Estimating the Labour Supply Responses of Married Women Using a Canadian Tax Reform

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Abstract:

I investigate the impact of the Canadian Federal tax reform of 1988 on the labour supply of lower income married women. The Canadian federal tax reform of 1988 replaced the spousal exemption with a non-refundable tax credit. This reduced the dependence of a low income married woman's effective marginal tax rate on the effective marginal tax rate of her husband. Using difference-in-difference estimators, I compare the labour supply of women married to higher income husbands (the "treatment" group) and the labour supply of women married to lower income husbands (the "control" group). The treatment group experienced significantly larger reductions in their effective marginal tax rate than the control group. I find a significant increase in labour force participation for women married to higher income husbands. I also show that the tax reform significantly increased the total annual working hours of women married to higher income husbands (relative to women married to lower income husbands).

JEL classifications: J22, H24
Keywords: Labour Supply; Canadian Tax Reform; Married Women; Difference-in-Difference.

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1. Introduction

The effect of income taxes on labour supply is a question of substantial interest to both policy makers and academics. Canadian income tax rates changed considerably during the late 80's and early 90's; however, the effects of Canadian personal income tax reforms on labour supply have not been widely studied, particularly in comparison to personal income tax reforms in the US.[1] This paper studies the effect of Canadian tax reform in 1988 on the labour supply of married women and places those effects in the context of studies of the labour supply of married women in the US.

I use the Canadian federal tax reform in 1988 as a natural experiment to examine tax effects on the labour supply of low income married women in Canada. There are two tax-filing systems for married women in Canada. Married women who have an income which is below the taxable level are allowed to file tax returns jointly with their spouses (for the rest of this study, I refer to these women as dependent-married women), while married women who have a taxable level of income file separate tax returns.

McCaffery in his book Taxing Women (1997), examines the effects of taxation on the labour decisions of women in the US, and argues that the US tax system distorts the labour decisions of women in the US. The taxation unit in the US is a household; therefore, if women are treated as secondary earners in the family, the first dollar of earnings by married women is effectively subject to high marginal tax rates determined

[1] The 1980's tax reform in the US has been richly studied. Eissa (1995, 1996) analyzes labour supply of married women. Austin and Carroll (1999) study the effect of income tax on household income. Also Gruber and Saez (2000) estimate the tax price elasticity of taxable income as does Feldstein (1995).

by their husband's income, and the joint filing system of married women with their spouses consequently limits married women's entry into the labour force.[2]

Given this point of view, the Canadian tax reform of 1988 is interesting because it reduced the correlation between the husband's marginal income tax rate and the dependent-married women's effective marginal income tax rate. The spousal exemption (tax deduction) was replaced with a non-refundable tax credit, and the value of this credit is less dependent on the marginal tax rate of the husband.

In this study, I employ a difference-in-difference estimation strategy to study the impact of the 1988 federal tax reform on the labour supply of married women. Among US studies of married women's labour supply, Eissa (1995) uses the difference-in-difference estimation method, treating the Tax Reform Act of 1986 (TRA86) as a natural experiment. She focuses particularly on the labour supply of women married to high income husbands. The TRA86 reduced the number of tax brackets from fourteen to two. The top marginal tax rate was lowered from 50 percent to 28 percent, and the marginal tax rates of lower brackets were changed relatively less. Her study compares the changes in labour supply of women married to higher income husbands to the changes in labour supply of women married to lower income husbands. She finds that TRA86 significantly increased the labour supply of women married to higher income husbands relative to the

[2] Empirical studies of the labour supply of married women (including Eissa) commonly define the wife's labour supply conditional on the husband's income and this is based on the neoclassical model (this model is also known as the chauvinist model). Under this model a married woman maximizes her utility function defined over consumption and leisure, subject to both a budget constraint that total consumption equals total income (earned income and unearned income), and a time constraint of total hours available. Unearned income for a married woman includes her husband's earned income, which is affected by the husband's labour supply behaviour. Consequently, this model, in which a married woman conditions her labour supply on her husband's labour supply decision, makes the wife the secondary earner in the household. However, the traditional 'chauvinistic' model neglects the potentially important aspect of simultaneous optimization by husband and wife. Both the Nash-bargaining model (McElroy and Horney 1981) and the collective model (Chiappori 1992, 1988) of household labour supply behaviour use the simultaneous optimization approach for household labour supply.

labour supply of women married to lower income husbands. In addition, Eissa (1996) uses the Economic Recovery Tax Act (ERTA) of 1981 as a natural experiment to examine the labour supply of married women. The ERTA reduced marginal tax rates by 23 percent within each bracket over a period of three years: by 10 percent in 1982, 10 percent in 1983 and 5 percent in 1984. For two - earner married couples, ERTA introduced a tax deduction equal to 10 percent of the income of the lower earning spouse as long as he or she earned less than $30,000. In this second study, she finds weak evidence that the labour force participation of upper income married women is responsive to taxes, and no significant evidence of an increase in labour supply (annual working hours) of upper income married women.

The difference-in-difference estimation method is distinguished by its ability to estimate labour supply responses without relying on knowledge of the exact functional form of the tax system (explicitly specifying the functional form of the tax system is unnecessary). However, Essia's studies have been criticized by Heckman (1996), Blundell and MaCurdy (1998) and Blundell, Duncan and Meghir (1998).[3] The main criticism is her use of husbands' income as a "grouping variable" to assign women to

[3] Blundell, Duncan and Meghir (1998) develop grouping instrumental variable estimators to estimate labour supply models that account for the endogeneity of gross wages and other income, and study how tax policy reforms in the UK during the 1980's affected the labour supply of married women. The grouping estimators are the extended forms of the differnece-in-differenceestimation method because they allow the consideration of more than two time periods. These two methods are very similar in the context of using differential changes between groups to control for correlation between unobservable characteristics of individuals and treatment effects (tax effects) in estimation. The differencing removes the source of endogeneity for treatment effects. Blundell, Duncan and Meghir (1998) explicitly control for the endogeneity of post tax wages using grouping instruments; therefore, the differential changes of marginal wages between groups reflect both differential growth in real wages between groups and differential impacts of the tax reforms on these groups. On the other hand, Eissa does not explicitly include a wage variable as a control variable in the differnece-in-differenceestimations of labour supply. Instead, she assumes there is no differential growth in real wages between the two groups during the pre and post tax reform periods. The key difference between these two studies is the way they define their groups. Eissa uses a distribution of the husband's income as a grouping variable, which is criticized because it is also subject to tax changes. Meanwhile, Blundell, Duncan and Meghir (1998) use women's level of education and age cohort as grouping variables, which are exogenous (independent) of tax reforms.

treatment and control groups. The concern is that the husband's income is not exogenous and may itself respond to the tax reform. Some women may switch groups (that is, there may be changing group composition) as a result of the tax reform, and this leads to biased estimates of the effects of the reform on labour supply behaviour. In spite of these criticisms I have adopted her identification strategy. Later, I will provide justifications for using the husband's income to determine treatment and control groups in this study.

In this study I employ data from the Canadian Survey of Consumer Finances (SCF) for the years from 1986 to 1991.[4] The SCF is an annual cross sectional data which consists of individual, census family, and economic family files. In addition, for the purposes of this study, I have developed a simulation model[5] of the effective marginal income tax rates of individuals in Canada. Using the information available in the SCF it calculates federal and provincial tax liabilities and effective marginal income tax rates for single or married male and female taxpayers with or without dependent children.

With this empirical strategy I find evidence that women married to higher income husbands increased their labour supply and labour force participation as a result of the Canadian federal tax reform in 1988.

An outline of the remainder of the chapter is as follows: in section 2, I describe in detail the expected impact of the Canadian federal tax reform of 1988 on lower income married women's labour supply in Canada. In section 3, I describe the data that I use and explain the identification strategy. In section 4, I present basic difference-in-difference results and this is followed by regression adjusted difference-in-difference estimates,

[4] The SCF was collected by Statistics Canada from 1970 to 1996 and was a cross sectional data series which used a different random sample of individuals each year. In the mid 1990s, this survey was replaced by the Survey of Labour and Income Dynamics (SLID), a longitudinal series which followed the same individuals for several years.

[5] Please see the appendix for more details.

which control for possible changes over time in the demographic characteristics of the treatment and control groups. I conclude this paper in section 5.

2. The Canadian Tax Reform of 1988 and Married Women's Labour Supply.

The 1988 federal tax reforms in Canada had a particular effect on the effective marginal income tax rates of married women. Prior to the reform, there were 10 tax brackets in the personal income tax schedule, with rates ranging from 6 to 34 percent. This was replaced with a schedule of only 3 brackets, with rates of 17, 26, and 29 percent.[6] The 1988 federal income tax reform also converted personal exemptions and many tax items that were formerly deductible into non-refundable tax credits. For example, personal exemptions for a dependent spouse and children were replaced with a personal non-refundable tax credit. Prior to 1988, a filing spouse was allowed to claim a spousal exemption, which acted to reduce the taxable income of the husband which, in turn, was taxed under the bracket related schedule of rates. Under this spousal exemption husbands could claim a maximum amount of $3700 in 1987. The exemption however was a decreasing function of the spouse's income in excess of a stated amount. After 1988 this spousal exemption was replaced by a non-refundable tax credit. Under the new rules, the maximum amount ($850) of the married or equivalent credit was reduced by an amount equivalent to 17 percent of the dependent spouse's net income in excess of $500. This credit phased out to zero at an income level of $5500, at which point the dependent

[6] However, in the Canadian tax system, effective marginal tax rates are affected by the high-income surtax, the various claw backs of refundable tax credits, and transfer payments, so that effectively, the number of true tax brackets is larger than three.

spouse had to file a separate return. As a result, under the current Canadian tax system, a lower-income spouse faces tax rates initially at the lowest bracket rate (17 percent in 1988). In contrast, under the tax system prior to 1988, the effective marginal tax rate of the lower-income spouse was the same as the effective marginal income tax rate of the (higher income) tax-filing spouse. For women with high income husbands, this could be much higher than 17%.

Hence, if prior to 1988, the husband's marginal income tax rate was relatively high, his wife's effective marginal tax rate was considerably reduced by the tax reform. On the other hand, if the husband's marginal income tax rate was relatively low, the change in his wife's effective marginal income tax rate after tax reform in 1988 was insignificant. I, therefore, identify the impact of the federal tax reform in 1988 on the labour supply decisions of dependent-married women as the difference between the change in labour supply of women who face large reductions in the effective marginal income tax rate (the treatment group) and the change in labour supply of women who face relatively small reductions in the effective marginal income tax rate (the control group).

In figure A.1, I present average simulated effective marginal income tax rates of working married women in the SCF during the reference years 1986 and 1990; the curve is calculated using income data from the SCF, individual effective marginal tax rates from my tax simulation program, and locally linear regression. The hump in the lower income range present in the 1986 graph shows that before the federal tax reform in 1988, women with very low income (dependent-married women) were subject to high effective marginal tax rates. In later years, this hump is absent because the tax reform reduced the

association between dependent women's effective marginal tax rates and those of their higher income husbands.

3. Data and identification strategy.

I use data from the Canadian Survey of Consumer Finances (SCF) for the survey years from 1986 to 1987, and from 1990 to 1991 (the actual reference years are from 1985 to 1986, and from 1989 to 1990). I draw the sample from the census family files and individual files of the SCF. First, I select married women from the census families, whose ages are between 20 and 64 and whose husband is present[7] and is a paid employee in the reference years. I exclude women who are self employed, ill or disabled, attending school, or whose income is the primary income for the family. Also I exclude women residing in Quebec because Quebec imposes its provincial income tax separately. The sample data has 22,473 women. The census family files do not contain information on spouses' working hours. Thus, as the next step, I combine individual files from the SCF with the census family files using key files provided by Statistics Canada

For the study, I first need to determine which women are more likely to be dependent-married women. A dependent-married woman is identified by her income being below the taxable threshold. I observe women's income in the data so that I can identify who might be dependent-married women. However, the composition of this group of women is itself changed by changes in tax policy. Thus, I estimate a simple probit model of dependency (with a dependent-married woman being assigned a value equal to one) on the observable characteristics of women in the data. I that find the level

[7] By present I mean the husband and wife are living in the same household.

of education of married women and the number of pre-school children both exhibit significant positive effects on the probability that a married women is "dependent" from the point of few of tax filing (as described above). Table 1 shows the percentages of women in each education group by dependency status. 37% of dependent-married women have an education level of less than high school. On the other hand, 50% of the independent women have an education level of more than high school. Using these results as a guide, I restrict the sample to married women having a level of education of no more than high school. My final sample includes 12,719 women.

I use total income of husbands to select the treatment and the control groups. (In the sample, married women's non-labour earnings are negligible.) In each year, the treatment group is made up of married women whose husband's income is over the 85th percentile of husbands' incomes (for that year). The 1,905 women in this group are characterized by having husbands whose total income is in excess of $42,292 (1986 dollars). Then, I choose the control group in the following manner. First, these women must be at a point in the distribution of husbands' incomes far enough below the high income group that their marginal income tax rate does not fall by as much as the margina income tax rates of women in the high income group. Second, these women cannot be so far down the husband's income distribution that they are fundamentally different from women in the treatment group in some unobservable way.[8] On the basis of these considerations, I chose a control group of women whose husband's income is between the 21st and the 35th percentile of the husbands' income distribution. 1,930 women belong to this control group, and the average total income of their husband is $ 22,872. The

[8] I already exclude women educated more than high school; therefore, there is less variation in unobservable characteristics compared to the case using the overall sample of women as in Eissa's sample data.

summary statistics for the two groups are presented in Table 2. Women in the control group tend to be younger, less educated, and have more children under age 7. Also they tend to work more than the treatment group (both more weeks and hours).

Conceptually, the following table presents average annual working hours of each group before and after the tax reform.

	Before 1988 tax reform	After 1988 tax reform
Control group	H_{cb}	H_{ca}
Treatment group	H_{tb}	H_{ta}

The changes in working hours by women married to a higher income husband are (H_{tb} - H_{ta}). Part of this change is due to the tax reform, and part is due to extraneous factors such as changes in labour demand. The assumption is that women married to a lower income husband (the control group) reflect these non-tax factors in the change in working hours, given by (H_{cb} - H_{ca}). Finally, the test that 1988 tax reform increased the labour supply of women in the treatment group is a test that (H_{tb} - H_{ta}) - (H_{cb} - H_{ca}) is greater than zero. In other words, I test whether women who faced significant tax rate reductions increased working hours more than women who experienced smaller tax rate reductions.

Regarding the difference-in-difference estimator, there are several concerns related to group identification. The first concern raised is finding an exogenous grouping variable. In spite of Heckman's criticisms of Eissa's approach, which are summarized in the previous section, I use the husband's total income as a grouping variable. There are several justifications for using the husband's income distribution to choose the treatment and control groups here. First, in their study of the impact of the 1988 Canadian tax

reform, Sillamaa and Veall (2001) find that taxable income (including capital income) is substantially less responsive to tax changes in Canada than in the U.S.[9] Sillamaa and Veall (2001) do find evidence of a much higher tax response in self-employment income. Thus, I have excluded from my sample those married women having self-employed husbands, and have only kept women whose major source of total family income is wages and salaries.

I use a wide income band from the husbands' income distribution to choose treatment and control groups to reduce the potential chances of changing composition of groups (switching groups by women) after tax reform.[10] In addition, the use of a wideband of the income distribution for control and treatment groups also gives me enough observations in each group to produce precise estimates.

The second concern regarding the identifying assumptions is that there are no contemporary shocks to the relative labour market outcomes over the period of the tax reforms. This includes both no relative demand and no relative supply shocks. For example, if there is a difference in wage growth between the treatment and control groups, the difference-in-difference estimates will be biased. And there is certainly a possibility of different growth rates in the wages of higher and lower educated women. My sample includes only low-educated women. Therefore, my analysis has less chance of

[9] They use similar methods to those applied by Auten and Carroll (1999) in the study of the effects of the TRA86 in the US. In contrast to the findings of Sillamaa and Veall, Auten and Carroll find both tax rates and non-tax factors appear to have had significant effects on relative income growth in the US during the late 1980s.

[10] Also I test using the husband's education as a grouping variable since individuals with a high level of education (more than high school) likely earn higher income, and accordingly have a high marginal tax rate in the pre tax reform period. Therefore, I identify dependent-married women who have a high marginal tax rate in the pre tax reform period as those having a husband with a higher level of education. However, the difference in changes in average marginal tax rates between women married to a higher educated husband and women married to a lower educated husband are not statistically significant. One possible reason is the smaller number (categories) of level of husband's education.

being biased in this way than Eissa's studies (1995, 1996), as she uses a sample which includes women of all different levels of education

The third concern regarding the difference-in-difference estimator is that the treatment and the control groups may differ in time trends of either observable or unobservable characteristics or both.[11] Any bias due to differential changes in observable characteristics between the treatment and control groups is reduced in a regression adjusted difference-in-difference approach by controlling for relevant factors (Meyer 1995).

Also, in general, the addition of more explanatory variables via a regression adjustment will be an efficiency improvement over estimates obtained by a simple difference-in-difference approach. Using a regression model framework will tend to improve the efficiency of the estimates obtained by this method by reducing residual variance (Meyer 1995).

In the regression framework, I estimate labour force participation and annual total working hours. First, I estimate a probit model analyzing the binary choice of whether or not to participate in the labour force. Next, I estimate the working hours equation on the sample of women, restricted to include only those who are working. To control for sample selection bias in the estimation of the labour supply equation, I include an inversed Mills' ratio calculated from the participation probit. [12]The participation and the labour supply equations are specified as:

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[11] Blundell and MaCurdy (1998) also argue that given the increasing dispersion of incomes and wages among all groups during the study period of Eissa (1995), the common time effects (common trends) assumption among the unobservable components across the treatment and control groups may not be satisfied.

[12] As I have only one tax reform, I effectively have a single instrument, and the selection correction is identified by nonlinearities.

$$P(LFP_{it}=1)=\Phi(\beta_0+\beta_1 X_{it}+\beta_2 hdtinc\_h_i+\beta_3 time_t+\beta_4(hdtinc\_h*time)_{it})$$

$$LS_{it}=\alpha_0+\alpha_1 X_{it}+\alpha_2 hdtinc\_h_i+\alpha_3 time_t+\alpha_4(hdtinc\_h*time)_{it}$$

where labour force participation *(LFP)* is a latent variable that equals one if an individual is a participant,[13] X_{it} *is a set of* demographic variables including age, age squared, the number of preschool children dummies, level of education dummies, and provincial dummies. '$hdtinc\_h$' is a dummy equal to one for women in the treatment group. Any differences in labour supply preferences across the treatment and the control group are reflected in the coefficients β_2 and α_2, in the labour force participation probit and labour supply equation respectively. Both β_2 and α_2 are expected to be negative, because higher income women have more leisure than their lower income counterparts. The variable '*time*', is equal to one for the post tax reform period. Its coefficients β_3 and α_3 are both expected to be positive because participation and labour supply are generally increasing over time. To test the impact of the federal tax reform of 1988, one only needs to test whether dependent-married women with a higher income spouse increased their labour supply (relative to women married to a low income spouse) after the federal tax reform. If β_4 and α_4 are both positive, then the tax reform had a positive impact on labour force participation and labour supply respectively. This would show that the tax reform's lessening of the joint relationship between the effective marginal income tax rate of

[13] This does not include unemployed married women. I redefined the LFP such that the number of working weeks in the reference year is at least one week.

dependent-married women and of their husbands is a significant factor in a wife's labour supply decision.

4. Results

I consider the impact of the Canadian federal income tax reform in 1988 on the effective marginal income tax rates and labour supply of each group of dependent-married women. Before discussing the results from the regressions, I present the basic difference-in-difference results. Table 3 presents the average effective federal marginal income tax rate[14] for each group. For women in the treatment group, there is an average reduction of 1.2 percentage points in the effective marginal income tax rate, and for women in the control group, there is an average decline of 0.4 percentage points.

Table 4 reports the basic difference-in-difference estimates of the effect of the tax reform on both the labour force participation and the labour supply of married women. Table 4.a compares the changes in the labour force participation of married women at higher income percentiles and married women at lower income percentiles before and after the tax reform. There is a significant increase (7.3%) in the labour force participation rate for women in the higher income distribution range. In addition, table 4.b and table 4.c show the difference-in-difference results for weeks worked in the reference year and for annual total hours worked for employed married women.[15] The relative increases are 1.5

[14] Table 3.b. presents the effective federal marginal income tax rate of dependent married women, who are identified by their income being below the taxable threshold. The differnece-in-difference of the effective marginal tax rate (0.0627) is larger than the one (0.0085) in table 3.

[15] The participation results suggest that more women are entering the labour force during this period. Because these women may be different than women in the labour force prior to tax reform, the population of working women in pre and post the tax reform may not be directly comparable.

weeks[16] and 42.75 hours over the pre and post tax reform period, and the numbers in square brackets [ ] show percentage changes between the various treatments. The magnitude of labour force participation and labour supply with respect to the tax price (the after tax wage) is very large. The percent changes in table 3 and 4 rely on the assumption that the relative market wage for the two groups remains constant over this period.

Turning to the regression results, I first present estimates of the labour force participation equation in table 5. As expected, the number of preschool children reduces the probability of labour force participation, and more educated women are more likely to participate in the labour force. The treatment (married to high-income husbands) dummy is significantly negative. The time dummy is positive but not significant.[17] The coefficient on the interaction of time and high income is significantly positive at the less than 5% significance level. Hence, I find evidence that there is an increase in the labour force participation of married women after replacing the spousal exemption (tax deduction) with a non-refundable tax credit.

Table 6 shows the results for annual total hours of work. Having more pre-school children significantly reduces the annual total hours worked by married women. By level of education, the effect of women's education on total hours of work is insignificant for women having less than a high school level of education. On the other hand, there is a significant positive increase in total hours of work for married women with a high school level of education. Adding these controls increases both the size and significance of the

[16] It is marginally significant only at the 20 percent confidence level for a two-tail test.
[17] There is sustained growth in the labour force participation of Canadian women during the 1970s and 1980s. For women aged 25-64 the labour force participation rate increased from less than 50 percent in the mid 1970s to 70 percent in the late 1980s. Then women's labour force participation rate remains around 75% throughout the 1990s (see Beaudry and Lemieux (1999) and Chaykowski and Powell (1999)).

interaction coefficient (*hdtinc _ h * time*). The coefficient of the interaction between time and high-income husbands is highly significant, and the women in the treatment group increased their annual working hours by 192.8 hours relative to the women in the control group.[18] Lastly, the coefficient on the inverse Mills' ratio calculated from the labour force participation probit is statistically significant; therefore, the sample selection correction is important in annual hours estimates.

5. Conclusions

I investigate the labour supply responses of married women using Canadian tax reform in 1988. I use difference-in-difference estimator to examine the impacts of the federal tax reform in 1988 on the labour supply of dependent-married women who have less than the taxable level of income. The federal tax reform in 1988 is interesting as a 'natural experiment' because it reduced the correlation between the husband's marginal income tax rate and the lower income wife's effective marginal tax rate by replacing the spousal exemption with a non-refundable tax credit. I compare the labour supply of women married to higher income husbands and the labour supply of women married to lower income husbands, since the (treatment) group of women married to higher income husbands experiences larger reduction in the effective marginal tax rate relative to the (control) group of women married to lower income husbands due to the tax reform in 1988. I find a significant increase in labour force participation for women married to

[18] I also estimate the equation of annual weeks worked. The coefficient of time is positive, the treatment dummy is negative and the interaction between time and treatment is positive, but none of these is significant. In terms of the fixed cost, Increasing number of hours given same number of working weeks may cost less than increasing number of working weeks given same number of working hours per week.

higher income husbands. Also, the results of difference-in-difference regression show that total annual working hours of women married to higher income husbands are significantly increased relative to women married to lower income husbands.

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Table 1. The percentages of women in each education group by dependency (joint tax filing) status.

	Independent married women	Dependent married women
Less than graduated from high school	19.26%	36.69%
Graduated from high school	30.59%	31.63%
More than high school	50.16%	31.68%
Total number of women	14263 (100%)	8210 (100%)

Note: It includes both working and nonworking married women.

Table 2. Summary statistics of the groups.

	Control group	Treatment group
Age	34.59	37.91
	0.22	*0.22*
Education	3.05	3.43
	0.02	*0.02*
Husband's education	3.51	4.49
	0.04	*0.04*
Pre-school children	0.72	0.58
	0.02	*0.02*
Husband's total income	22872.34	53601.74
	32.45	*321.52*
Total income	8334.14	10093.05
	158.97	*264.58*
Total wage	7087.25	9160.80
	154.75	*251.79*
Weeks worked	30.61	28.61
	0.51	*0.54*
Weekly usual hours worked	19.37	18.38
	0.41	*0.41*
Labour force participation	0.74	0.66
	0.01	*0.01*
Obs	1930	1905

Notes: all incomes are in 1986 dollars. Standard errors are in italics.

Table 3. Average effective federal marginal income tax rates for the sample.

Group	Pre tax reform	Post tax reform	Change	Differential change
Control	.1635 (.0018)	.1603 (.0017)	.0039* (.0025)	
Treatment	.1932 (.0028)	.1815 (.0023)	.0117*** (.0037)	-.0085** (.0044)

Note:

1. Marginal tax rates are calculated conditional on working women.
2. Numbers in parentheses are standard errors.
3. * is not statistically significant (for a two tail test).
4. ** is significant at less than 5% significance level (for a two tail test).
5. *** is significant at less than 1% significance level (for a two tail test).

Table 3.a. The percent change in the after tax wage.

Group	Change	Relative change
Control	0.38 %	
Treatment	1.45 %	1.07 %

Table 3.b. Average effective federal marginal income tax rates for the dependent married women.

Group	Pre tax reform	Post tax reform	Change	Differential change
Control	.1516 (.0064)	.1471 (.0053)	.0045* (.0087)	
Treatment	.2238 (.0110)	.1565 (.0461)	.0672*** (.0132)	-.0627*** (.0154)

Note:

1. marginal tax rates are calculated conditional on working women.
2. Numbers in parentheses are standard errors.
3. * is not statistically significant (for a two tail test).
4. ** is significant at less than 5% significance level (for a two tail test).
5. *** is significant at less than 1% significance level (for a two tail test).

Table 4. Difference-in-difference estimates

Table 4.a. Labour force participation

Group	Pre tax reform	Post tax reform	Change	Differential change
Control	.7381 (.0133)	.7482 (.1500)	-.0101* (.0201) [1.37 %]	
Treatment	.6269 (.01472)	.7103 (.0158)	-.0835*** (.0218) [13.30 %]	.0733** (.0296) [11.93 %]

Table 4.b. Working weeks in the reference years

Group	Pre tax reform	Post tax reform	Change	Differential change
Control	40.4901 (.5647)	42.1834 (.6188)	-1.6933** (.8413) [4.18 %]	
Treatment	41.6750 (.6111)	44.8652 (.5657)	-3.1902*** (.8417) [7.65 %]	1.4968* (.8459) [3.47 %]

Note:

1. Working weeks are calculated conditional on working women.
2. Numbers in parentheses are standard errors.
3. [ ] is percentage change (percent increase).
4. * is not statistically significant (for a two tail test).
5. ** is significant at less than 5% significance level (for a two tail test).
6. *** is significant at less than 1% significance level (for a two tail test).

Table 4.c. Annual total working hours conditional on working women.

Group	Pre tax reform	Post tax reform	Change	Differential change
Control	1503.919 (27.3957)	1547.333 (29.7154)	-43.415* (40.6325) [2.89 %]	
Treatment	1443.350 (29.0993)	1529.516 (29.7689)	-86.165** (41.6793) [5.97 %]	42.750* (58.1987) [3.08 %]

Table 4.d. Annual total working hours

Group	Pre tax reform	Post tax reform	Change	Differential change
Control	863.514 (27.4615)	902.919 (31.5528)	-39.405* (41.7938) [4.56 %]	
Treatment	759.095 (26.7471)	956.642 (31.8042)	-197.547*** (41.3425) [26.02 %]	158.142*** (58.7941) [21.46 %]

Note:

1. In table 2.4.c, Annual total working hours are calculated conditional on working women.
2. In table 2.4.d, Annual total working hours are calculated conditional on all women.
3. Numbers in parentheses are standard errors.
4. [ ] is percentage change (percent increase).
5. * is not statistically significant (for a two tail test).
6. ** is significant at less than 5% significance level (for a two tail test).
7. *** is significant at less than 1% significance level (for a two tail test)

Table 5. Labour force participation probit.

Variables	Coef.	Std. Err.
Age	0.0175	0.0184
Age^2	-0.0004***	0.0002
one pre-school child	-0.3350*	0.0588
two pre-school children	-0.6831*	0.0684
Education		
grade 9-10	0.4509*	0.0880
grade 11-13 not graduate	0.6610*	0.0954
grade 11-13 graduate	0.6808*	0.0828
Province		
NFLD	-0.4820*	0.0929
PEI	-0.0651	0.1428
NS	-0.3848*	0.0946
NB	-0.3139*	0.0870
MAN	-0.1380	0.0899
SASK	-0.1544***	0.0855
ALTA	-0.1653**	0.0676
BC	-0.2540*	0.0744
Time	0.0105	0.0647
Higher income	-0.4437*	0.0624
Higher income * Time	0.2151**	0.0891
Constant	0.4589	0.3674
Obs	3835	

Note:

1. * is significant at less than 1% significance level.
2. ** is significant at less than 5% significance level.
3. *** is significant at less than 10% significance level.

Table 6. 2SLS of Annual total working hours.

Variables	Coef.	Std. Err.
Age	4.9036	14.8773
Age^2	-0.2162	0.2276
one pre-school child	-401.9745*	112.5450
two pre-school children	-704.0824*	239.3432
Education		
grade 9-10	305.3159	199.6253
grade 11-13 not graduate	384.6639	266.2753
grade 11-13 graduate	528.6390***	270.2486
Province		
NFLD	-444.9371**	185.4826
PEI	-93.1342	83.8841
NS	-298.3100**	149.1454
NB	-376.0407*	120.3510
MAN	-195.7731*	72.1197
SASK	-152.5111**	74.4554
ALTA	-178.8472**	69.8978
BC	-300.3208*	97.6202
Time	41.3197	40.2629
Higher income	-381.7452**	158.9480
Higher income * Time	192.8356**	96.3451
Inverse_Mills	1351.9820***	722.5898
Constant	1031.5780***	531.1278
Obs	2200	

Note:

1. * is significant at less than 1% significance level.
2. ** is significant at less than 5% significance level.
3. *** is significant at less than 10% significance level.

Appendix

Taxpayers' effective marginal income tax rates differ from their statutory marginal income tax rates. Macnaughton, Matthews and Pittman (1998)[19] report that in Canada, there are nineteen separate sources of differences between effective and statutory marginal tax rates, and 56 percent of the population experiences at least some difference between effective and statutory marginal tax rates. More than one-fifth of the population has at least a ten percentage point difference between the effective and statutory tax rates. Also, they mention that high effective tax rates are concentrated in the lowest federal statutory rate bracket (17 percent). In fact more taxpayers with effective rates above 45 percent come from this bracket than from the supposedly top bracket of 31.32 percent.

For the purpose of my study, I have developed a simulation model ('Smltax') calculating the effective marginal income tax rates in Canada using STATA. This simulation model is distinguished from a similar application by Statscan (SPSD/M) because of its ability to calculate the effective marginal tax rates of married women, including and especially, dependent tax filing spouses. This program is easy to use for calculating effective marginal tax rates using several variables provided in most Canadian survey micro data sets with labour supply information. I developed this program based on the Survey of Consumer Finances (SCF) data files but it is also compatible for use with other micro data sets such as the Family Expenditure Survey (FAMEX),[20] and the Survey of Labour and Income Dynamics (SLID).[21]

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[19] Macnaughton, Matthews and Pittman (1998) use the Social Policy Simulation Database and Model (SPSD/M), which is a database of personal income tax returns and other financial data on individuals which contains a software facility enabling the user to simulate the revenue and income distribution effects of changes to tax laws and provincial and federal social programs such as employment insurance. However, to protect confidentiality, the individuals represented on the SPSD/M are synthetic in the sense that they are composites of several similar individuals. Since it has not been originally designed for calculating marginal tax rates, there are certain difficulties associated with calculating the effective marginal tax rates. In addition, this simulation model is not comparable with other micro survey data.

[20] FAMEX contains reported data by survey respondents like the SCF; therefore, all information (variables) are from corresponding questions on the survey. There are several tax related variables in FAMEX: income before tax, income after tax, personal taxes (this is income tax in each year) and provincial tax credits.

[21] In the SLID there are two sources of income data, which depend on each respondent's preferences. Respondents can either report income sources during the interview or grant their permission for Statistics Canada to access their tax file data from Revenue Canada for purposes of the survey. In effect, well over half of SLID's income data come directly from Revenue Canada (Statistics Canada Working paper No. 94-11 "The Use of Tax File Data in the Survey of Labour and Income Dynamics: Summary Report"). In SLID,

Smltax calculates federal and provincial tax liabilities and effective marginal income tax rates for single male and female taxpayers with or without children, as well as for married male and female taxpayers with or without children. These computations reflect the provisions of the federal and provincial income tax legislation as follows:

1) The Federal and Provincial Tax payable are computed using the rate schedules published in "The National Finances" and "Preparing your income tax returns".
2) Total income is assumed to be from either Canadian employment or Canadian taxable government transfers. Deductions are taken for CPP or QPP and UI premiums (credits are used where applicable).
3) For the Federal Child Tax Credit, family total income is defined as respondents' total income plus their spouses' total income. And I assume that children under 16 (or 18 - whichever information is available in the data: SCF) have no income; therefore, the full tax savings is assigned to these children.
4) Because a refundable sales tax credit was introduced in 1986 and the GST credit was introduced in 1991, these values were reflected in the tax simulation model.
5) Provincial rates are levied as a percentage of federal rates with special flat taxes, surtaxes and low income deductions/reductions. In addition, certain tax credits issued by the provinces such as Cost Of Living Credits, and Provincial Sales Tax Credits are reflected in the program's calculations.

There are certain limitations of the model since it cannot cover all the phase out of the tax under each family specific circumstance. In particular, it is not suitable for calculating marginal tax rates of self-employers and those whose main income source is capital income. Therefore, my tax simulation is more suitable for calculating effective marginal tax rates of taxpayers whose main income source is employment income (wage and salaries).

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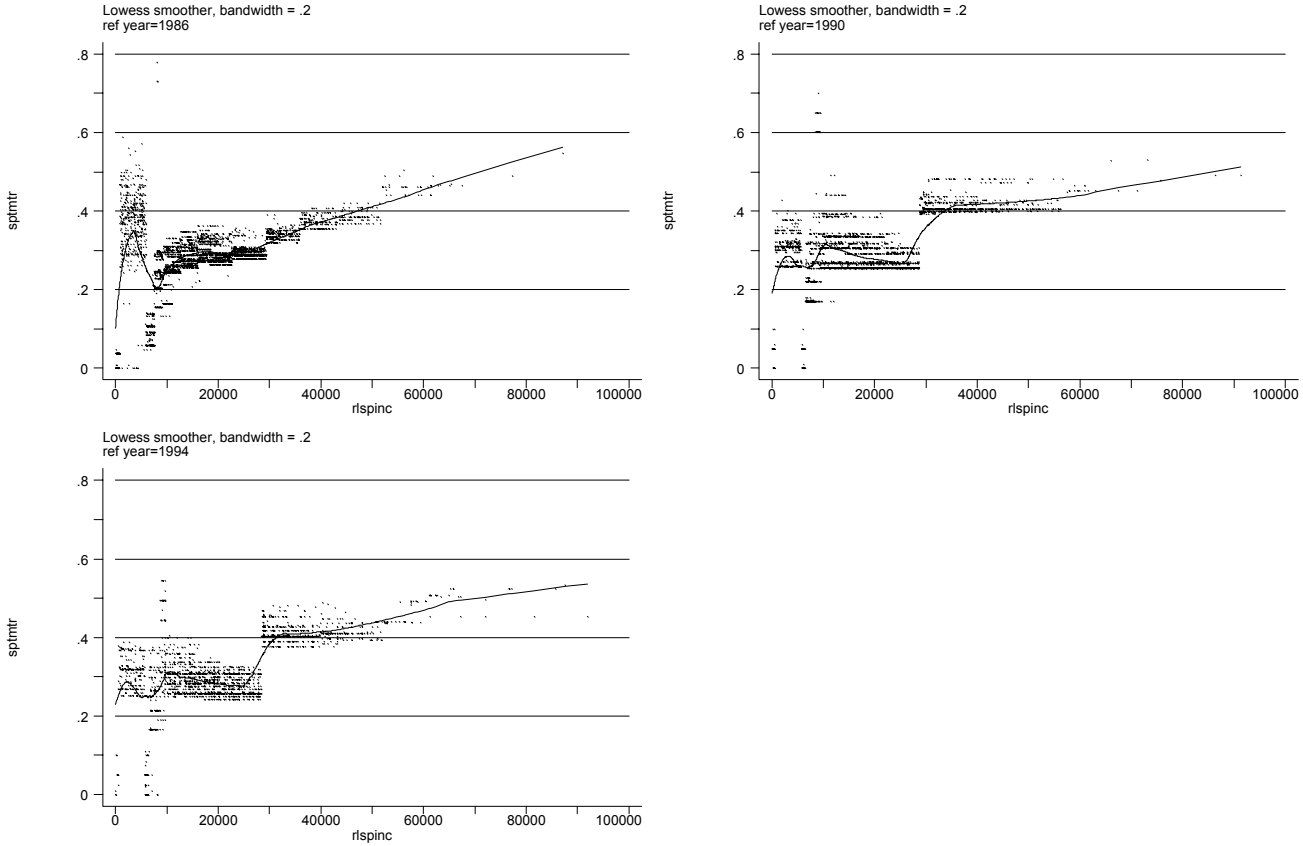
there are various variables related to income and tax information such as income tax (federal +provincial), federal income tax, provincial income tax, CPP/QPP, Child Tax Benefit, GST, etc. Also, when non-response occurs, certain types of data are imputed. Federal and provincial taxes payable are imputed using linear regression analysis, and the Child Tax Benefit and GST are imputed based on respondents' characteristics.

Figure A.1. The effective marginal income tax rates of working married women in Canada. [22]



[22] Income is in 1992 dollars.