"Tax and Female Labour Supply":
The Bush Tax Cuts as a Natural Experiment

Student ID: 1111614*

Research in Applied Economics
Department of Economics - University of Warwick

April 2014

Abstract

This paper discusses the implications of the Economic Growth and Tax Relief Reconciliation Act of 2001 (EGTRRA), the first instalment of the Bush tax cuts, on female labour supply. Motivated by the failure of existing literature to account for the labour adjustment behaviour of unmarried females in response to taxation, this paper attempts to identify how the intensive margin of female labour supply reacted to the EGTRRA, accounting for both married and unmarried individuals. Using a difference-in-difference estimation, the empirical results suggest that females significantly react to marginal tax changes and do so in a manner consistent with studies on the married female labour supply. This paper supports the general consensus that the substitution effect dominates the income effect for female labour supply, thus females increased their hours worked in response to tax cut provisions in the EGTRRA.

Research Supervisor: Dr. Eugenio Proto

---

* I would like to thank Dr. Eugenio Proto for his invaluable guidance and feedback, and am grateful for the assistance of Dr. Jeremy Smith in all data-related issues.

Table of Contents

1. Introduction

The impact of taxation on labour market supply is a considered, continually growing field of empirical economic study due to its implications for public policy. Eissa (1995, 2004) and Hausman (1984, 1985), among others, have covered the field extensively, with economic literature inclining towards larger tax reforms such as the Tax Reform Act of 1986 in the United States as opposed to the modest tax reforms which occur on an annual basis. Despite being the most substantial tax reform in the United States over the last fifteen years, the Bush tax cuts have not been acknowledged in labour economics literature to the same extent.

The Bush tax cuts, so called because they were introduced under the Bush administration, comprised of two separate US tax laws: the Economic Growth and Tax Relief Reconciliation Act of 2001 (EGTRRA) and the Jobs and Growth Tax Relief Reconciliation Act of 2003 (JGTRRA). The EGTRRA focussed on personal taxes, reducing marginal income tax rates for all tax-payers and introducing a new 10% tax bracket for incomes below $34,550. It also reformed provisions on the child tax credit, marriage penalty and education incentives (US House and Senate, 2001)[1]. As a result, the EGTRRA is likely to have most benefitted families with children or incomes at either end of the income distribution. Comparatively, the JGTRRA affects investment taxes by reducing the tax rate on long-term capital gains and qualified dividends; additionally, the JGTRRA accelerated many provisions in the EGTRRA (US House and Senate, 2003). The Bush tax cut legislation was a "sunset" provision which ended in 2010, repealing any provisions which had not yet phased out.

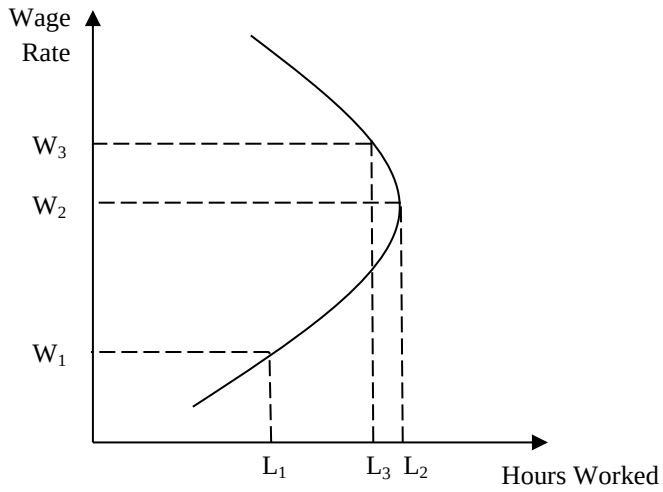
The existing body of literature reports on several variables which have a predictive power on labour supply, namely gender, marital status and income. When observing female labour supply, this literature predominantly documents the effect on married women, the justification being that married females adjust their labour supply as a result of their husbands' wages (Mincer, 1962) or are directly affected by policies such as the marriage penalty. However, given the increasing number of female 'breadwinners'[2] and that individuals may consider future expectations (for example, of marriage) when making labour supply choices, omitting the unmarried female population from studies of labour supply is to ignore a pertinent subset of the population. This paper looks to supplement the existing labour supply literature, by examining the labour supply of the female population as a whole, and its responsiveness to the Bush tax cuts.

The neoclassical theory of labour supply, based on the microeconomic model of consumer choice, lends itself well to this analysis. The theory states that consumers face a basic trade-off between consumption and leisure, with labour supply being determined by a combination of income and substitution effects. As a result, the relationship between wage and individual labour supply is non-monotonic and is often modelled through a 'backward-bending' supply curve (see Figure 1). This implies that at low wage rates, the

[1] See Summary A1 for details on the EGTRRA.
[2] According to Wang, Parker and Taylor (2013), currently '40% of all households with children under the age of 18 include mothers who are either the sole or primary source of income for the family', compared to 11% in 1960.

substitution effect dominates whilst the income effect dominates at high wages. The effect of a reduction in marginal income tax rates, as evident in the Bush tax cuts, is to effectively raise the wage rate. Thus, the existing literature on labour supply looks to determine which effect prevails after tax reform.

Figure 1: **Backward-Bending Supply Curve**



The principle objective of this paper is to determine the response of the female labour supply to the EGTRRA, or more generally, marginal tax reductions. Labour supply is affected by decisions at both the intensive and extensive margin; this study will look to determine the response of usual hours worked per week by individuals in the labour market, in other words, the intensive margin. The analysis will adopt a difference-in-difference approach, as first popularised by Card and Kruger (1994), to exploit the exogenous time variation in the adoption of the EGTRRA across US states. This approach enables labour supply to be estimated without 'explicitly parameterizing the tax system, and therefore without relying on functional form assumptions for identification' (Eissa 1995, p.2). The following hypotheses outline the direction of this study; Hypothesis I postulates the main purpose of this paper, whilst Hypothesis II and III will enable a comparison with the current literature.

Hypothesis I: *Females will increase their usual hours worked in response to the EGTRRA, due to the dominance of the substitution effect.*

Hypothesis II: *Married female labour supply will be more responsive to a change in tax than that of unmarried females.*

Hypothesis III: *The EGTRRA will have a small impact on the intensive margin of female labour supply.*

2. Literature Review

This paper contributes to the existing literature through examining the responsiveness of the female labour supply, as a whole, to tax reductions such as the EGTRRA. Thus, this literature review will be structured as follows: firstly, an overview of the elasticity of married female labour supply to changes in taxation, with a direct comparison to male responsiveness. This will be followed by a review of the different methodologies utilised to analyse labour supply, a comparison of the intensive to the extensive margin and an outline of the current literature on the Bush tax cuts.

There is a general consensus in international literature that the labour supply of married females is more responsive to a change in tax than that of married males, see Feenberg and Rosen (1983), Klevmarken (2000) and Causa (2008). Eissa (1995) finds an elasticity of hours worked with respect to after-tax wage of between 0.6 and 0.8 in high-income, married women in the US. This is consistent with more contemporary studies, with Causa (2008) finding a tax-rate elasticity of married women between -0.7 and -0.8 across samples from OECD countries. Comparatively, reviews by Pencavel (1987) and Moffit and Wilhelm (1998) conclude that males' elasticity of hours worked with respect to wages, and thus labour taxation, is relatively small. The highly responsive nature of married female hours worked may be attributed, in part, to the interaction between the husband and wife's working hour choices: Mincer (1962) states that women make a 'three-way choice between leisure, paid work, and unpaid housework or family chores'. Hausman and Rudd (1984, p.10) use a model of family labour supply to find that a '1% change in the mean husbands' wage leads to a predicted decrease of 30.9 hours for the average wife' in the US, whilst Yamada (2008) confirms income adjustment behaviour by married women after Japanese tax reforms on the spousal allowance system. Conversely, Klevmarken (2000) found no evidence that Swedish women moderated their hours worked as a result of their husbands' change in earnings, suggesting that the interdependence of family labour supply choices cannot fully explain the varied response by married females to tax reforms.

The magnitude of the effect of taxes is debated in existing literature with some studies suggesting a negligible influence of taxes on hours worked; see Barlow, Brazer and Morag (1966) and Holland (1969). It is understood that the results from various labour supply studies differ due to the methodology, datasets and models used[3]. Klevmarkin (2000) briefly discusses the shortfalls of non-experimental data, and cites future expectations as a weakness of using conventional utility maximisation models. Davis (2008) weighs in on model specifications, suggesting macro studies obtain higher elasticities of hours worked in response to tax changes due to the incorporation of government spending-side responses which would typically be excluded from studies of individual labour supply. Hausman (1985) highlights the difficulty of examining high income groups due to the lack of data for this particular subset of the population; hence, Eissa (1995) used CPS data for its considerable sample size. Additionally, Eissa (1995) outlines the main criticisms of current labour supply literature to be that: tax rates are endogenous to hours worked, tax coefficients reflect

[3] Refer to Table A8 for an outline of the datasets and methodology used in the main literature.

underlying tastes for work and wage is endogenous to labour supply preferences. Therefore a difference-in-difference approach is advocated to exploit exogenous time variation in tax rates, as demonstrated by both Eissa (1995) and Blundell, Duncan and Meghir (1998).

The current literature utilises both the intensive and extensive margin to evaluate labour supply. Blundell, Bozio and Laroque (2011) show that both margins have foundations in explaining changes to total hours worked in the UK, US and France. Triest (1990) estimates labour supply elasticities for married women using the Panel Survey of Income Dynamics, and concludes that labour force participation is more responsive to changes in the net-wage than hours conditional on working. Conversely, Burtless (1991) finds evidence that the impact of tax reforms is on the intensive margin of labour supply rather than the extensive margin. Analysis of the margins of labour supply can result in different conclusions for public policy, with negative income tax and substantial guaranteed income support being favoured where behavioural responses to taxation are concentrated along the intensive margin compared to a smaller guaranteed income where responses concentrated along the extensive margin (Saez, 2000).

The effect of the Bush tax cuts is less prominent in the existing literature than that of the 1986 reforms in the United States. Consistent with previous studies, Heim (2009) uses a family labour supply model to predict that wives' annual hours will increase by 1.59 percent, and that of married men by 0.1 percent after the tax cuts. Gale and Potter (2002) predict similar responses, with female wage elasticities forecast to be substantially smaller than figures found in preceding literature. Davis (2008) proposes that this will lead to a small overall effect on hours worked due to the moderate size of the Bush tax cuts. In an analysis of the data post-tax cuts, Labonte (2010) finds that private sector employees worked, on average, 0.6 hours less per week after the tax reform implying that the income effect dominated the substitution effect in this instance. This suggests that existing economic theory and the labour market data are not aligned; as the literature regarding this tax reform is largely prognostic, this area would benefit from further analysis of labour market data.

3. Data and Related Issues

3.1. Outline of Data

The analysis in this paper uses data from the Merged Outgoing Rotation Group (MORG) extracts of the Current Population Survey (CPS), between 1997 and 2007. The CPS is a longitudinal, rotating panel dataset sponsored jointly by the United States Census Bureau and United States Bureau of Labor Statistics; approximately 56,000 households across the US are sampled each month on a 4-8-4 rotating scheme, with roughly 75% overlap between samples month-to-month. The CPS covers key demographic, economic and social indicators whilst the MORG extracts have additional data on hours worked and earnings (NBER, 2014a; NBER, 2014b).

When merging the CPS datasets, a unique identifier was created using the household identifier, household number and line number to match individuals across samples due to a lack of consistent individual identifiers in the dataset. Due to recording errors this identifier alone is not inter-temporally consistent; thus, additional merge criteria for sex, race and age were included to minimise the number of potentially invalid merges[4].

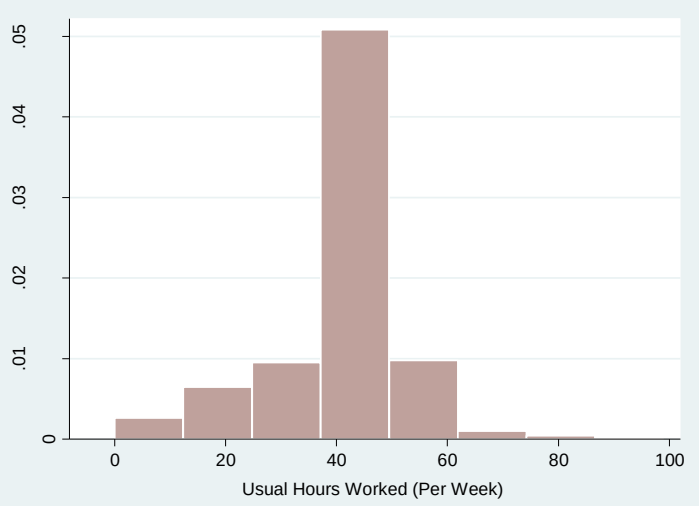
3.2. Dependent Variable

The dependent variable for this study is Usual Hours Worked (Per Week), which in aggregate gives the total labour supply. The data reports on the CPS question:

"How many hours per week do you usually work at your main job?"

Answers are input in the form of discrete numbers between 0 and 99, with a mean of 38.96 hours[5]. Figure 2 shows that the distribution of the variable, later referred to as HW_{it}, is negatively skewed across the samples used in this analysis.

Figure 2: **Distribution of Usual Hours Worked (Per Week)**



[4] See Madrian and Lefgren (1999) for details on longitudinally matching the CPS. Dr. Jeremy Smith provided assistance in matching the datasets and writing merge criteria codes in Stata.
[5] See Table A1 for detailed summary statistics of the key variables.

4. Methodology

4.1. Outline of Methodology

This paper will use two separate regression techniques: pooled ordinary-least-squares (OLS) and difference-in-difference (DD), in its endeavour to identify a causal relationship between the introduction of the EGTRRA and adjustments to female labour supply.

An initial analysis using a pooled OLS regression will help to explain variation in hours worked across individuals, identifying which variables can be predictive of hours worked. The results of this can then be related to the literature outlined in Section 2. However, this approach aggregates all observations into a single sample and ignores concerns of unobserved heterogeneity, which is likely to result in biased coefficients.

A difference-in-difference regression is a version of fixed effects estimation. The approach is appropriate given that the EGTRRA varies only at the state level, thus the source of bias must be unobserved variables at the state and year level. Furthermore, the approach facilitates a computation of the direct effect of the EGTRRA by comparing the hours worked of individuals in states which adopted the EGTRRA when it was enacted in June 2001, against individuals in California where the law was adopted in May 2002. Any states in which the year of adoption was not clear have been omitted from the regression[6]. The assumption underlying the difference-in-difference model is that of common trends: in the absence of the EGTRRA, usual hours worked by individuals in treatment and control states would follow the same time trend. Section 6.2. will evaluate the validity of this assumption.

4.2. Pooled OLS Approach

The Pooled OLS regression will take the form:

$$\begin{aligned} HW_{it} = \alpha + \beta_1 female_{it} + \beta_2 postEGTRRA_t + \beta_3 married_{it} + \beta_4 union_{it} + \beta_5 age_{it} + \beta_6 children_{it} \\ + \beta_7 earnings_{it} + \beta_8 race_{it} + \beta_9 highestgrade_{it} + \beta_{10} student_{it} + \beta_{11} state_i \\ + \beta_{12} privatesector_{it} + \beta_{13}(female_{it} \times postEGTRRA_t) + \beta_{14}(age_{it})^2 + \varepsilon_{it} \end{aligned}$$

where t refers to the time period, i refers to the individual. The key variable of interest is the interactive variable, $female_{it}$ x $postEGTRRA_t$, which will determine the effect of the tax cut on hours worked by females. Control variables are included where there is an economic rationale, with a non-liner variable for age given the possibility that hours worked increase in age at a decreasing rate. A detailed list of key control variables can be found in Table A2.

[6] Please see Table A5 for a list of states included in the control and treatment groups.

4.3. Difference-in-Difference Approach

This approach should provide a more robust analysis with a smaller residual variance, thus smaller standard errors, given that a difference-in-difference estimation controls for systematic differences in any other pre-treatment variables[7].

Let:

$HW_{1,\,ist}$ = hours worked by individual *i* at time *t* if the state adopted the EGTRRA when the law was enacted in June 2001

$HW_{0,\,ist}$ = hours worked by individual *i* at time *t* if the state adopted the EGTRRA in May 2002

In order to conduct this analysis, we must assume that in the absence of the EGTRRA, hours worked would be determined by the sum of time invariant state effects and a year effect that is common across the states:

$$\mathrm{E}(HW_{0,ist}) = \gamma_s + \lambda_t$$

The treatment effect, also known as the difference-in-difference estimator, is given by:

$$\delta = \mathrm{E}[HW_{1,ist} - HW_{0,ist}|s,t]$$

Then the regression equation is as follows:

$$HW_{ist} = \alpha + \gamma treatment_s + \lambda postEGTRRA_t + \delta(treatment_s \times postEGTRRA_t) + \varepsilon_{is}$$

where $treatment_s$ and $postEGTRRA_t$ are dummy variables:

$$treatment_s = \begin{cases} 0\text{ , if California} \\ 1\text{ , otherwise} \end{cases}$$

$$postEGTRRA_t = \begin{cases} 0\text{ , if before 7 June 2001} \\ 1\text{ , otherwise} \end{cases}$$

and $E[\varepsilon_{ist}|s,t] = 0$.

Therefore, to obtain the causal effect of the EGTRRA on usual hours worked (per week):

$$\begin{aligned}\delta = (\,&\mathrm{E}[HW_{ist}|\,s = \text{California},\, t = \text{post-2001}] - \mathrm{E}[HW_{ist}|\,s = \text{California},\, t = \text{pre-2001}]) \\ &- (\mathrm{E}[HW_{ist}|\,s = \text{Other States},\, t = \text{post-2001}] \\ &- \mathrm{E}[HW_{ist}|\,s = \text{Other States},\, t = \text{pre-2001}])\end{aligned}$$

The main difference-in-difference estimator of interest is determined for the female population alone. Additionally, difference-in-difference regressions will be also be estimated for all individuals, males, married females, unmarried females, low-income females and high-income females[8]; this will facilitate a comparison of the effect of the EGTRRA on different demographic groups, and of the results of this paper to the existing body of literature.

[7] The following difference-in-difference approach is adopted from Angrist and Pischke (2008).

[8] Due to top-coding in the CPS, 'High-Income' refers to individuals in the highest 10th percentile for the sample whilst 'Low-Income' refers to those in the lowest 10th percentile; this does not necessarily capture the same individuals as the top and bottom income tax brackets.

5. Empirical Results and Discussion

5.1. Outline of General Results

Table 1 presents coefficient estimates from the initial pooled OLS regression. The variable of interest in this regression is the interactive variable between female and post-EGTRRA. A coefficient of 0.134 suggests that females responded to the EGTRRA by increasing usual hours worked per week relative to their male counterparts, indicating a small but significant substitution effect. The coefficient on earnings illustrates that the substitution effect also dominates the income effect when considering the labour supply as a whole, as a unit increase on hourly earnings is associated with a 0.010 increase in hours worked per week. Additionally the results indicate that being female, a student, married or with children has a negative influence on the intensive margin whilst a higher level of qualifications has a positive effect on hours worked.

Applying a difference-in-difference technique yields results consistent with the pooled OLS method. Table 2 presents the changes in mean usual hours worked per week by females in the treatment and control groups. The figures demonstrate that usual hours worked per week fell by 0.155 hours in California compared to a 0.061 increase in all other states. Therefore, a relative increase of 0.217 hours per week is found, significant at the 5% level. Assuming a constant growth rate in hours worked per week, this indicates a relative increase of 0.59%[9]. This would suggest that the female labour supply is subject to a weak, but significant, dominance of the substitution effect. The results of the difference-in-difference estimation for different demographic groups are presented in Table 3. The results indicate a relative decrease in usual hours worked per week of 0.261 and 1.316, significant at the 1% level, for males (iii) and low-income females (vii) respectively. Conversely, increases of -0.033, 0.214, 0.214 and 0.277 hours per week for all individuals (i), married females (iv), unmarried females (v) and high income females (vi) respectively were found to be insignificant.

The empirical outcomes both complement and contradict expectations from the current literature. Heim (2009) proposed that the substitution effect will dominate the income effect for the married female labour supply; the empirical results outlined above confirm this holds true for the female population as a whole, however, at a smaller magnitude than the 1.59% increase in annual hours outlined in his paper. Contradictory to the central beliefs supported by Feenberg and Rosen (1983), among others, the results indicate that males were more responsive to the introduction of the EGTRRA than females. However, both males and females demonstrate a negligable response to the EGTRRA; this itself confirms Davis' (2008) conjecture that the Bush tax cuts will have a small overall effect on hours worked. Contradictory to existing literature the pooled OLS estimation finds no significant income effect on private sector workers as proffered by Labonte (2010), or highly responsive nature of high-income females as suggested by Eissa (1995).

[9] Please see Table A7 for mean outputs of the difference-in-difference regressions.

Table 1: **Results of the Pooled OLS Estimation**

	Pooled OLS
Usual Hours Worked	(ii)
Constant	16.524
	(0.222)
Female	-5.759*
	(0.040)
Post-EGTRRA	-0.236*
	(0.040)
Married	-0.578*
	(0.032)
Union	0.079
	(0.088)
Age	0.742*
	(0.006)
Children	-0.512*
	(0.11)
Earnings	0.010*
	(0.001)
Race	-0.104*
	(0.010)
Highest Grade	0.326*
	(0.005)
Student	-8.094*
	(0.134)
State	0.010*
	(0.000)
Private Sector	-0.056
	(0.056)
Female x Post-EGTRRA	0.134**
	(0.056)
$(Age)^2$	-0.009*
	(0.000)
R^2	0.1293
No. Observations	673,016

Note:
***,**,* correspond to the coefficient being significant at the 1%, 5% and 10% significance levels respectively. The inclusion of age^2 in specification (ii) has the expected result of changing the coefficient on *age* and the constant due to the high correlation between the variables and is not of multicolinearity concern[10].

Table 2: **Average Hours Worked (Per Week) by Females, Before and After the Introduction of the EGTRRA**

Variable	California (i)	All Other States (ii)	Difference (ii) – (i)
1. Usual hours worked before, all observations for females	36.570 (0.074)	36.182 (0.027)	-0.389 (0.078)
2. Usual hours worked after, all observations for females	36.415 (0.060)	36.243 (0.021)	-0.172 (0.063)
		Difference-in-Difference:	0.217 (0.101)

[10] No other explanatory variables exhibit a high degree of correlation (see Table A3).

Table 3: **Difference-in-Difference Regression: Results**

	Demographic						
Usual Hours Worked	All (i)	Females (ii)	Males (iii)	Married Females (iv)	Unmarried Females (v)	High-Income Females (vi)	Low-Income Females (vii)
Constant	38.945	36.570	40.959	36.678	36.461	37.250	32.031
	(0.051)	(0.074)	(0.068)	(0.103)	(0.105)	(0.253)	(0.214)
Post-EGTRRA	-0.143**	-0.156	-0.129	-0.145	-0.168	0.300	0.747*
	(0.066)	(0.949)	(0.087)	(0.133)	(0.135)	(0.305)	(0.400)
Treatment	0.206*	-0.389***	0.932***	0.224**	-0.592***	-0.672**	-2.138***
	(0.055)	(0.078)	(0.072)	(0.110)	(0.112)	(0.275)	(0.227)
(Post-EGTRRA x	-0.033	0.217**	-0.261***	0.214	0.214	0.277	-1.316***
Treatment)	(0.070)	(0.101)	(0.093)	(0.141)	(0.114)	(0.331)	(0.417)
R^2	0.0001	0.0001	0.0007	0.0000	0.0002	0.0004	0.0038
No. Observations	1,096,886	524,135	572,751	280,160	243,975	74,957	56,764

Note:
***,**,* correspond to the coefficient being significant at the 1%, 5% and 10% significance levels respectively.
Standard errors are in parentheses.

5.2. Focussed Discussion of Key Findings

The empirical results for both the pooled OLS and difference-in-difference estimations provide positive coefficients for the effect of the EGTRRA on female labour supply. This implies a negative relationship between taxation and female labour supply, significant at the 5% level; thus, this paper validates Hypothesis I outlined in Section 1. Furthermore, the difference-in-difference estimates show that married and unmarried females demonstrated equal increases in usual hours worked in response to the EGTRRA, although these results were not significant at the 10% level. This is somewhat counterintuitive, given that the EGTRRA removed the marriage penalty in addition to reducing the average statutory marginal tax rate; as married females effectively faced a larger increase in their net-wage relative to unmarried females, one might expect the results to show a greater responsiveness of married female labour supply to the introduction of the EGTRRA. The results therefore enable a rejection of Hypothesis II. Robinson and Tomes (1985) posited that the dominance of the substitution effect for females would generate a positively sloped labour supply curve, consistent with the upward trend in female labour force participation. This is at odds with the canonical neoclassical model of a backward bending supply curve, which is typically exhibited by males due to the relatively higher hours worked and wages received than women which results in a dominance of the income effect.

Furthermore, the dominance of the substitution effect for low-income females is not consistent with the assumptions of the backward bending supply curve. The relatively high responsiveness of low-income females may be considered surprising, given a widespread criticism of the EGTRRA was that it favoured taxpayers at the top-end of the income distribution. However, this result may be a consequence of the methodology applied in this paper: there is a trade-off between utilising the exogenous time variation in the implementation of the EGTRA and accounting for its full effects. Whilst the reductions in the marginal

tax rates for high-income tax brackets occurred incrementally over a scheduled time period, the introduction of a 10% income tax bracket occurred immediately. Thus, as the difference-in-difference model can only account for the effect of the EGTRRA in the year after its introduction, it may predominantly pick up the incentive effects imposed on low-income individuals. The limitations of the model are discussed further in Section 6.2.

The estimations outlined in this paper demonstrate that the initial effect of the EGTRRA on hours worked was minimal. This complements ex-ante estimations by Gale and Potter (2002), which predict individuals will have increased hours worked by 0.5% by the time the act was repealed in 2010. The small effect of marginal tax reductions can be related back to the neoclassical theory of labour supply: the substitution and income effect work in opposing directions, and so cancel out to a certain extent. Alternatively, this result may demonstrate certain aspects of Ricardian Equivalence. The concept of Ricardian Equivalence proposes that forward-looking consumers will not change their behaviour, or specifically their spending, when faced with a tax cut as such individuals would see that future taxes have a present value equivalent to the incurred debt of financing the current tax cuts. Taking this application of rational expectations, females may not respond to the EGTRRA by substantially changing hours worked given that it is financed through an increase in the public deficit and has a specified reversion date due to being a "sunset" provision. Thus, we are able to accept Hypothesis III.

6. Limitations and Potential Extensions

6.1. Limitations of the Data

The main limitation of the CPS is the measurement error of the individual identifier over time. Including merge criterion helps to invalidate the number of incorrect merges; however, the compromise is potential sample selection bias generated though excluding a greater number of observations (Madrian and Lefgren, 1999). Additionally, earnings data in the CPS is top-coded. This prohibits a specific analysis of the effect of the EGTRRA on high-income tax brackets, which would have benefitted this study as the existing literature expects high-income individuals to be particularly affected by the tax reform.

6.2. Limitations of the Model

The key assumption underlying the validity of the DD regression is that trends in hours worked would have been the same in the absence of the EGTRRA. Using data from 1997 to 2007, Figure A1 demonstrates that usual hours worked in California moved in the same direction as that of the rest of the US[11] with two exceptions: late 1997 and 2002. However, they do not perceptibly demonstrate parallel trends. This is also evident when looking at the female labour supply alone, as shown in Figure A2. It is therefore questionable whether California provides a good measure of counterfactual hours worked in the US in the absence of the EGTRRA. The diverging trends of the treatment and control group could be accounted for by the introduction of state-specific labour policies; however, further econometric analysis would benefit this estimation to ensure the robustness of the results.

Furthermore, the model attempts to identify a casual effect of the EGTRRA on hours worked in the year immediately following its introduction. It is arguable that the labour supply is not immediate to adjust in response to changes in taxation, and so the difference-in-difference regression may not fully identify the effects of the EGTRRA. The model also fails to account for the additional impact of the JGTRRA, which was intended to accelerate the provisions in the EGTRRA.

6.3. Potential extensions

Several authors have looked to improve the robustness of difference-in-difference regressions, including Autor (2003), Besley and Burgess (2004) and Yelowitz (1992). Autor (2003) includes leads and lags of the treatment variable to test the identifying assumption where the model includes multiple treatment groups (states) and periods. Moreover, Besley and Burgess (2004) advocate the inclusion of individual level variables or time varying variables at the state level, and introducing state-specific parametric time trends among these regressors to query the robustness of the common trends assumption. Finally, Yelowitz (1992) highlights the benefits of using a higher order differences than outlined in this paper. If a treatment and control group could be identified within each state, a difference-in-difference-in-difference regression could be identified which is robust to different time trends across state. Given that the EGTRRA was introduced at the federal level, a synthetic control group (Abadie and Gardeazabal, 2005) could be utilised.

[11] 'Treated' states which were subject to the EGTRRA from June 2001.

7. Conclusions

There is a lack of consensus in current literature over the impact of marginal tax rates for different demographic groups. Whilst it is generally understood that the substitution effect dominates in female models of labour supply and the income effect in male models, the magnitude of this effect varies depending on the sample and dataset used. This paper was motivated by the failure of the existing literature to adequately account for the unmarried female labour supply, choosing instead to focus on the married female labour supply due to the prevalent belief that wives are more responsive to changes in taxation than other demographic groups.

The evidence outlined in this paper would dispute this belief. The empirical results, whilst not significant, find that unmarried females react to marginal tax changes in an equivalent manner to that of the married female labour supply. Furthermore, the results highlight the importance of the EGTRRA for females at the lower end of the income distribution; however, no one demographic group demonstrated a considerable response to the introduction of the EGTRRA. These conclusions, it must be observed, are contingent on the common trends assumption which has been shown to be potentially unreliable in Section 6.2. This paper would benefit from further econometric analysis to improve the robustness of the difference-in-difference regression, and to empirically verify the common trends assumption. Additionally, alternative methodology could be applied to corroborate the findings; Table A8 identifies the empirical techniques used in the main labour supply literature.

It is noted that this paper is limited in examining the impact of the EGTRRA on female labour supply for two reasons: restrictions to the empirical model and indirect effects of taxation on labour supply. Whilst the former has been discussed earlier in this paper, it is also worth highlighting that a study of the intensive margin of labour supply only identifies the incentive effect of the EGTRRA on usual hours worked. Taxation can also have an indirect effect, not accounted for in the empirics outlined in this paper; for instance, taxation can affect worker productivity, human capital accumulation and occupational choice (Eissa, 1995). Thus, this paper only offers a brief insight into the effects of the EGTRRA and so the results may not be generalizable to alternative tax reforms.

8. References

Abadie, A. and Gardeazabal, J. (2008). Terrorism and the World Economy. *European Economic Review*. Vol. 52, No. 1, p.1-27.

Alesina, A., Glaeser, E. and Sacerdote, B. (2005). Work and Leisure in the US and Europe: Why so Different? [Online]. *Harvard Institute of Economic Research Working Papers*, No. 2068. [Accessed: 21 April 2014]. Available: http://www.nber.org/chapters/c0073.pdf

Angrist, J. and Pischke, J. (2008). *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton, NJ: Princeton University Press.

Aronsson, T. and Palme, M. (1998). A Decade of tax and Benefit Reforms in Sweden: Effects on Labour Supply, Welfare and Inequality. Economica. Vol. 65, No. 257, p.39-67. Cited in: Heim, B. (2009). Structural Estimation of Family Labor Supply with Taxes: Estimating a Continuous Hours Model Using a Direct Utility Specification. *Journal of Human Resources*. Vol. 44, No.2, p. 350-385.

Autor, D. (2003). Outsourcing at Will: The Contribution of Unjust Dismissal Doctrine to the Growth of Employment Outsourcing. Journal of Labour Economics. Vol. 21, No. 1. P.1-42. Cited in: Pischke, J. (2005). *Difference-in-Differences*. [Online]. EC524 Empirical Methods in Applied Economics. October 2005, London School of Economics. [Accessed: 21 April 2014]. Available: http://econ.lse.ac.uk/staff/spischke/ec524/

Barlow, R., Brazer, H. and Morag, J. (1966). *Economic Behavior of the Affluent*. Washington, D.C.: The Brookings Institution.

Besley, T. and Burgess, R. (2004). Can Labour Regulation Hinder Economic Performance? Evidence from India. The Quarterly Journal of Economics. Vol. 119, No. 1, p.91-134. Cited in: Pischke, J. (2005). *Difference-in-Differences*. [Online]. EC524 Empirical Methods in Applied Economics. October 2005, London School of Economics. [Accessed: 21 April 2014]. Available: http://econ.lse.ac.uk/staff/spischke/ec524/

Blundell, R., Bozio, A. and Laroque, G. (2011). Extensive and Intensive Margins of Labour Supply: Working Hours in the US, UK and France. [Online]. *IFS Working Papers*, W11/01. [Accessed: 14 April 2014]. Available: http://www.ifs.org.uk/wps/wp1101.pdf

Blundell, R., Duncan, C. and Meghir, C. (1998). Estimating Labour Supply Responses Using Tax Reforms. [Online]. *Econometrica*. Vol. 66, No.4, p.827-861. [Accessed: 12 April 2014]. Available: http://www.ucl.ac.uk/~uctp39a/Blundell-Duncan-Megir-1998.pdf

Burgoon, B. and P. Baxandall (2004), Three Worlds of Working-Time: Policy and Politics in Work-Time Patterns of Industrialized Countries. Paper prepared for presentation at the American Political Science Association Annual meeting, Boston, MA, 28 August-1 September, 2002. Cited In: Causa,O. (2008). Explaining Differences in Hours Worked among OECD Countries: An empirical analysis. [Online]. *OECD Economics Department Working Papers*, No. 596. Available: http://www.oecd-ilibrary.org/economics/

Burman, L., Rohaly, J. and Maag, E. (2002). EGTRRA: Which Provisions Spell the Most Relief? [Online]. *Urban Institute Working Paper*, No. 3 in Tax Policy: Issues and Options. [Accessed: 26 April 2014]. Available: http://www.urban.org/publications/310510.html

Burtless, G. (1991). The Supply Side Legacy of the Reagan Years: Effects on Labour Supply. In: *The Economic Legacy of the Reagan Years: Euphoria or Chaos?* ed. A. Sahy abd T. Ronald, 43-63. New York: Praeger.

Card, D. and Krueger, A. (1994). Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania. *American Economic Review*. Vol. 84, No. 4, p.772-693.

Causa,O. (2008). Explaining Differences in Hours Worked among OECD Countries: An empirical analysis. [Online]. *OECD Economics Department Working Papers*, No. 596. Available: http://www.oecd-ilibrary.org/economics/

Davis, S. (2008). *Comments on 'Evidence on Labor Supply and Taxes, and Implications for Tax Policy' by Nada Eissa*. [Online]. Washington, D.C.: American Enterprise Institute. [Accessed: 2 April 2014]. Available: http://faculty.chicagobooth.edu/steven.davis/pdf/eissacomments.pdf

Eissa, N. (1995). Taxation and Labor Supply of Married Women: The Tax Reform Act of 1986 as a Natural Experiment. [Online]. *NBER Working Paper Series*, No. 5023. [Accessed: 25 April 2014]. Available: http://www.nber.org/papers/w5023

Eissa, N. and Hoynes, H. (2004). Taxes and the Labor Market Participation of Married Couples: The Earned Income Tax Credit. *Journal of Public Economics*. Vol. 88, p. 1931-1958.

Five Points Bank. (2008). *Tax Highlights of the EGTRRA and JGTRRA.*[Online]. Five Points Bank. [Accessed: 20 February 2014]. Available: https://www.5pointsbank.com/

Feenberg, D. and Rosen, H. (1983). Alternative Tax Treatment of the Family: Simulation Methodology and Results. *NBER Working Paper Series*, No. 497.

Gale, W. and Potter, S. (2002). The Bush Tax Cut: One Year Later. [Online]. Brookings Policy Brief Series, No. 101. Washington D.C.: Brookings Research. [Accessed: 27 March 2014]. Available: http://www.brookings.edu/research/papers/

Hausman, J. and Rudd, P. (1984). Family Labor Supply With Taxes. *American Economic Review*. Vol. 74, No. 2, p. 242-248.

Hausman, J. (1985). Taxes and Labor Supply. *Handbook of Public Economics*. Vol. 1, Ch. 4, p. 213-263.

Heim, B. (2009). Structural Estimation of Family Labor Supply with Taxes: Estimating a Continuous Hours Model Using a Direct Utility Specification. *Journal of Human Resources*. Vol. 44, No.2, p. 350-385.

Holland, D. (1969). The effect of taxation on effort: The results for business executives. In: *Tax Institute of America Annual Conference on Taxation, 1969*. Washington D.C.: National Tax Association.

Klevmarken, A. (2000). Did the Tax Cuts Increase Hours of Work? A Pre-Post Analysis of Swedish Panel Data. *Uppsala University Working Paper Series*, 1997:21. [Accessed: 20 March 2014]. Available: http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.25.9008

Labonte, M. (2010). *What Effects Would the Expiration of the 2001 and 2003 Tax Cuts Have on the Economy?*. [Online]. Washington D.C.: Congressional Research Service. [Accessed: 21 April 2014]. Available: http://www.fas.org/sgp/crs/misc/R41443.pdf

Madrian, B. and Lefgren, L. (1999). A Note on Longitudinally Matching Current Population Survey (CPS) Respondents. *NBER Technical Working Paper*, No. 247.

Mincer, J. (1962). Labor Force Participation of Married Women: A Study of Labor. [Online]. *Aspects of Labor Economic*s. Vol.62, p. 63-106. [Accessed: 20 March 2014]. Available: http://www.nber.org/chapters/c0603.pdf

Moffit, R. and Wilhelm, M. (1998). Taxation and the Labor Supply: Decisions of the Affluent. NBER Working Paper Series, No. 6621. Cambridge, MA: National Bureau of Economic Research.

NBER. (2014a). CPS Merged Outgoing Rotation Groups. [Online]. The National Bureau of Economic Research. [Accessed: 25 April 2014]. Available: http://www.nber.org/data/morg.html

NBER. (2014b). Index of MORG, Annual. [Online]. The National Bureau of Economic Research. [Accessed: 20 April 2014]. Available: http://www.nber.org/morg/annual/

Pencavel, J. (1987). Labor Supply of Men: A survey. *Handbook of Labor Economics*. Vol. 1, Ch. 1, p. 3-102.

Robinson, C. and Tomes, N. (1985). More on the Labour Supply of Canadian Women. *Canadian Journal of Economics*. Vol. 18, No. 1, p.156-163.

Saez, E. (2000). Optimal Income Transfer Programs: Intensive Versus Extensive Labor Supply Responses**.** [Online]. *NBER Working Paper Series*, No. 7708. [Accessed: 17 April 2014]. Available: http://www.nber.org/papers/w7708

Triest, R. (1990). The Effect of Income Taxation on Labor Supply in the United States. *The Journal of Human Resources.* Vol. 25, No. 3, p. 491-516.

U.S. House and Senate. (2001). *The Economic Growth and Tax Relief Reconciliation Act of 2001*. 107th Congress, 16th Session. H.R.1836.ENR .Washington: Government Printing Office, 2001. [Accessed: 5 April 2014]. Available: http://www.gpo.gov/

U.S. House and Senate. (2003). *The Jobs and Growth Tax Relief Reconciliation Act of 2003*. [Online]. 108th Congress, 27th Session, H.R.2.ENR. Washington: Government Printing Office, 2003. [Accessed: 5 April 2014]. Available: http://www.gpo.gov/

Van Soest, A. (1995). Structural Models of Family Labour Supply: A Discrete Choice Approach. [Online]. *Journal of Human Resources.* Vol. 30, No. 1, p.63-88. [Accessed: 23 April 2014]. Available: http://www.jstor.org/discover/

Wang, W., Parker, K. and Taylor, P. (2013). *Breadwinner Moms*. [Online]. Washington D.C.: Pew Research Center. [Accessed: 19 March 2014]. Available: http://www.pewsocialtrends.org/

Yamada,K. (2010). Labor Supply Responses to the 1990s Japanese Tax Reforms. *Labour Economics*. Vol. 18, No. 4, p. 539-546.

Yelowitz, A. (2005). The Medicaid Notch, Labor Supply, and Welfare Participation: Evidence From Eligibility Expansions. Quarterly Journal of Economics. Vol. 110, No. 4, p.909-939. Cited in: Pischke, J. (2005). *Difference-in-Differences*. [Online]. EC524 Empirical Methods in Applied Economics. October 2005, London School of Economics. [Accessed: 21 April 2014]. Available: http://econ.lse.ac.uk/staff/spischke/ec524/

9. Appendix

9.1. Outline of the EGTRRA

Summary A1: **Provisions Outlined in the EGTRRA of 2001**

(i) Income Tax Reductions

In coordination with the acceleration of the 10% income tax bracket for 2001, the following marginal tax rates (in bold) will be substituted for those below:

	28.0%	**31%**	**36%**	**39.6%**
2001……..	27.5%	30.5%	35.5%	39.1%
2002 and 2003……	27.0%	30.0%	35.0%	38.6%
2004 and 2005……	26.0%	29.0%	34.0%	37.6%
2006 onwards…….	25.0%	28.0%	33.0%	35.0%

(ii) Modified Transfer Taxes

Substantial modifications to the taxation of asset transfers:

- Gradual phase out and repeal of the estate tax and generation-skipping transfer tax;
- Gift taxes left in force;
- New income tax consequences on post-mortem transfers.

(iii) Expanded Child Tax Credit

In addition to expansions in the adoption credit and adoption assistance programmes, the per child tax credit will rise from **$500** to:

2001, 2002, 2003 or 2004……..	$600
2005, 2006, 2007 or 2008……..	$700
2009……...	$800
2010 onwards…….	$1,000

(iv) Marriage Penalty Relief

Changes to the Earned Income Tax Credit follow the phase-out schedule shown below:

	2000	**2002**	**2005**	**2006**	**2007**	**2008**	**2009**
Increase EITC phase-out range for married couples….	2000 Level	+$1,000	+$2000	+$2000	+$2000	+$2000	+$3,000
Increase married standard deduction as a % of single…	167%	167%	174%	184%	187%	190%	200%
Increase size of married 15% bracket as % of single...	167%	167%	180%	187%	193%	200%	200%

(v) Pension Reform

Numerous changes to pension plans and Individual Retirement Accounts (IRAs) through 2010:

- Expansions to the number and types of plans available;
- Increasing contribution limits, portability, accelerating vesting, and strengthening participant protections.

At the following dates, the deductible amount will change from **$2,000** to:

2002 through 2004…….	$3,000
2005 through 2007…….	$4,000
2008 onwards…….	$5,000

(vi) Education Incentives

Education incentives in the form of:

- Changes to Coverdell Education Savings Accounts (ESAs);
- State-sponsored qualified tuition programs;
- Favourable tax treatment of higher education expenses, student loan interest, and employer-provided educational assistance.

Sources: US House and Senate (2001); Five Points Bank (2008); Burman, Rohaly and Maag (2002)

9.2. Data and Summary Statistics

Table A1: **Summary Statistics for Key Variables**

This table shows the descriptive statistics for the main variables used in the Pooled OLS regression.

Variable	Mean and Std. Deviation		No.	Min. Value,
	Pre-EGTRRA	Post-EGTRRA	Observations	Max. Value
Usual Hours Worked, Per Week	39.060	38.899	1,627,118	0, 99
(*uhourse*)	(11.614)	(11.302)		
Earnings, Hourly	13.747	16.801	1,535,876	0, 2884.61
(*earnhr*)	(9.841)	(13.812)		
Age	43.622	44.457	2,829,033	16, 90
(*age*)	(18.262)	(18.016)		
Female	0.525	0.521	2,829,033	0, 1
(*female*)	(0.499)	(0.500)		
Married	0.540	0.542	2,829,033	0, 1
(*married*)	(0.498)	(0.498)		
Union	0.007	0.008	2,829,033	0, 1
(*union*)	(0.086)	(0.092)		
Number of Children	0.886	0.860	1,347,811	0, 11
(*ownchild*)	(1.140)	(1.132)		
Race	1.270	1.383	2,829,033	1, 21
(*race*)	(0.701)	(1.216)		
Highest Grade Achieved	39.581	39.812	2,829,032	31, 46
(*grade*)	(2.839)	(2.806)		
Student	0.084	0.085	2,829,033	0, 1
(*student)*	(0.277)	(0.278)		
Private Sector	0.031	0.032	1,628,228	0, 1
(*privatesector*)	(0.173)	(0.176)		

Note: Standard deviations are given in parentheses

Table A2: **Definitions of Variables: Pooled OLS Regression**

This table outlines the key definitions of variables used in the Pooled OLS regression. Note that variables marked with a * are binary dummy variables, taking the value of 0 or 1.

Variable	**Variable Name**	**Definition**
Usual Hours Worked	*uhourse*	Imputed hourly wage for weekly workers and actual hourly wage for hourly workers.
Female*	*female*	Equal to 1 if female, 0 otherwise.
Post-EGTRRA*	*postegtrra*	Equal to 1 if after June 2001, 0 otherwise.
Married*	*married*	Equal to 1 if married, 0 otherwise.
Union*	*union*	Equal to 1 if covered by a union contract, 0 otherwise.
Age	*age*	Years of age; top-coded at 90 years.
Children	*ownchild*	Number of own children less than 18 in primary family.
Earnings	*earnhre*	Hourly earnings, reported in pennies.
Race	*race*	Race of participant.
Highest Grade	*grade*	Highest grade completed, i.e. level of schooling.
Student*	*student*	Equal to 1 if enrolled in school full or part-time, 0 otherwise.
State	*state*	Geographical location of participant, using US Census code for states.
Private Sector*	*privatesector*	Equal to1 if worker in private sector, 0 if in public sector.

Table A3: **Correlation Matrix of Key Variables**

This table shows the correlation coefficients between variables included in the pooled OLS estimation. The general rule of thumb is that correlation coefficients which exceed 0.8 indicate multicolinearity.

	(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**	**(j)**	**(k)**	**(l)**	**(m)**	**(n)**	**(o)**
	Usual Hours Worked	**Married**	**Female**	**Post-EGTRRA**	**Union Contract**	**Number of Children**	**Hourly Earnings**	**Race**	**Age**	**Highest Grade Achieved**	**Student**	**State**	**Private Sector**	**(Female x Post-EGTRRA)**	**Age^2**
(a)	1.00														
(b)	0.06	1.00													
(c)	-0.29	-0.21	1.00												
(d)	-0.01	0.00	0.00	1.00											
(e)	0.00	0.00	0.01	-0.01	1.00										
(f)	0.01	-0.03	-0.03	-0.01	0.00	1.00									
(g)	0.11	0.12	-0.18	0.06	0.01	0.00	1.00								
(h)	-0.01	-0.05	0.02	0.03	0.00	0.03	-0.01	1.00							
(i)	-0.03	0.16	-0.06	0.04	0.02	-0.36	0.12	-0.03	1.00						
(j)	0.10	0.11	0.01	0.02	0.04	-0.03	0.37	0.01	0.05	1.00					
(k)	-0.10	-0.09	0.03	0.00	0.00	-0.04	-0.05	0.01	-0.16	-0.02	1.00				
(l)	0.02	-0.02	-0.01	-0.01	0.01	0.03	-0.03	0.13	-0.06	-0.07	0.01	1.00			
(m)	0.01	0.01	-0.02	0.00	0.06	-0.02	0.06	0.03	0.06	0.06	-0.01	0.02	1.00		
(n)	-0.24	-0.17	0.83	0.39	0.01	-0.03	-0.12	0.03	-0.04	0.02	0.03	-0.01	-0.02	1.00	
(o)	-0.05	0.14	-0.06	0.04	0.01	-0.39	0.10	-0.03	0.99*	0.03	-0.13	-0.05	0.05	-0.04	1.00

Note: * a correlation coefficients greater than 0.8 not considered a problem here due to significant coefficients on *age* and age^2 in the pooled OLS estimation.

9.3. Intermediate Pooled OLS Regression

Table A4: **Results of Intermediate Pooled OLS Regression**

This table presents the pooled OLS regression output for the intermediate regression (i) and the final model (ii) as previously outlined in Section 5.1.

	Pooled OLS	
Usual Hours Worked	(i)	(ii)
Constant	30.690	16.524
	(0.194)	(0.222)
Female	-5.513*	-5.759*
	(0.023)	(0.040)
Post-EGTRRA	-0.202*	-0.236*
	(0.028)	(0.040)
Married	-0.307*	-0.578*
	(0.321)	(0.032)
Union	0.153***	0.079
	(0.089)	(0.088)
Age	-0.064*	0.742*
	(0.001)	(0.006)
Children	-0.226*	-0.512*
	(0.011)	(0.11)
Earnings	0.017*	0.010*
	(0.001)	(0.001)
Race	-0.100*	-0.104*
	(0.100)	(0.010)
Highest Grade	0.364*	0.326*
	(0.005)	(0.005)
Student	-11.232*	-8.094*
	(0.133)	(0.134)
State	0.009*	0.010*
	(0.058)	(0.000)
Private Sector	0.116**	-0.056
	(0.194)	(0.056)
Female x Post-EGTRRA		0.134**
		(0.056)
$(Age)^2$		-0.009*
		(0.000)
R^2	0.1074	0.1293
No. Observations	673,016	673,016

Note:
***,**,* correspond to the coefficient being significant at the 1%, 5% and 10% significance levels respectively. Standard errors are given in parentheses.

9.4. Difference-in-Difference Mean Outputs

Table A5: **States in Control and Treatment Groups**

This table outlines the US states included in the difference-in-difference regression. 'Treatment' group refers to those states which adopted the EGTRRA in June 2001 whilst 'Control' group includes those that adopted the EGTRRA in May 2002. States where the date of EGTRRA adoption were not clear have been omitted from the regression.

Group	**States**
Treatment	Alaska, Colorado, Connecticut, D.C., Delaware, Florida, Illinois, Kansas, Louisiana, Maryland, Michigan, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Mexico, New York, North Dakota, Ohio, Oklahoma, Oregon, Rhode Island, South Dakota, Tennessee, Texas, Utah, Vermont, Virginia, Washington, Wyoming
Control	California
Omitted	Alabama, Arizona, Arkansas, Georgia, Hawaii, Idaho, Indiana, Iowa, Kentucky, Maine, Massachusetts, Minnesota, New Jersey, North Carolina, Pennsylvania, South Carolina, West Virginia, Wisconsin

Table A6: **Difference-in-Difference Regression: Definition of Variables**

This table defines the variables used in the difference-in-difference regressions. 'Variable Name' refers to the term used for the variable in Stata. Regressions follow the format outlined in Section 4.3.

Regression	**Variable**	**Variable Name**	**Definition**
All Observations	treatment	*treatment*	1 if treatment group, 0 if control group.
	postEGTRRA	*postegtrra*†	1 if time is after June 2001, 0 otherwise.
	(treatment x postEGTRRA)	*interaction*	A multiplicative variable of (*treatment* x *postegtrra*)
Female Observations	treatment	*treatment_2*	1 if treatment group and female; 0 if control group and female.
	(treatment x postEGTRRA)	*interaction_2*	A multiplicative variable of (*treatment_2* x *postegtrra*)
Male Observations	treatment	*treatment_3*	1 if treatment group and male; 0 if control group and female.
	(treatment x postEGTRRA)	*interaction_3*	A multiplicative variable of (*treatment_3* x *postegtrra*)
Married Female Observations	treatment	*treatment_4*	1 if treatment group, female and married; 0 if control group, female and married.
	(treatment x postEGTRRA)	*interaction_4*	A multiplicative variable of (*treatment_4* x *postegtrra*)
Unmarried Female Observations	treatment	*treatment_5*	1 if treatment group, female and unmarried; 0 if control group, female and unmarried.
	(treatment x postEGTRRA)	*interaction_5*	A multiplicative variable of (*treatment_5* x *postegtrra*)
High-Income Female Observations	treatment	*treatment_6*	1 if treatment group, female and high income; 0 if control group, female and high income.
	(treatment x postEGTRRA)	*interaction_6*	A multiplicative variable of (*treatment_6* x *postegtrra*)

Note: † indicates a variable which is common across all DD regressions

Table A7: **Results of the Difference-in-Differences Estimation: Mean Outputs**

		Pre-EGTRRA (a)	Post-EGTRRA (b)	Difference (b-a)	Difference-in-Difference (d)
(i)	*Treatment Group:*				
	Observations from All Other States	39.151	38.975	-0.176	
	[970,751]	(0.019)	(0.01)	{-0.45%}	
	Control Group:				
	Observations from California	38.945	38.802	-0.143	-0.033
	[126,135]	(0.051)	(0.042)	{-0.37%}	(0.070)
					{-0.08%}
(ii)	*Treatment Group:*				
	Female Observations from All Other States	36.182	36.243	0.061	
	[466,226]	(0.027)	(0.021)	{0.17%}	
	Control Group:				
	Female Observations from California	36.570	36.415	-0.155	0.217**
	[57,909]	(0.074)	(0.060)	{-0.42%}	(0.101)
					{0.59%}
(iii)	*Treatment Group:*				
	Male Observations from All Other States	41.891	41.501	-0.390	
	[504,525]	(0.026)	(0.020)	{-0.93%}	
	Control Group:				
	Male Observations from California	40.959	40.830	-0.129	-0.261***
	[68,226]	(0.068)	(0.055)	{-0.31%}	(0.093)
					{-0.62%}
(iv)	*Treatment Group:*				
	Married Female Observations from All Other States	36.454	36.523	0.069	
	[250,886]	(0.037)	(0.028)	{0.19%}	
	Control Group:				
	Married Female Observations from California	36.678	36.533	-0.145	0.214
	[29,274]	(0.103)	(0.084)	{-0.40%}	(0.141)
					{0.59%}
(v)	*Treatment Group:*				
	Unmarried Female Observations from All Other States	35.868	35.915	0.047	
	[215,340]	(0.040)	(0.031)	{0.13%}	
	Control Group:				
	Unmarried Female Observations from California	36.461	36.293	-0.168	0.214
	[28,635]	(0.105)	(0.086)	{-0.46%}	(0.144)
					{0.59%}
(vi)	*Treatment Group:*				
	High-Income Female Observations from All Other States	36.578	37.155	0.577	
	[63,744]	(0.108)	(0.071)	{1.58%}	
	Control Group:				
	High-Income Female Observations from California	37.250	37.550	0.30	0.277
	[11,213]	(0.253)	(0.170)	{0.81%}	(0.331)
					{0.77%}
(vii)	*Treatment Group:*				
	Low-Income Female Observations from All Other States	29.893	29.324	-0.569	
	[51,524]	(0.076)	(0.088)	{-1.90%}	
	Control Group:				
	Low-Income Female Observations from California	32.031	32.778	0.747	-1.316***
	[5,240]	(0.214)	(0.338)	{2.33%}	(0.417)
					{-4.23%}

Note:

***,**,* correspond to the coefficient being significant at the 1%, 5% and 10% significance levels respectively.

Each cell contains the mean for that group, standard errors in ( ), % change in {} and number of observations in [ ].

9.5. Testing the Common Trends Assumption

Figure A1: **Usual Hours Worked (Per Week) in Treatment and Control States, 1997 to 2007**

The graph shows the trend in usual hours worked over time, separated for the treatment and control group. The vertical lines indicate the dates of EGTRRA adoption for each group: 1 for treatment, 2 for control.

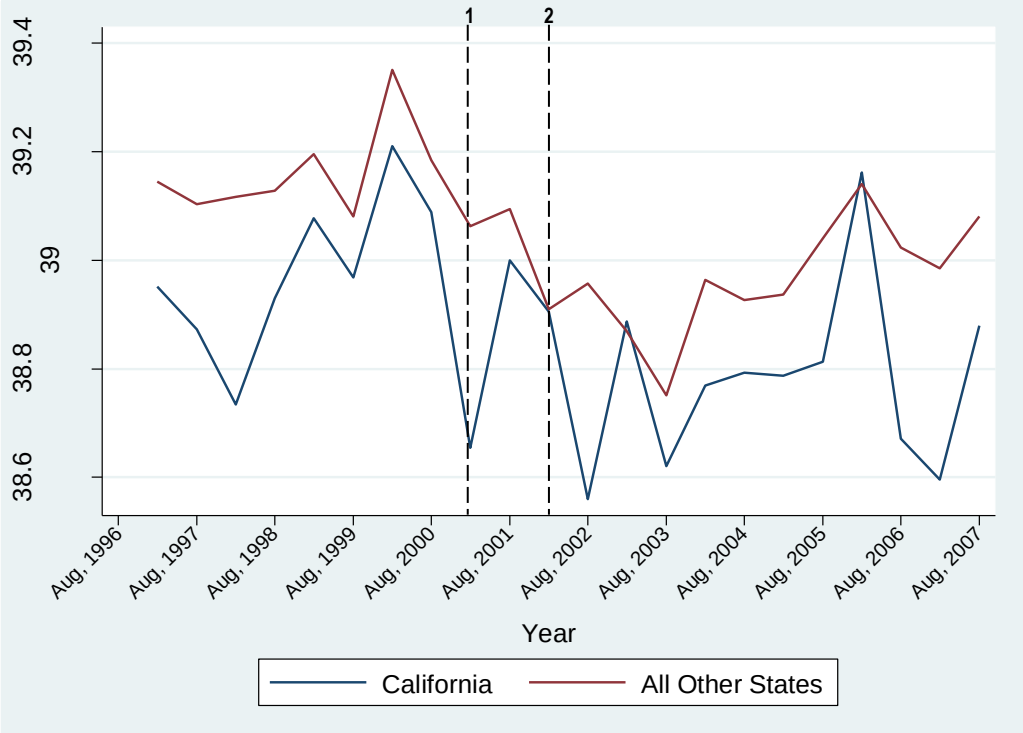
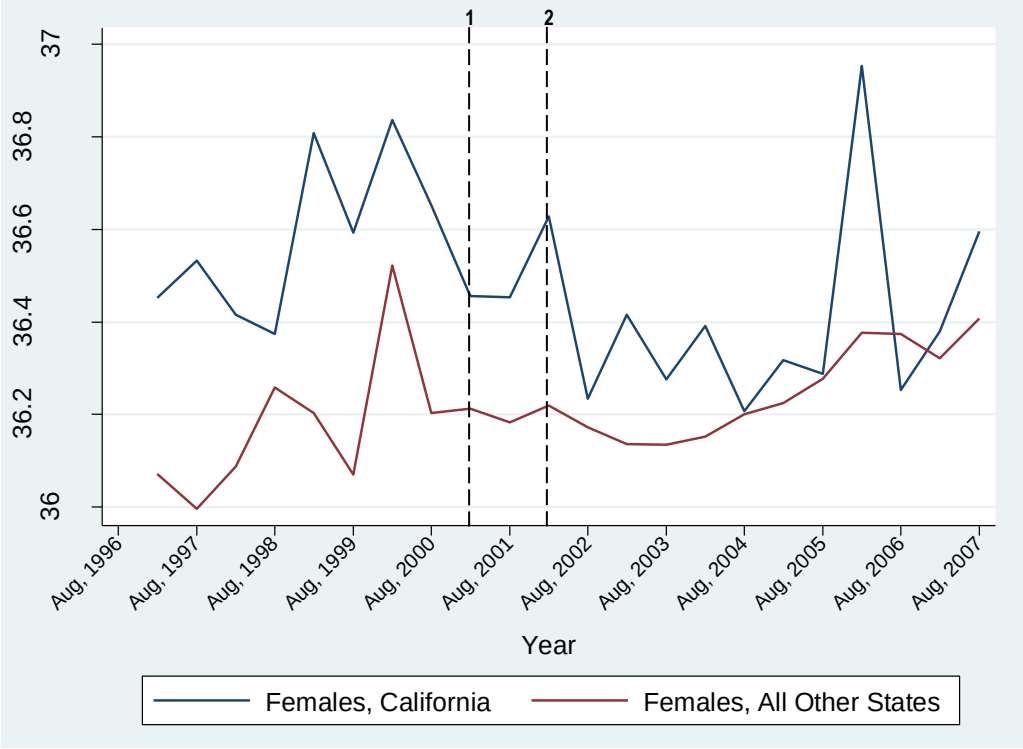


Figure A2: **Usual Hours Worked (Per Week) by Females in Treatment and Control States, 1997 to 2007**

The graph shows the trend in usual hours worked by females, for the treatment and control group.



9.6. Main Literature

Table A8: **Literature on Labour Supply**

This table summarises the main literature on labour supply referenced in this paper with the addition to further studies, to demonstrate the scope of data and estimation methods used in labour supply studies.

Study	Tax Reform	Sample	Data and estimation period	Estimation Method	Findings
Alesina, Glaeser and Sacerdote (2005)	n/a	All Individuals	OECD, 1960-1995.	OLS with and without country year fixed effects.	Hours worked elasticity w.r.t. tax rate is -0.50 (without country fixed effects); -0.18 (with country fixed effects).
Aronsson & Palme (1994)	Swedish Tax Reform of 1991	All Individuals	n/a	Maximum Likelihood Estimation	Hours worked elasticity w.r.t. income of 0.01 for men and -0.06 for women.
Blundell, Duncan and Meghir (1998)	Tax Reforms in the 1980s	Married Women	UK Family Expenditure Survey, 1978-92	Difference-in-Differences	Hours worked elasticities w.r.t. own wage is between 0.14 and 0.43 (depending on controls for children).
Burgoon and Baxandall (2004)	n/a	All Individuals	OECD & Total Economy Database (Groningen University)	Feasible Generalised Least Square (FGLS)	Hours worked elasticity w.r.t. tax rate is 0.28 (no country fixed effects); -0.05 (country fixed effects).
Causa (2008)	n/a	Individuals Aged 24-56	European Labour Force Survey, 1995-2005	Fixed Effects	Hours worked elasticity w.r.t. tax rate is between -0.7 and -0.8
Eissa (1995)	Tax Reform Act of 1986	High Income, Married Women	Current Population Survey, 1984-86 and 1989-91	Difference-in-Differences and Probit Model	Hours worked elasticity w.r.t. after-tax wage is between 0.6 and 0.8.
Eissa and Hoynes (2004)	Earned Income Tax Credit	Married, Low Educated Males	Current Population Survey, 1984-86	Probit Estimation	Hours worked elasticity w.r.t. wage is between 0.06 and 0.07.
Hausman and Rudd (1984)	n/a	Husband and Wife (Joint Labour Supply)	Panel Survey of Income Dynamics, 1977	Maximum Likelihood Estimation	Hours worked elasticity w.r.t. wage is -0.034.
Heim (2009)	n/a	Married Individuals	Panel Survey of Income Dynamics, 2001	Maximum Likelihood Estimation	Hours worked elasticity w.r.t wage is 0.25 to 0.34 for married females, and 0.042 to 0.067 for married males.
Klevmarken (2000)	Swedish Tax Reform of 1991	Married Women	Household Market and Nonmarket Activities Survey, 1986 and 1983	Difference-in-Differences	Hours worked elasticity w.r.t. wage rate of 0.1 to 0.27.
Moffit and Wilhelm (1998)	Tax Reform Act of 1996	High-Income Men	Survey of Consumer Finances, 1983 and 1989	Difference-in-Differences	No significant change in hours worked due to taxation.
Triest (1990)	n/a	Married Women	Panel Survey of Income Dynamics, 1984	Maximum Likelihood Estimation	Hours worked elasticity w.r.t. income is between -0.15 an d-0.33.
Van Soest (1995)	n/a	Husband and Wife (Joint Labour Supply)	Socio Economic Panel, 1987	Maximum Likelihood Estimation	Hours worked elasticity w.r.t. own wage is between 0.07 and 0.153.