 2, we survey the literature on the wage incidence of income support programs, and discuss key insights existing studies provide on the potential impacts of Basic Income on inequality. Section 3 presents the model –similar to Rothstein (2008, 2010)– we use to estimate the predicted incidence of Basic Income on wages in the BC context. Details on existings program and descriptive statistics are reported in Section 4. Finally, Section 5 uses the master files of the 2016 Canadian Census to evaluate how introducing Basic Income in BC would affect wages and the distribution of earnings.

2 Literature survey

As mentioned earlier, a large literature has looked at the impact of income support programs on the labour supply decisions. While estimating labour supply effects of Basic Income is not the prime motivation of our paper, it is an essential ingredient in assessing the potential size of equilibrium wage effects. If labour supply effects are small, equilibrium effects will be small too, as relatively unchanged labour supply won't have much impact on the market equilibrium values of hours and wages. Accordingly, first review a selected number of studies seeking to assess the effect of Basic Income on labour supply. We then summarize the small literature on wage incidence in the second part of the Section.

2.1 Labour Supply Effects of Basic Income

2.1.1 Basic Income with phase out

One version of Basic Income provides a basic income grant to all individuals, but is gradually phased out as earnings increases. This version of Basic Income is similar to Negative Income Tax (NIT) schemes that have been extensively studied in the literature. Most interestingly, both the United States and Canada ran randomized field experiments back in the 1970s to evaluate the labor supply impacts of these interventions.

Hum and Simpson (1993) review the evidence from NIT experiments in New Jersey (3 years, 1968), Rural NC-Iowa (3 years, 1970), Seattle-Denver (3,5,20 years, 1970), Gary IN (3 years, 1971), and Manitoba (3 years, 1975). They conclude that, on balance, the NIT experiments had a negative impact on hours of work (Hum and Simpson, 1993, p. S280):

"The results indicate ... that hours worked will decline with the introduction of a guaranteed income program ... The reduction in hours worked is very small for men, never exceeding 9%, but larger for women. Weighted averages of the U.S. results ... imply a reduction in hours worked of about 6% for husbands, 19% for wives, and 15% for single mothers." (Hum and Simpson, 1993, p. S280)

That said, the evidence on negative labour supply effects are far from overwhelming:

"Note, however, that only the results from Seattle-Denver are statistically significant; as far as can be determined from published reports, the estimates

for New Jersey, Gary, and the Rural experiments are generally insignificant. Response in the Canadian experiment is similarly modest–1% for men, 3% for wives, and 5% for unmarried women–and statistically insignificant when time effects are properly included." (Hum and Simpson, 1993, p. S280)

Hum and Simpson also qualify these findings by mentioning a number of implementation issues with the NIT experiments. This includes some evidence of non-random selection, imperfect take-up, attrition, interactions between individuals in the experimental and non experimental groups, and the use of an assignment model to keep cost low. On the latter point, it appears that "Families with low pre-experimental income are less likely to be allocated to generous plans (low t, high G)" (Hum and Simpson, 1993, p. S278).

Robins (1985) presents another summary of the NIT experiments, and reaches conclusions similar to those of Hum and Simpson (1993):

"*Despite the wide range of treatments and evaluation methodologies, the labor supply responses from the four NIT experiments are remarkably consistent. On average, husbands reduced labor supply by about the equivalent of two weeks of full-time employment. Wives and single female heads reduced labor supply by about the equivalent of three weeks of full-time employment. Youth reduced labor supply by about the equivalent of four weeks of full-time*" (Robins, 1985, p. 580)

More recently, Price and Song (2016) linked individuals who participate to the Seattle/Denver Income Maintenance Experiments (SIME/DIME) to social security data observed decades after the end of the experiments. Using this matched data set, Price and Song (2016) find new evidence of labour supply effects decades after the experiment ended. They estimate that, on average, treatment decreased the probability that participants work in a given year by 3.3 percentage points (4.6% of the mean probability of working for adults in their sample), and decreased average annual earnings by $1,800 (7.4% of mean annual earnings).

Overall, the evidence suggest that these NIT experiments had a negative impact on labour supply, though the effects tend to be quite modest for men in particular.

2.1.2 Unconditional cash grants

At the other end of the spectrum, one could consider a Universal Basic Income program where the net grant remains constant regardless of earned income. Note, however, that higher-income earners would still have to pay back the transfer through higher taxes that would unavoidably have to be introduced to pay for Basic Income.

Although no large universal basic income with no phase out has been explicitly introduced at this point, some smaller sub-national jurisdictions have had, de facto, a Basic Income program for a number of years. One example of a Basic Income-like program is the Alaska Permanent Fund that has distributed royalty income from the oil and gas sector to residents of the State since 1982. All residents receive a dividend payment from the fund that has averaged $2000 a year in recent years.

Jones and Marinescu (2017) estimate the labour supply effects of the dividend by comparing Alaska to a synthetic cohort of other states (mix of Utah, Wyoming, Washington, Nevada, Montana, and Minnesota). They find that the dividend has no impact on the employment rate in the population, but that it increases the fraction of individuals working part time, suggesting a modest decline in hours of work. This is consistent with the prediction that Basic Income (with no phase out) should reduce labour supply due to an income effects, though the estimated effect is quite small in Jones and Marinescu (2017)'s setting.

Akee et al. (2010) study the impact of another Basic Income-like unconditional transfer program. The setting is an Eastern Cherokee reservation in North Carolina where profits from the local casino are distributed on a per capital basis to all members of the band. Akee et al. (2010) don't find any evidence of labour supply effects linked to the dividend payment, though they document positive impacts on child outcomes such as educational achievement.

In a related study, Cesarini et al. (2017) look at the impact of lottery winnings on labour supply. Like an unconditional Basic Income, lottery winnings should have a negative impact on labor supply due to a wealth effect. Using detailed Swedish data, they document a modest, though statistically significant effect of lottery winnings on labour supply.

2.1.3 Labour Supply Effects: Summary

Overall, the existing evidence seems to suggest that income support programs with characteristics similar to those of Basic Income schemes tend to have an adverse impact on labour supply, though the effect tends to be small in most contexts. This suggests, nonetheless, that there is scope for Basic Income to have an impact on equilibrium wages by reducing the amount of labour being supplied to the labour market.

2.2 Effects of Income Support Program on Equilibrium Wages

To the best of our knowledge, no existing study has sought to estimate the impact of Basic Income schemes on equilibrium wages in the labour market. The focus of the small U.S. literature on the topic, starting with Rothstein (2008, 2010), has instead been on the EITC program. Unlike Basic Income or NIT, the EITC provides an incentive for workers to increase their labour supply, at least in the "phase-in" part of the EITC where it acts as a wage subsidy. This fundamental feature of the EITC is shared by similar, though smaller, programs in Canada such as the federal Canada Workers Benefit (CWB).

To the extent that EITC does increase the supply of low-wage workers in the labour market, it also likely results in lower wages for this segment of the workforce.[1] These lower wages may undermine the benefits of EITC by eroding the value of the wage subsidy provided by the program.

This simple argument is the point of departure of the influential paper by Rothstein (2010). The paper considers a partial equilibrium tax model with nonlinear and heterogeneous (across workers) tax schedules, partially substitutable differentiated labour, and where labor supply decisions are made on the intensive and extensive margins. It then "plugs in" plausible labour supply and labor demand elasticities. The key finding is that the indirect effects EITC due to lower wages –also referred to as negative spillover effects in the paper– are large relative to the intended direct effects of the transfer.[2]

In a closely related contribution, Rothstein (2008) attempts to empirically estimate the elasticity of labour demand, and obtains an estimate similar to Hamermesh (1996)'s best guess of 0.3. The estimation is based on repeated cross-sections from the March Current Population Survey (CPS). An important estimation challenge is to distinguish changes in the skill composition of the labor force and changes in equilibrium wages for workers of different skill levels. As noted above, if the EITC attracts low-skill workers in the workforce by providing an implicit wage subsidy, this could shift the observed wage distribution downward even with no change in any individual worker's wage. These composition effects could potentially confound the "true" impact of the EITC on equilibrium wages. To address these issues, Rothstein (2008) adapts DiNardo et al.'s (1996) reweighting strategy to balance the skill distribution in pre- and post-tax reform cross sections.

[1]A large liteterature, including Eissa and Liebman (1996) and Meyer and Rosenbaum (2001), provide evidence that the expansion of the EITC in the 1990s lead to an increase in the labour supply of workers most affected by the expansion ("low-skill" single women with children). This conclusion has been challenged, however, in recent work by Kleven (2020) who argues that other confounding factors such as welfare reform may account for the labour supply impacts documented in previous work.

[2]Rothstein's baseline estimates are based on a participation elasticity of 0.75, an elasticity of hours conditional on working of zero, a labor demand elasticity of 0.3 (Hamermesh (1996)'s "best guess"), and no income effects.

Although the empirical part of the paper nicely complements the calibration exercise in Rothstein (2010), a further empirical challenge is to distinguish equilibrium wage effects linked to the expansion of the federal EITC in the 1990s from other secular trends in the wages of workers of different skills. An alternative estimation strategy pursued by Leigh (2010) is to use variation in state-level EITC programs to identify the effect of EITC on wages earned by high school dropouts between 1989 and 2001. Leigh (2010) finds a negative effect of the EITC on the wages of workers with children (who receive EITC) and relative to those without children. The paper provides evidence of covariate balance on states that expanded vs. did not expand their EITC programs, and that these expansions did not affect labour mobility. Various estimation methods, including a simulated instrument *a la* Currie and Gruber (1996), yield similar results.

Kasy (2017) extends the model of Rothstein (2010) and applies his framework to re-examine the findings of Leigh (2010). A key contribution is to provide formal conditions for identifying the conditional causal effect of policy changes (like EITC) on wages given baseline labor supply and wages. He points out that, even with exogenous policy variation, conditional causal effects are only partially identified when looking at more than one outcome variables (e.g. labour supply and wages). Kasy also provides assumptions restricting heterogeneity of causal effects just enough for point-identification and propose corresponding estimators.

Like Leigh (2010), Kasy then use variation in EITC state supplements in order to identify causal effects. He finds negative welfare effects of depressed wages as a consequence of increased labor supply, in particular for individuals earning around $20,000 a year.

In another recent paper, Kasy (2018) use arguments similar to Rothstein (2010) to argue in favour of Basic Income over EITC. His point is that the EITC wage subsidy is partially captured by employers through increased labour supply and lower wages. Under a Basic Income scheme, wages may well increase since labour supply declines (due to an income effect), and workers have a better bargaining position that may further help increase wages.

Another point made by Kasy (2018) is that if workers are competing for the same jobs (e.g. during a recession) we may empirical observe that EITC increases the labour supply of EITC recipients, but they may just be taking jobs from nonrecipients (as in Crepon et al., 2013), therefore not increasing aggregate employment. This decreases incomes at the lower end of the distribution, leading to an increase in poverty and inequality.

3 Wage Incidence of Basic Income: Model

Our proposed approach closely follows Rothstein (2010) who considers a model with differentiated labour (by skill group) to look at the incidence of the EITC program in the United States. We adapt Rothstein's approach to the BC context and use it to look at the wage incidence of Basic Income. We then use the findings to look at how Basic Income would likely affect the distribution of income.

Before getting into the details of the model, we provide a very brief overview of the conventional tax incidence approach in public finance. We use "wage incidence" and "equilibrium wage effects" of Basic Income interchangeably in the paper. As the former terminology follows a long tradition of work in public finance, it is useful to briefly describe the approach to help provide context for Rothstein (2010).

3.1 Tax Incidence Analysis: Basic Concepts

The conventional analysis of tax incidence looks at how a tax on a good affects its price in equilibrium. If the price barely moves the agent being taxed will bear most of the burden of the tax. If not, the burden will be shared between consumers and producers.

Consider a simple demand and supply system:

$$D(p) = S(p)$$

We next introduce a tax t on consumers:

$$D(p + t) = S(p)$$

Simple differentiation yields:

$$\frac{\partial D}{\partial p}\left(\frac{\partial p}{\partial t} + 1\right) = \frac{\partial S}{\partial p}\frac{\partial p}{\partial t}.$$

Rearranging and rewriting this expression in terms of elasticities yields:

$$\begin{aligned}\frac{\partial p}{\partial t} &= \frac{\partial D/\partial p}{\partial D/\partial p - \partial S/\partial p} \\ &= \frac{\partial D/\partial p \Big/ D/p}{\partial D/\partial p \Big/ D/p - \partial S/\partial p \Big/ D/p} \\ &= \frac{\epsilon_D}{\epsilon_S - \epsilon_D},\end{aligned}$$

where the last equality uses the fact that $S = D$ in equilibrium. This last expression can also be rewritten as:

$$\frac{\partial p}{\partial t} = \frac{1}{\frac{\epsilon_S}{\epsilon_D} - 1}.$$

Recalling that $\epsilon_D < 0$ and $\epsilon_S > 0$, the relevant quantity is the relative elasticity $|\frac{\epsilon_S}{\epsilon_D}|$, and $\frac{\partial p}{\partial t} \in (-1, 0)$.

The two key implications of the model are as follows:

- If $|\epsilon_D|$ is large relative to ϵ_S, suppliers bear more of the incidence as prices fall steeply with taxes. Consumers are shielded from the tax cut by the price decrease. As $|\frac{\epsilon_S}{\epsilon_D}| \to 0$, $\frac{\partial p}{\partial t} \to -1$ and the price falls one-for-one with t. This could happen if, for example, the tax is imposed on a good with an untaxed close substitute.

- If ϵ_S is large relative to $|\epsilon_D|$, consumers bear more of the increase as prices are less sensitive to taxes. Since producers do not face the tax directly and prices do not respond, they are shielded from the tax. As $|\frac{\epsilon_S}{\epsilon_D}| \to \infty$, $\frac{\partial p}{\partial t} \to 0$ and the price does not change in response to t. This could happen, for example, in the case of a tax on a life-saving drug with no substitute.

3.2 Model and its Implementation in the BC Context

Our main empirical exercise is to simulate the effects of transitioning from the tax and transfer system as it existed in British Columbia in 2015 to a Basic Income on equilibrium wages and earnings for different population sub-groups. The model we use to perform this simulation is adapted from Rothstein (2008) and features

- Imperfect substitution of heterogeneously skilled workers
- Extensive and intensive margin labour supply responses
- Nonlinear tax-and-transfer schedules that vary for different demographic subgroups

The key to the model is that it divides all workers into two overlapping groups, which we refer to as tax groups and labour market groups. A more detailed discussion of Rothstein's model, along with a derivation of the equations presented below, is presented in the Appendix.

Workers in the same tax group (which we denote by g) face the same tax and transfer schedules, and therefore conditional on income face the same incentives to change their hours worked or enter/exit the labour force in response to changes in the tax schedule.

Workers in the same labour market group (which we denote by s) compete directly with each other in a common labour market, and compete imperfectly with workers in other groups. The elasticity of substitution between each labour market is given by ρ. This is a key parameter in the analysis as it determines the slope of the labour demand curve and therefore the extent to which transfers can be passed-through to employers in the form of lower wages. Larger values of ρ are associated with more pass-through.

Workers' labour supply responses are summarized by the extensive- and intensive-margin elasticities of substitution σ_e and σ_i. The intensive-margin is more sensitive to changes in marginal tax rates (MTR) while the extensive-margin is more responsive to average tax rates (ATR).

Consider a single childless worker who works part-time at a low hourly wage. If they qualify for Social Assistance, which includes a steep phase-out rate, the worker therefore faces a high effective marginal tax rate net of transfers. To the extent that labour supply is elastic at the intensive margin (larger values of σ_i), transitioning to a Basic Income that gives a transfer as generous as Social Assistance but with no phase-out will reduce their MTR and they will increase their hours worked. On the other hand, a single parent with 3 children with the same earnings will qualify for a generous child benefit under Canada's existing transfer system. To the extent that labour supply is elastic at the extensive margin, transitioning to a Basic Income that gives a transfer that is less generous than her Child Benefits will increase her ATR and increase the chance she drops out of the labour force entirely.

Suppose that both workers sell their labour in a common labour market. Transitioning to a Basic Income will increase the labour supply of low-income childless single workers and decrease the labour supply of low-income single workers. Depending on which effect dominates, employers can respond by substituting between workers in other labour markets. This will lead to an endogenous wage response as labour supply slides along the labour demand curve. If single childless workers at the Social Assistance threshold supply a larger share of labour in the market and labour is more elastic along the intensive margin, the labour supply curve will shift to the right and wages for the labour market as a whole will decrease. Notice that this compounds the earnings losses of low income single parents: not only did they lose transfers and reduce their labour supply, but their hourly wage fell as well.

On the other hand, if the effect among single parents dominates, labour supply shifts to the left and hourly wages increase. The increase in wages partially compensates single parents who reduced their labour supply (those who didn't exit the labour force entirely), just as it benefits childless singles. The extent to which this wage incidence channel operates depends on the extent to which employers can take advantage of shifts in labour supply by substituting across different types of labour, which are captured by the elasticity of substitution ρ.

This mechanism is captured in the following system of equations, derived in the Appendix:

$$d\ln L_{sg} = (\sigma_i + \sigma_e + \sigma_i\sigma_e) d\ln w_s - \sigma_i(1+\sigma_e) dMTR_{sg} - \sigma_e dATR_{sg}, \quad (1)$$

$$d\ln w_s = \frac{1}{\sigma_i + \sigma_e + \sigma_i\sigma_e - \rho}[d\ln\psi + (\sigma_i + \sigma_i\sigma_e) dMTR_s + \sigma_e dATR_s], \quad (2)$$

where ATR_{sg} and MTR_{sg} are the hours-weighted average changes in marginal and average tax rates net-of-transfers for workers in labour market group s and tax group g. ATR_s and MTR_s are defined analogously for labour groups.

We calculate this system of equations, for a partition of all workers into 2 labour market groups and 4 tax groups. We assume that the labour market is segmented by workers' level of education as measured by whether they have a University Degree. Tax groups g are defined by whether a worker is single or in a couple and whether they are parents or childless.

The division of tax groups is motivated by the eligibility criteria of the 3 main groups of transfer programs existing in British Columbia. Couples face a different WITB schedule than single workers, only workers with children are eligible for Child Benefits, and single individuals are the primary recipients of Social Assistance.

To estimate MTR and ATR schedules for each tax group, we take a data-driven approach and estimate transfer receipt and income taxes paid as a function of income separately for members of each tax group using the 2016 Census.[3] An alternative approach would be to calculate MTR and ATR net of transfers using program parameters and the tax code. This was the approach taken by Milligan (2020, this volume). The benefit of using transfers as reported in the Census, however, is that they represent the actual transfers received. For programs such as social assistance, which depend on the discretion of social workers to determine eligibility, program parameters based on hard income thresholds don't give a full picture of actual transfer take-up. For programs like WITB and child benefits, which involve little to no discretion, the estimates are very close to existing program parameters. While accurate self-reporting of income, taxes, and transfer receipt would normally be a source of measurement error, this information was obtained by matching respondents from the 2016 Census to their personal income tax information. As such, the quality of the income data is as good as in other linked administrative data.

[3]Specifically, we first calculate average transfer receipt for each group of programs–child benefits, WITB, social assistance–for $1000 income bins. We then fit a linear polynomial through the binned values and use predicted values as our estimates of transfer receipt. Predicted marginal tax rates are calculated as the difference between the predicted value of taxes net of transfers at each worker's current income and the predicted value for their income plus $1.

4 Data and Descriptive Statistics

As noted above, our analysis relies on the master files of the 2016 Census. Table 1 shows some descriptive statistics for the four tax groups (couples with and without children, lone parents, and singles) and two labour market groups (workers with and without a university degree) used in the analysis. Not surprisingly, singles, who represent about 35 percent of the workforce, tend to be younger than individuals living in couples and/or having children. Another 20 percent of workers are in couples that don't have children. As these two groups are not eligible for the CCB, they represent the core group of individual who would most benefit income-wise from the introduction of a Universal Basic Income.

Table 1 also shows that only a small fraction of workers with children are lone parents. They tend to work fewer hours than individuals in couples with children because they are disproportionately single mothers (not shown in the table) who cannot share child care duties with a partner. Not surprisingly, university graduates work more hours and are less likely to work part time than their less educated counterparts.

Before showing how the introduction of Basic Income would affect the ATR and MTR of the different groups of workers listed in Table 1, we provide more information on expected impacts on low-income individuals by looking at the case of a single parent with two children. Using the parameters of the existing transfer programs in British Columbia in 2016, Figure 1 shows how transfers depend on labour income. A family with no earned income gets a base transfer of about $25,000 a year. Almost all of the base transfer comes from BC Income Assistance and the CCB.

Once labour income exceeds a small deductible, transfers fall sharply as social assistance payments decline in a one-to-one fashion with increased labour income (the "welfare wall"). The small EITC-like Working Income Tax Benefit (WITB, now called the Canada Workers Benefit) only has a modest impact on the welfare wall. Thus, there are large disincentives to work for individuals at the bottom of the wage distribution.

To better illustrate this point, consider the case where the single parent earns $11,248 by working 20 hours per week at the BC minimum wage. Under the current system, the worker would be receiving $12,077 in CCB plus $8,231 in other transfers (mostly social assistance). If the single parent decides to work full time instead ($22,496 for 40 hours per week at the BC minimum wage), she still receives the $12,077 CCB payment but the other transfers decline to $927. Thus, about two thirds of the additional labour income is being implicitly taxed away in the form of lower transfers under the current system. Moving to Basic Income would improve work incentives for these low income individuals. However, for slightly higher income individuals who are beyond the welfare wall, Basic Income would likely worsen work incentives because of standard income effects.

Using data from the Canadian Income Survey, we next show in Figure 2 the average amount of transfers for individuals by decile of the earnings distribution. Three main messages emerge from the figure. First, individuals age 65 and above ("seniors" panel in the figure) have access to a transfer system resembling a Basic Income scheme as old age benefits (OAS and GIS) start at a relatively high level, and only decline slowly as a function of income.

Second, adults under the age of 65 without children ("No children" panel in the figure) get very little transfers that are concentrated at the bottom of the income distribution. Thus, the current transfer system for these individuals is very far from a Basic Income scheme. Adults under the age of 65 with children ("Children" panel in the figure) are in-between the two other groups because of to the CCB that is only clawed back at the top end of the income distribution.

The large differences in current transfers available to different groups mean that introducing Basic Income would likely have very different labour supply impacts on these different groups. We next formally show how replacing the current transfer programs with a revenue-neutral Universal Basic Income would change the MTR and ATR for the different groups presented in Table 1. We also show the results for individuals divided on the basis of their hourly wage (three groups) instead of education. Although our main simulation analysis divides workers in two labour markets based on education, looking at changes in the MTR and ATR by wage level provides additional information on how basic income would affect workers at different points in the earnings distribution.

Although introducing a revenue-neutral Universal Basic Income is a useful benchmark experiment, we must stress that it does not represent a realistic program that could be introduced in practice. The dollar amount of the revenue-neutral Basic Income is only about $2,000 a year, reflecting the fact that most BC adults do not receive much transfers from the different levels of governments. The clear "winners" under a revenue-neutral Basic Income are adults without children. The "losers" are adults with children who see their CCB being replaced by a relatively meager Basic Income. In a future revision of the paper, we plan to show results based on a more generous Basic Income where adults with children would no longer experience a large drop in government transfers after the introduction of a Basic Income.

The results on the changes in the MTR and ATR for the different groups are reported in Table 2. Not surprisingly, introducing a pure Basic Income with no clawback reduces the MTR for all groups. The decrease in the MTR is systematically larger for lower-wage or lower-education adults with children who are more likely to face a steep "welfare wall". And as discussed above, adults with children lose out when the CCB is replaced with a relatively small Basic Income. This explains why these groups generally experience a substantial increase in their ATR. The increase in the ATR is particularly large for workers at the lower end of the wage or education distribution who lose both the CCB and (in many cases) Social Assistance when a Basic Income is introduced. By contrast, high-wage workers who receive lower amounts of transfers under the current system are relatively unaffected, and only experience a small change in their ATR.

5 Simulation Results and Impacts on Inequality

The results of the simulations we ran are presented in Table 3 and Table 4. The only thing that varies across the two simulations are the elasticities chosen. In both simulations, we set the labour supply elasticities to $\sigma_e = 0.75$ and $\sigma_i = 0.25$. These are the same numbers used for the baseline simulation in Rothstein (2010) and are based on estimates from the literature, where a robust finding is that extensive margin elasticities are larger than intensive margin elasticities.

Table 3 depicts the case with $\rho = -\infty$. That is, labour demand is perfectly inelastic and therefore wages do not change in response to the change in transfer programs. Since the labour supply responses of each group do not lead to wage spill-overs, each group's change in hours are the only behavioural response mediating the change in transfers.

As would be expected from Table 2, which showed that average change in the MTR and ATR for childless workers were small, the labour supply responses by these groups are modest. Both groups increase their annual hours worked by less than 1 percent in response to a Basic Income. These patterns hold for both workers with and without a university degree.

While we would expect couples without children to have an unambiguously positive labour supply response, as both their MTR and ATR decrease, for singles the values of $dMTR$ is negative and the value of $dATR$ is positive. Even though we assumed that labour supply is larger on the extensive margin and therefore more responsive to changes in average tax rates (as discussed in Section 3), the decline in marginal tax rates is large enough to dominate. This likely comes from the loss of social assistance, which created a steep phase-out for low income singles.

In contrast to workers without children, the labour supply responses for parents are very large and negative, with the exception of university-educated couples with children, who modestly increase their labour supply. Lone parents are expected to reduce their labour supply by 7 percent for the university educated and 12 percent for those without a university degree. Couples with children without a university degree are expected to reduce their labour supply by over 7 percent. All of these reductions are equivalent to a decrease of several weeks of work full time. Table 2 shows that both groups face substantial reductions in the MTR, which should push them to increase their hours worked to the extent that labour supply is elastic on the intensive margin. However, they also face even larger increases in ATR. Since our model assumes that labour supply is more elastic on the extensive margin, the effect of the loss of Child Benefits dominates.

Since there is no equilibrium response by wages when labour demand is perfectly inelastic, the changes in labour supply translate directly to changes in earnings. Note that workers' earnings losses are compensated by a UBI equivalent to approximately $2000, although this masks substantial heterogeneity; for the worst-off the UBI will not cover the combined estimates of earnings or transfers lost. In future work we hope to include updated tables with distributional effects.

Table 4 shows how the labour supply effects are mediated by the equilibrium wage response. In this simulation, employers respond to the overall reduction in labour supply in both the university and non-university labour market by raising wages by 1.62 percent and 2.13 percent, respectively. Labour supply decreases since the labour supply by workers with children was large, and they represent a large share of both labour markets, as seen in Table 1.

This increase in wages in turn dampens the labour supply decreases among parents seen in Table 3 and further boosts the labour supply increase by childless workers. Lone parents without a university degree only reduce their labour supply by 9 percent when incidence is taken into account rather than 12 percent. The combination of higher wages and less-reduced hours translates to a smaller loss in earnings. The group loses only 7 percent of earnings on average compared to 12 percent in the case with perfectly inelastic demand. Single workers without children increase their labour supply by 2.8 percent when wages respond, compared to 0.3 percent when $\rho = -\infty$, which nets them a total increase of labour earnings of 5 percent.

Since the transfer considered had an overall effect of reducing labour supply, it ended up inducing a transfer from employers to workers in the case with incidence. This increase in wages tempers the reduction in labour supply by lower income families with children who reduce their labour supply in response to the large increase in effective average tax rates created by the replacement of generous child benefits with a smaller universal transfer.

6 Conclusion

While the results presented are based on a simplistic model and a somewhat extreme change in transfers, they demonstrate the important role that changes in equilibrium wages play in mediating the labour supply responses to changes in transfers. In future work, we will consider other transfers (such as NIT) at varying levels of generosity. We will also extend our analysis to look at the distributional effects of income net of transfers for workers within each group. Finally, we hope to probe the robustness of the results to the specification of labour markets, incorporating occupational and geographic factors into the labour demand specification.

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Appendix: Detailed Derivation of the Model

Rothstein’s Model

Summary of the proposed approach

As discussed earlier, an unconditional transfer would allow some individuals to withdraw from the labour force or otherwise reduce their attachment. The elasticity of labour supply, σ, summarizes how workers adjust employment and hours worked conditional on employment in response to changes in wages (after tax and transfers). Labour supply shifts back along the labour demand curve, which is summarized by the elasticity of labour demand, ρ. The new equilibrium wage will be proportional to the change in transfers, adjusted by the ratio $\frac{\sigma}{\sigma-\rho}$. Intuitively, as long as labour demand is not perfectly elastic, a Basic Income will cause workers to reduce their labour supply, thereby increasing the equilibrium wage. This effect is stronger the more responsive labour supply is to the Basic Income.

The model we use is adapted from Rothstein (2010) and incorporates extensive and intensive margin labour supply responses (summarized by elasticities σ_i and σ_e), nonlinear tax schedules that can vary by demographic group (summarized by the average and marginal tax rates that workers in each tax group g face at each income level), and heterogeneous skilled labour markets (indexed by s).

The tax groups g are defined by conditions on demographic characteristics in the tax and transfer system. For example, childless households and households with one child would be classified as belonging to two different groups, as only the latter are eligible for the CCB. The labour market groups s are intended to capture separate labour markets, and we intend to use a combination of demographic variables (such as education), as well as industry and geography to define these.

The key insight of Rothstein's model is that, since the demographic groups g that taxes and transfers are defined by do not overlap perfectly with the boundaries of skilled labour markets s, the effects of changes in transfers spillover to other workers in the same labour market who may not be directly exposed to the change in transfers. The universal nature of Basic Income limits these spillovers relative to policies that are more targeted. Our analysis will allow us to quantify who stands to benefit under a shift from the current tax and transfer system (where the most generous transfers go towards families with children and seniors) to a more universal program. However, these effects are likely to be highly heterogeneous depending on how the s and g groups overlap and on the income distributions within each group.

We now derive the model in more detail, and discuss how we plan to adapt it to the introduction of Basic Income in the BC context.

Detailed derivation: Homogenous Labour

First consider a simple tax incidence model without any differentiation of labour by skill group or geographical area. The supply for labour in this setting is:

$$L^S(w) = \alpha(w(1-\tau))^\sigma$$
$$L^D(w) = \beta w^\rho$$

where:

- w is the pre-tax wage
- $w(1-\tau)$ is the after-tax wage
- $\rho < 0$ is the elasticity of labour demand with respect to w
- $\sigma > 0$ is the elasticity of labour supply with respect to w

Employers only care about wage they pay w, while workers care about their take home wage $w(1-\tau)$. The equilibrium wage, w^*, and labour, L^*, are obtained by solving $L^* = L^S(w^*) = L^D(w^*)$:

$$w^* = (\beta\alpha^{-1}(1-\tau)^{-\sigma})^{\frac{1}{\sigma-\rho}}$$
$$L^* = (\beta^\sigma\alpha^{-\rho}(1-\tau)^{-\sigma\rho})^{\frac{1}{\sigma-\rho}}$$

It is useful to approximate the log wage using $\ln(1-\tau) \approx -\tau$ for small τ:

$$\ln w^* = \frac{1}{\sigma-\rho}\ln(\beta\alpha^{-1}) - \frac{\sigma}{\sigma-\rho}\log(1-\tau) \approx \frac{1}{\sigma-\rho}\ln(\beta\alpha^{-1}) + \frac{\sigma}{\sigma-\rho}\tau$$

Taking derivatives yields:

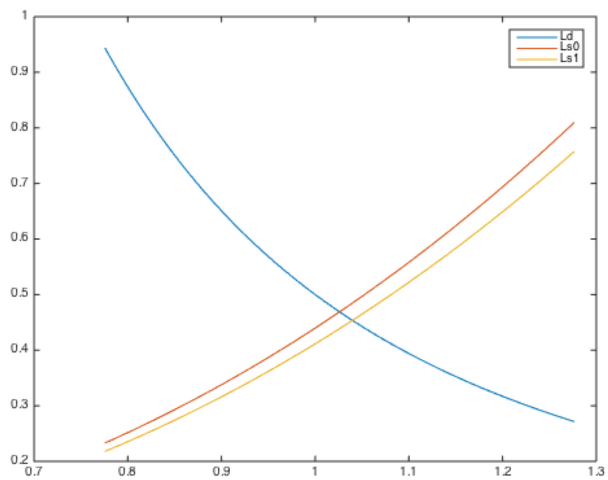
$$d\ln w = \frac{\sigma}{\sigma-\rho}d\tau$$

This equation is the basic building block for analysing the incidence of the tax τ. It implies that:

- Employers do not pay the tax directly, but have to pay $\frac{\sigma}{\sigma-\rho}d\tau$ higher wages.

- Workers pay the full increase of tax, but earn $\frac{\sigma}{\sigma-\rho}d\tau$ higher wages, so on net their incidence is $\frac{-\rho}{\sigma-\rho}d\tau$.

We illustrate this result graphically in the case of a simple parametrization with $\sigma = 2.5$, $\rho = -2.5$ (so that incidence is split 50-50 between worker and employer) and the tax increases from $\tau_0 = 0.05$ to $\tau_1 = 0.075$. Then $w_0^* = 1.026$, $w_1^* = 1.04$, so employers pay 0.014, which is about half of $d\tau = 0.025$, and workers pay $w_0^*(1-\tau_0) - w_1^*(1-\tau_1) = 0.0129$.[4]



Model with Differentiated Labour by Skill Groups

We now consider the full version of Rothstein (2010) where the following extensions to the simple model above are introduced:

- Non-linear tax schedules that are heterogeneous across workers (e.g. between workers with and without children)

[4]The reason the numbers don't add exactly to 0.025 is because of the approximation $\log(1-\tau) \approx -\tau$.

- Imperfectly substitutable labour
- Discrete (extensive) and continuous (intensive) labour supply decisions

As we just saw above:

$$\begin{aligned} L^S(w) &= \alpha(w(1-\tau))^\sigma, \\ L^D(w) &= \beta w^\rho, \end{aligned}$$

and $d\ln w \approx \sigma/(\sigma-\rho)d\tau$.

We first extent the model by introducing differentiated workers with linear taxes. L_{is} is the labour supply of individual i working in skill-level labour market s:

$$L_{is} = \alpha_i(w_s(1-\tau_{is}))^\sigma,$$

and

$$d\ln L_{is} = \sigma(d\ln w_s + d\ln(1-\tau_{is})) \approx \sigma(d\ln w_s - d\ln\tau_{is}).$$

The supply of labour in skill-level labour market s is $L_s = \sum_i L_{is}$. It follows that:

$$d\ln L_s = \frac{dL_s}{Ls} = \frac{1}{L_s}\sum_i dL_{is} d\ln L_{is}.$$

Substituting $d\ln L_{is}$ from above yields:

$$d\ln L_s \approx \sigma\big(d\ln w_s - L_s^{-1}\sum_i L_{is}d\tau_{is}\big).$$

Now define

$$d\tau_s = L_s^{-1}\sum_i L_{is}d\tau_{is},$$

as the individual labour supply-weighted mean tax rate, and write

$$d\ln L_s \approx \sigma(d\ln w_s - d\tau_s).$$

The latter expression can be interpreted as the aggregate labour supply in skill-level labour market s, which depends on the wage and on the weighted mean tax rate. Labour demand is given by

$$L_s = \psi \beta_s^{-\rho} w_s^{\rho},$$

where $\psi = \psi(w_1, ..., w_S)$ reflects aggregate demand for labour, but we shut down this channel for the purpose of the exercise. Also assume that the β_s are time invariant. Taking logs, differentiating and rearranging yields the inverse demand

$$d \ln w_s = \rho^{-1} d \ln \psi + \rho^{-1} d \ln L_s.$$

Now substitute $d \ln L_s \approx \sigma(d \ln w_s - d\tau_s)$ to get

$$\begin{aligned} d \ln w_s &\approx \frac{1}{\sigma + \rho} d \ln \psi + \frac{\sigma}{\sigma - \rho} d\tau_s, \\ d \ln L_s &\approx \frac{\sigma}{\sigma + \rho} d \ln \psi + \frac{\rho\sigma}{\sigma - \rho} d\tau_s. \end{aligned}$$

In this setting, all individuals in the same subgroup g face the same tax rate. This is unrealistic as taxes and transfers tend to depend on other characteristics of workers such as the presence of children.

We now extend the model to the case where taxes can vary by within-market subgroups g. Define $d\tau_{sg} = (\sum_{i \in g} L_{isg})^{-1} \sum_{i \in g} L_{isg} d\tau_{isg}$, the supply-weighted mean tax change for subgroup g in market s. It follows that:

$$d \ln L_{sg} \approx \frac{\sigma}{\sigma + \rho} d \ln \psi + \frac{\sigma^2}{\sigma - \rho} d\tau_s - \sigma d\tau_{sg}.$$

The final extension consists of including nonlinear tax schedules and labour supply response at both the extensive and intensive margin. Total labour supply for skill group s in demographic group g is $L_{sg} = N_{sg} p_{sg} h_{sg}$, where N_{sg} is the number of individuals in the group, p_{sg} is the participation rate of group g in market s, and h_{sg} are the average hours among participants.

Let σ_e denote the extensive margin labour supply elasticity and σ_i the intensive margin labour supply elasticity. Let summarize the nonlinear tax schedules by their marginal tax rates (MTR) and average tax rates (ATR), and define $dMTR_{sg}$ and $dATR_{sg}$ as the labour-supply weighted change in mean MTR and ATR in the subgroup. It follows that:

$$d\ln h_{sg} = \sigma_i(d\ln w_s - dMTR_{sg}),$$

and can also be shown that:

$$d\ln p_{sg} \approx \sigma_e(1+\sigma_i)d\ln w_s - \sigma_e\sigma_i dMTR_{sg} - \sigma_e ATR_{sg}.$$

Finally, the overall change in labour supply in response to a tax change is $d\ln L_{sg} = d\ln p_{sg} + d\ln h_{sg}$, or:

$$d\ln L_{sg} = (\sigma_i + \sigma_e + \sigma_i\sigma_e)d\ln w_s - \sigma_i(1+\sigma_e)dMTR_{sg} - \sigma_e dATR_{sg}, \quad (3)$$

while the effect of tax change on wages is

$$d\ln w_s = \frac{1}{\sigma_i + \sigma_e + \sigma_i\sigma_e - \rho}[d\ln\psi + (\sigma_i + \sigma_i\sigma_e)dMTR_s + \sigma_e dATR_s] \quad (4)$$

These are the two key equations that will be used to simulate the impact of Basic Income by computing how it would affect the MTR and ATR for each worker.

Model Implementation in Rothstein (2010)

Before discussing how we implement the model in the BC context, it is useful to summarize the various steps Rothstein (2010) goes through to simulate the effect of the EITC in the United States. The main data set used in the paper is the 1993 March CPS. Rothstein then simulates EITC for each tax unit (family head and spouse if present) based on the number of resident children under 18 years old (or under 24 years old and enrolled in school), annual earnings, and Adjusted Gross Income (computed using the National Bureau of Economic Research Taxsim sofware). He next calculates the MTR and ATR (on her earnings) that each working woman faces, incorporating only the federal EITC. The ATR on a women's earnings are calculated as the difference between -1 times the EITC due to the family with and without her earnings, as a share of those earnings.

Rothstein restricts the analysis to the labour market for women, and divides labour markets (s) by the intersection of education (less than high school, high school, some college, college graduate), five-year age intervals, and marital status. He calculates annual-hours-weighted averages of MTR and ATR over women within each market, and ignores kink points. The d in $dATR$ and $dMTR$ are the change from making EITC 1$ more generous (as in, 1$ extra for the whole country). He also considers a counterfactual NIT policy which costs the same as the EITC and phases out at the same point.

Figures

Figure 1:

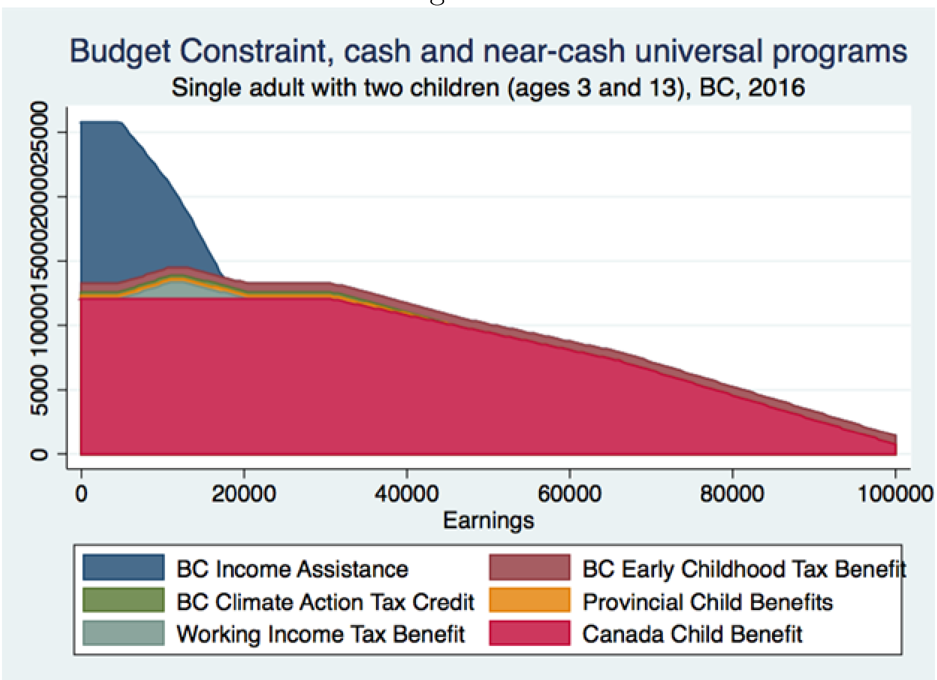


Figure 2:

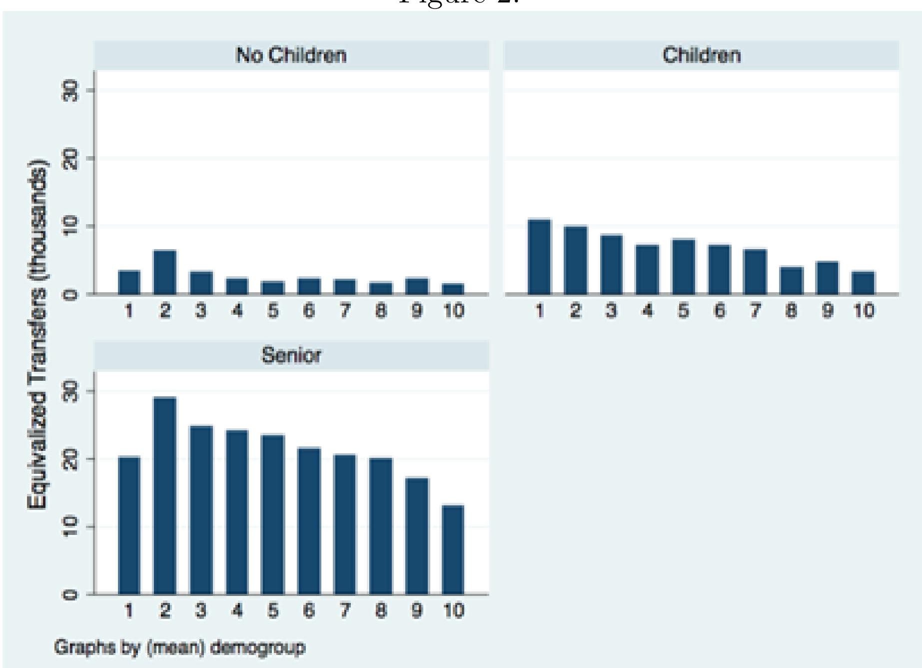

No Children
Children
Senior
Equivalized Transfers (thousands)
0
10
20
30
1 2 3 4 5 6 7 8 9 10
Graphs by (mean) demogroup

Table 1: Summary statistics for the different groups of workers

		Average:			Number of workers (weighted)					
Tax groups	Education	Age	Hours	Children	Total	%	Full time	%	Part time	%
Couple w/o children	Less than univ.	44.2	1430	0.00	306615	14.8	255460	15.7	51155	11.5
Couple w/o children	Univ. graduate	39.1	1555	0.00	139300	6.7	119805	7.3	19500	4.4
Couple with children	Less than univ.	43.3	1390	1.81	511110	24.6	418765	25.7	92345	20.7
Couple with children	Univ. graduate	43.6	1460	1.79	270155	13.0	222305	13.6	47850	10.7
Lone-parent	Less than univ.	44.1	1195	1.55	81045	3.9	62335	3.8	18710	4.2
Lone-parent	Univ. graduate	46.6	1340	1.51	23305	1.1	18675	1.1	4635	1.0
Single	Less than univ.	33.6	1085	0.00	554410	26.7	385390	23.6	169020	38.0
Single	Univ. graduate	33.9	1315	0.00	190860	9.2	148735	9.1	42125	9.5

Notes: Data from the master files of the 2016 Census for British Columbia.

Table 2: Change in marginal and average tax rates when replacing transfers with a revenue neutral Basic Income

	Couples w/o children		Couples with children		Lone parents		Singles	
	dMTR	dATR	dMTR	dATR	dMTR	dATR	dMTR	dATR
Education:								
Less than univ.	-0.012	-0.002	-0.037	0.119	-0.098	0.219	-0.033	0.015
Univ. graduates	-0.008	-0.003	-0.028	0.090	-0.068	0.139	-0.021	0.007
Wage level:								
Low	-0.037	0.011	-0.070	0.284	-0.160	0.442	-0.062	0.039
Medium	-0.004	-0.008	-0.034	0.086	-0.076	0.121	-0.012	-0.005
High	-0.001	-0.006	-0.015	0.035	-0.037	0.042	-0.004	-0.004

Notes: Data from the master files of the 2016 Census for British Columbia.

Table 3: Wage Incidence Simulation with Perfectly Inelastic Labour Demand

Parameters

σ_i = 0.25 σ_e = 0.75 ρ = −∞

Labour Market Groups

	Less than University				University			
% Chg. Hourly Wage	0.00%				0.00%			
Avg. Hourly Wage Before	$38.94				$30.81			
Avg. Hourly Wage After	$38.94				$30.81			
Abs. Change Hourly Wage	$0.00				$0.00			
Tax Groups								
	Single	**Couple no Child**	**Lone Parent**	**Couple w/ Child**	**Single**	**Couple no Child**	**Lone Parent**	**Couple w/ Child**
% Chg. Annual Hours	0.30%	0.71%	-12.12%	-7.29%	0.42%	0.71%	-7.44%	0.59%
Avg. Annual Hours Before	1085	1430	1195	1390	1315	1430	1340	1555
Avg. Annual Hours After	1088	1440	1050	1289	1321	1440	1240	1564
Abs. Change	3	10	-145	-101	6	10	-100	9
% Chg. Annual Earnings	0.30%	0.71%	-12.12%	-7.29%	0.42%	0.71%	-7.44%	0.59%
Avg. Annual Earnings Before	$33,426.56	$44,055.29	$36,815.43	$42,822.97	$51,212.41	$52,186.03	$52,186.03	$60,559.16
Avg. Annual Hours After	$33,527.97	$44,366.23	$32,353.98	$39,699.22	$51,427.95	$56,084.13	$48,304.82	$60,913.77
Abs. Change	$101.41	$310.95	-$4,461.45	-$3,123.75	$215.54	$393.07	-$3,881.21	$354.61

Table 4: Wage Incidence Simulation with Elastic Labour Demand

Parameters

σ_i = 0.25 | σ_e = 0.75 | ρ = −0.3

Labour Market Groups

	Less than University	University
% Chg. Hourly Wage	1.63%	2.13%
Avg. Hourly Wage Before	$38.94	$30.81
Avg. Hourly Wage After	$39.58	$31.47
Abs. Change Hourly Wage	$0.63	$0.66

Tax Groups

	Less than University: Single	Less than University: Couple no Child	Less than University: Lone Parent	Less than University: Couple w/ Child	University: Single	University: Couple no Child	University: Lone Parent	University: Couple w/ Child
% Chg. Annual Hours	2.84%	3.24%	-9.58%	-4.76%	2.35%	2.64%	-5.51%	2.52%
Avg. Annual Hours Before	1085	1430	1195	1390	1315	1430	1340	1555
Avg. Annual Hours After	1116	1476	1080	1324	1346	1468	1266	1594
Abs. Change	31	46	-115	-66	31	38	-74	39
% Chg. Annual Earnings	5.03%	5.44%	-7.65%	-2.73%	4.02%	4.31%	-3.97%	4.18%
Avg. Annual Earnings Before	$33,426.56	$44,055.29	$36,815.43	$42,822.97	$51,212.41	$52,186.03	$52,186.03	$60,559.16
Avg. Annual Hours After	$35,108.65	$46,453.31	$33,997.32	$41,654.81	$53,269.39	$58,089.19	$50,114.58	$63,092.92
Abs. Change	$1,682.09	$2,398.03	-$2,818.11	-$1,168.16	$2,056.98	$2,398.14	-$2,071.44	$2,533.76