Intensive Margin Responses when Workers are Free to Choose: Evidence from a Dutch Tax Reform

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Preliminary and unfinished work – do not quote

Abstract

We exploit a large tax reform in the Netherlands to estimate the response in weekly working hours, the 'intensive margin', to changes in net wages. Workers in the Netherlands are arguably more free to choose their working hours than workers in countries like France, the UK or the US. Hence, responses are more likely to reflect preferences for work and leisure, rather than a mixture of preferences and demand side restrictions. Following Blundell et al. (1998) we deal with the endogeneity of net wages by using cohort-education-period dummies. We use data for the period 1999-2005. This period covers a large tax reform in 2001 which generates exogenous and heterogeneous variation in the cohort-education-period dummies. We find rather modest intensive margin responses, ranging from essentially zero for men in couples to .2 for single mothers. A number of robustness checks show that these elasticities remain small under a number of different specifications, though the elasticities rise somewhat for some groups in some specifications. Our results line up well with the results of a structural discrete choice model estimated on the same data, where we also find small intensive margin elasticities.

JEL codes: C21, C23, H24, J22

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1 Introduction

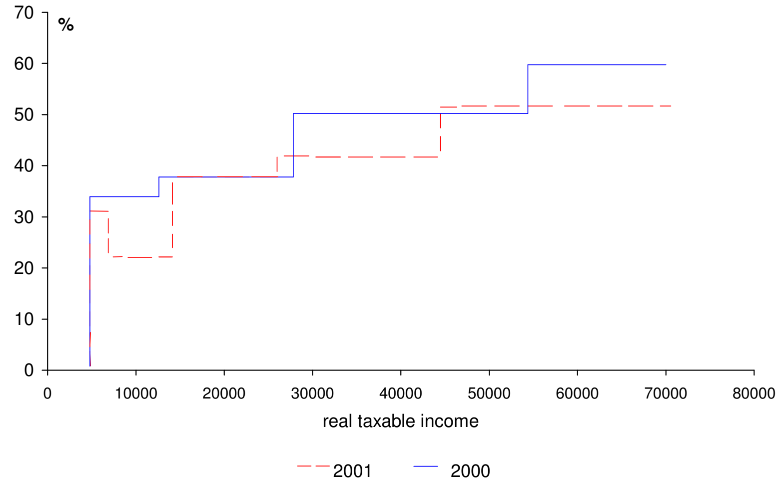
There is an active academic debate on the relative importance of the so-called extensive and intensive margin of labour supply responses to changes in financial incentives. The extensive margin measures the response in the number of employed persons, whereas the intensive margin measures the response in hours worked per employed person. For some time it has been considered a stylized fact that the extensive margin is more important than the intensive margin, see *e.g.* Heckman (1993), Blundell and MaCurdy (1999) and the overview and empirical work presented in Bargain et al. (2011). However, recent work by Chetty (2012) casts doubt on this stylized fact. His analysis suggests that optimization frictions may hide part of the intensive margin responses, with larger changes in marginal tax rates generating larger intensive margin elasticities.

The relative importance of the extensive and intensive margin of labour supply responses plays a key role in the policy debate on income support and in-work tax credits. In a seminal paper Saez (2002) shows that earned income tax credits targeted at the participation margin are part of an optimal tax system when the extensive margin is important and the intensive margin is not, whereas a negative income tax is part of an optimal system when the intensive margin is important and the extensive margin is not. Also, the intensive margin gets increasing attention from policy makers. Female participation rates across OECD countries have recently largely converged to those of men. Policymakers now hope to stimulate hours worked by women already working.[1]

We study the intensive margin response following a large tax reform in the Netherlands that substantially reduced marginal tax rates, by up to 10 percentage points, for a large part of workers. This is illustrated in Figure 1, which shows marginal tax rates before (2000) and after (2001) the tax reform, for different levels of income. Given the large changes in marginal tax rates, we may expect to get a good look at the behavioural responses (if any), as the change in financial incentives is likely to overcome optimization frictions. With the largest share of part-time workers in the OECD, see Figure 2, the Netherlands is a particularly interesting

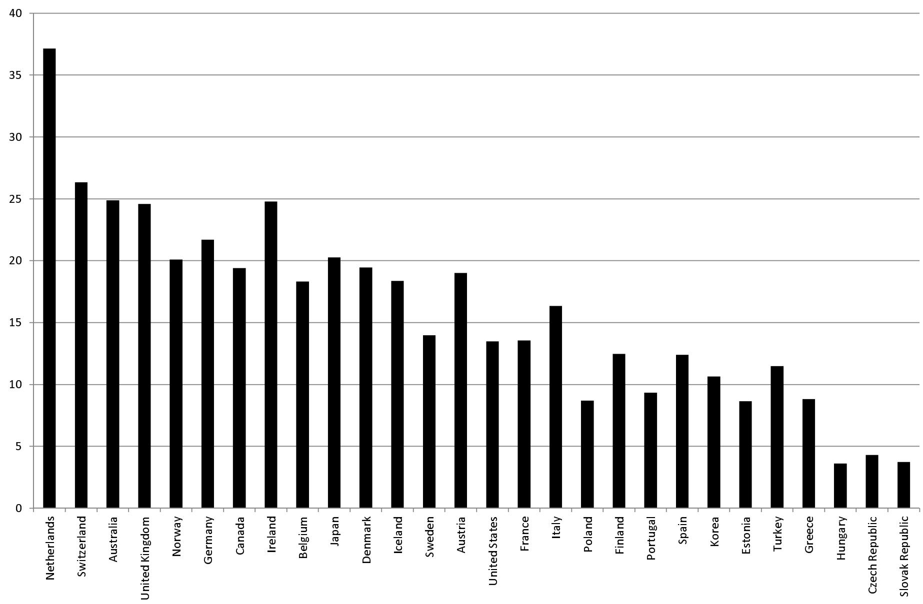
[1]For example, in the Netherlands there was a taskforce called Taskforce deeltijd+ (2010), which goes by the English name of '24ormore'.

Figure 1: Marginal tax rates before and after the reform of 2001



Source: Own calculations.

Figure 2: Part-time employment as a % of total employment, 2010



Source: OECD Employment and Labour Market Statistics.

country to study the intensive margin response.[2] Workers in the Netherlands are arguably more free to choose their working hours than workers in countries like France, the UK or the US. Hence, responses are likely to reflect mostly preferences for work and leisure, rather than a mixture of preferences and demand side restrictions. As we have a very large data set we can do the analysis for a large number of subgroups that have attracted attention in the labour supply literature: single men and women, single mothers and fathers, men and women in couples without children, and men and women in couples with children.

Our methodology follows Blundell et al. (1998). Specifically, we regress the hours worked per week by workers on their net hourly wages and a number of control variables. In our base specification we deal with selection in participation using the inverse Mills' ratio from a probit regression. In a robustness check we control for selection using individual fixed effects, exploiting the panel dimension of our dataset. We deal with endogenous net hourly wages by regressing net hourly wages on a set of education-cohort-period dummies, as well as education-cohort and period dummies. Variation in the education-cohort-period dummies comes from a large tax reform in our data period that affected the incomes of different education groups differently, as well as non-parallel changes in gross wages for different education groups. Our data comes from a very large administrative household panel data set covering over 1 million individuals aged 15 and over in the Netherlands, the *Arbeidsmarktpanel* constructed by Statistics Netherlands. The data set covers the period 1999-2005, which gives us two years of pre reform data and five years of post reform data. To calculate effective marginal tax rates we use the MIMOSI model. MIMOSI is a very detailed tax-benefit calculator at CPB that takes into account all income dependent taxes and subsidies.

Our main findings are as follows. Across all groups we find that intensive margin responses are rather small. The intensive margin elasticities to changes in net hourly wages range from essentially zero for men in couples to .2 for single mothers, with women in couples and single men and women in between these numbers. A number of robustness checks show that these elasticities remain small under a number of

[2] In the Appendix we further show the distribution of hours worked for men and women in a number of OECD countries, see Figure 3. Compared to other countries, the distribution of hours worked is more evenly distributed in the Netherlands. This may also indicate that workers in the Netherlands are more free to choose their working hours than the other OECD countries.

different specifications, though the elasticities rise somewhat for some groups in some specifications. Our results line up well with the results of a structural discrete choice model estimated on the same data, where we also find small intensive margin elasticities.

(**PM Relation to the literature.**)

The outline of the paper is as follows. In Section 2 we first consider the tax reform of 2001 that is our main source of exogenous variation in net hourly wages. Section 3 then presents our empirical methodology. Section 4 considers the data we use for the analysis and gives some descriptive statistics. Section 5 then presents the empirical results, a number of robustness checks, and a comparison of the resulting intensive margin elasticities with the results of an estimated discrete choice model using the same dataset. Section 6 concludes.

2 The Dutch tax system and the 2001 reform

The Dutch tax system is an individualized progressive tax system, with the exception of some general tax credits and allowances that can be transferred between partners and some subsidy schemes that depend on household income (targeted at low incomes).

A major tax reform in 2001 substantially reduced marginal tax rates. Table 1 shows for each year the marginal tax rates for the four different income brackets in the Dutch tax system. The most substantial reduction occurred in the highest two brackets, where marginal tax rates were reduced by eight percentage-points. Furthermore, next to changes in marginal tax rates there was also some change in the cut-off points of the tax brackets (see Figure 1).

The tax reform of 2001 also increased in-work tax credits, in particular the general tax credit for working individuals ('Arbeidskorting'). This EITC rises from 150 euro at 50 percent of the annual minimum wage to 900 euro close to the annual minimum wage. Figure 1 shows the effective marginal tax rates at different taxable incomes in 2000 and 2001.[3] The figure shows that the EITC led to a substantial

[3]When computing the effective marginal tax rates in the figure we take the nontransferable allowances and tax credits into account, but ignore the transferable allowances and tax credits. Taking account of the transferable allowances and tax credits would cause that the effective marginal tax rates at low incomes are not zero but dependent on the partner's income.

Table 1: Main characteristics of the tax system.

	1999	2000	2001	2002	2003	2004	2005
Marginal tax rates							
Income bracket 1	35.75	33.90	32.35	32.35	32.35	33.40	34.40
Income bracket 2	37.05	37.95	37.6	37.85	37.85	40.35	41.95
Income bracket 3	50.00	50.00	42.00	42.00	42.00	42.00	42.00
Income bracket 4	60.00	60.00	52.00	52.00	52.00	52.00	52.00
General tax allowance/credit							
Tax allowance[a] (in €)	4,674	4,646					
Tax credit[b] (in €)			1,731	1,752	1,715	1,881	1,916

[a] The general allowance reduces taxable income.

[b] The tax credit reduces the amount of tax paid.

drop in effective marginal tax rates between 8 and 16 thousand euro. (**PM Add EITCs to Table 1.**)

Finally, to compensate for the reduction in marginal tax rates on labour, the government increased value added taxes from 17.5 to 19 percent which increased the inflation rate in 2001.[4] This increases effective marginal tax rates across the board.[5]

3 Empirical methodology

Our empirical methodology follows Blundell et al. (1998). Our interest is in the causal effect of the net hourly wage $w_{i,t}$ of person i belonging to group g in year t on this persons hours worked per week $h_{i,t}$. Below we will define $3X3 = 9$ education-cohort groups. We postulate the following relation between hours worked per week and net hourly wages

$$h_{i,t} = \beta_g + \beta_t + \beta_1 \log(w_{i,t}) + X'_{i,t}\beta_2 + \varepsilon^h_{i,t}, \tag{1}$$

[4] The value added tax on some essential goods, like food, is only 6 percent.

[5] In the empirical analyses below the change in indirect taxes enters our net wages via the price deflator which we use to convert nominal net hourly wages to real net hourly wages.

where the education-cohort groups are assumed to have their own group specific intercept β_g, the β_t are period dummies capturing common macroeconomic shocks, the parameter β_1 is restricted to be the same across groups, the $X_{i,t}$ are observed demographic characteristics (dummies for age of the youngest child) with coefficients β_2, and $\varepsilon^h_{i,t}$ is a white noise error term.

We distinguish between men and women, between singles and couples and between families with an without childeren. For men and women in couples, the vector $X_{i,t}$ also contains information on their respective spouses. Because labour supply decisions of both partners may not be uncorrelated, we follow Blundell et al. (2007) and include the partners earnings in $X_{i,t}$ in a robustness check.

The key parameter of interest is β_1. Using OLS to estimate equation (1) yields inconsistent estimates for β_1 because the net hourly wage may be correlated with the error term $\varepsilon^h_{i,t}$. This may be due to a number of reasons. First, there may be reverse causality. Working more hours increases income and due to the progressity of the tax system, individuals enter an income bracket with a higher marginal tax rate. Second, the vector $X_{i,t}$ may not capture all relevant heterogeneity in individual preferences or ability. If there is unobserved ability and more able individuals earn higher wages and have a stronger preference for work, then there is a direct relation between $\log(w_{i,t})$ and $\varepsilon^h_{i,t}$. To solve these problems we need exogenous variation in net hourly wages. The tax reform of 2001 provides exogenous variation in net hourly wages. The tax reform of 2001 allows us to deal with endogeneity of $\log(w_{i,t})$. Specifically, we add the first-stage regression

$$\log(w_{i,t}) = \alpha_g + \alpha_t + \alpha_{g,t} + X'_{i,t}\alpha_2 + \varepsilon^w_{i,t} \tag{2}$$

where we explain net hourly wages with a group dummy α_g, a period dummy α_t, education-cohort-period dummies $\alpha_{g,t}$, and again other demographic characteristics $X_{i,t}$, and an error term $\varepsilon^w_{i,t}$. Below we will test whether our set of instruments, the education-cohort-period dummies, explain part of the variation in net hourly wages once controlling for the group fixed effects, the common period effects and the other demographic characteristics.

Another concern is that the composition of working individuals changes over time or due to the tax reform. Furthermore, the decision to work might directly be related to unobserved preferences for work and ability. Self selection into employment is probably not random and hence cannot be ignored. To control for selective labour participation, we add a probit model to explain the participation probability $P_{i,t}$ for a given individual

$$\Pr(P_{i,t} = 1) = \Phi\left(\gamma_g + \gamma_t + \gamma_{g,t} + X'_{i,t}\gamma_2\right). \tag{3}$$

We then follow the control function approach with residual addition technique of Blundell et al. (1998). The first-stage wage equation generates residuals $\hat{\varepsilon}^w_{i,t}$. The first-stage participation probit generates the inverse Mills' ratio $\hat{\lambda}_{i,t} = \frac{\phi\left(\hat{\gamma}_g+\hat{\gamma}_t+\hat{\gamma}_{g,t}+X'_{i,t}\hat{\gamma}_2\right)}{\Phi\left(\hat{\gamma}_g+\hat{\gamma}_t+\hat{\gamma}_{g,t}+X'_{i,t}\hat{\gamma}_2\right)}$ We add these as regressors to the hours equation (1), which gives the second-stage equation

$$h_{i,t} = \beta_g + \beta_t + \beta_1 \log(w_{i,t}) + X'_{i,t}\beta_2 + \beta_3\hat{\varepsilon}^w_{i,t} + \beta_4\hat{\lambda}_{i,t} + \epsilon_{i,t} \tag{4}$$

Estimating this model using OLS on the sample of workers generates consistent parameter estimates for β_1. Furthermore, equation (4) provides a direct test of endogeneity of wages and of selection into participation.

As a robustness check we also estimate this equation with individual fixed effects α_i

$$h_{i,t} = \beta_g + \beta_t + \beta_1 \log(w_{i,t}) + X'_{i,t}\beta_2 + \beta_3\hat{\varepsilon}^w_{i,t} + \beta_4\alpha_i + \epsilon_{i,t} \tag{5}$$

where we deal with selection with the individual fixed effects and drop the inverse Mills' ratio.

Finally, note that the parameter β_1 gives the uncompensated effect of changes in net wages on hours worked. A positive value of β_1 implies that the substitution effect dominates the income effect. Given the log-linear labour supply specification, dividing the parameter β_1 by mean working hours gives the uncompensated wage elasticity evaluated at the mean.

4 Data

The data we use are from the *Arbeidsmarktpanel* of Statistics Netherlands (see Statistics Netherlands, 2009). The *Arbeidsmarktpanel* is a very large administrative household panel data set covering individuals aged 15 and over, over the period 1999-2005. The data set combines information from the *Gemeentelijke Basisadministratie* (data from municipalities) 1999-2005 on e.g. demographics and household characteristics, the *Sociaal Statistisch Bestand* (Social Statistical Panel) 1999-2005 on e.g. wage income and hours worked, and the *Enquete Beroepsbevolking* (Labour Force Survey) 1996-2005 on e.g. educational attainment.

Entry into the panel occurs mostly because people turn 15 or immigrate, exit from the panel occurs mostly because people die or emigrate. We make a selection from this data set. We drop all individuals under 20 years old and over 57 years old. The maximum age is set at 57 years old because we do not want outcomes to be influenced by the changes in early retirement benefits in the data period. We also drop students. We further drop households for which we have incomplete demographic information (e.g. the age of the children is missing) or households for which we have incomplete partner information. When there is a time gap for a household we only keep the longest period.

For the education-cohort-period dummies, that capture exogenous changes in net hourly wages per group, we define the following education groups and cohorts. Education is subdivided into three groups: lower educated (up to lower secondary education), middle educated (in between lower secondary education and tertiary education) and higher educated (tertiary education). For cohorts we also use three groups: born in the 50s (1950-1959), born in the 60s (1960-1969) or born in the 70s (1970-1979). We observe these individuals over the period 1999-2005.

Table 2 gives some descriptive statistics for couples. Men in couples are on average somewhat older and are more likely to have a college or university degree. About one third of the women lives in couples without a child, one quarter has a child that is too young to go to school, and about one quarter has a youngest child in elementary school.

(**PM Descriptive statistics for singles.**)

To determine log hourly net wages we need to calculate marginal tax rates. We calculate marginal tax rates by increasing gross hourly wages by 3%, and then calculate the resulting increase in net disposable income. The change in net disposable income relative to the change in gross wages gives us (one minus) the marginal tax rate. To calculate net disposable income for different levels of gross wage income we use the MIMOSI model of CPB (see Romijn et al., 2008). MIMOSI is, among other things, a very detailed (non-behavioural) tax-benefit calculator for the Netherlands. MIMOSI takes into account all income dependent taxes and subsidies, which may depend on individual but also on household income.

Table 3 gives some descriptive statistics on the average marginal tax rates on all

Table 2: Descriptive statistics couples, 1999-2005

	Women	Men
Age	39.5	40.7
Level of education		
Primary + lower secondary (in %)	33	28
Higher secondary (in %)	46	44
College or university (in %)	22	28
No children (in %)	32	28
Youngest child 0-3 (in %)	24	26
Youngest child 4-11 (in %)	27	29
Youngest child 12-17 (in %)	17	16
Partner		
Age	42.1	38.5
Level of education		
Primary + lower secondary (in %)	28	31
Higher secondary (in %)	43	47
College or university (in %)	28	22
Observations	1,091,370	1,042,172

individuals, and on women and men, in the years 1999-2005. We see that in 2001 marginal tax rates dropped on average by 4.75 percentage points, with a slightly larger drop for women than for men on average. We also see that in the other years there are some minor changes in average marginal tax rates, which are much smaller in size than the change from 2000 to 2001. We use these data to motivate the choice of our preferred instrument. That is, in our base specification we use a cohort-education-period treatment dummy where the period is the whole period 2001-2005, as in Bosch and van der Klaauw (2012). As a robustness check we

Table 3: Marginal tax rates, 1999-2005

	1999	2000	2001	2002	2003	2004	2005
All	0.466	0.470	0.425	0.433	0.441	0.430	0.435
Women	0.438	0.440	0.390	0.399	0.406	0.382	0.385
Men	0.492	0.499	0.457	0.464	0.471	0.476	0.485

also consider annual cohort-education-period dummies as in Blundell et al. (1998). However, this seems more appropriate for their dataset than ours. They study data with a number of consecutive changes in marginal tax rates whereas we basically have one major change in marginal tax rates. (**PM Bar plot of changes in marginal tax rates from large negative to large positive.**)

5 Results

We first consider the results for singles and then consider the results for couples. Here we only report the estimates for the hours worked equation, to ease the exposition we relegated the estimates for the participation and wage equations to the Appendix (**PM Insert tables**).

5.1 Singles

Table 4 gives the results for the hours equation (4) for singles. We split the sample into four groups: single women without children, single men without children, single women with (dependent) children and single men with (dependent) children.

First, consider the results for single women without children, column (1). The log net wage has a significant, positive coefficient. This suggests that the intensive margin response is positive for this group. Given the log specification for net wages, division of the coefficient by mean hours worked per week gives the intensive labour supply elasticity at the mean. This yields a value of 0.148. The coefficient of the residual from the wage equation has a significant negative effect on hours worked. Hence, it is important to control for endogeneity of the wage in the hours equation. Furthermore, we do not suffer from a weak instrument problem, as a F-test on the cohort-education-period dummies in the wage equation shows that we clearly

Table 4: Hours per week: singles

	Without children		With children	
	(1)	(2)	(3)	(4)
	Women	Men	Women	Men
Log net wage	4.913**	7.029***	6.233***	PM
	(2.402)	(1.291)	(2.228)	
Residual wage equation	–10.36***	–9.560***	–17.10***	
	(2.404)	(1.396)	(2.240)	
Inverse Mills' ratio	–22.90***	–13.92***	6.419***	
	(2.188)	(1.755)	(1.460)	
Observations	84936	91605	36289	
F-test instruments wage equation	47.03	60.27	27.67	
Mean hours per week	33.22	35.99	30.36	
Intensive elasticity	0.148**	0.195***	0.205***	
	(0.072)	(0.036)	(0.073)	

Robust standard errors in parentheses, ***p<0.01, ** p<0.05, * p<0.1.
Complete set of cohort-education and time dummies included.

reject the null hypothesis that they are jointly zero. We also find a significant coefficient for the inverse Mills' ratio.[6] Hence, it is important to take selection into employment into account. Furthermore, Table (**PM**) in the Appendix shows that the education-cohort-period dummies, and hence the reform, play a significant role in the participation probability.

Next, consider the results for single men without children, column (2). The parameter estimate for log net wages is higher than for single women, and again highly significant. Dividing by mean hours we obtain the intensive margin elasticity at the mean of 0.195 (**PM signficantly different from single women?**). The residual from the wage equation and the inverse Mills' ratio from the participation equation are again highly significant, again suggesting it is important to control for the endogeneity of the net hourly wage and selection into participation. Again, we

[6] As opposed to Blundell et al. (1998).

do not seem to suffer from a weak instrument problem in the wage equation and the education-cohort-period dummies again play an important role in the participation equation (see Table (**PM**) in the Appendix).

The parameter estimate for the log net hourly wage single mothers, column (3), is in between the estimate for single women and single men. However, given their lower mean number of working hours the elasticity is the highest among the singles, at 0.205, though the estimate is not signficantly different from the estimate for single women and men without children. Again, the estimates show that it is important to control for selection into participation and the endogeneity of wages. Furthermore, we also do not suffer from a weak instrument problem in the wage equation of single mothers.

(**PM Results for single fathers.**)

5.2 Couples

Table 5 gives the estimation results for the hours equation for women and men in couples. (**PM split into women and men in couples without and with children.**)

First, consider the results for women in couples, column (1). The parameter estimate for the log net wage for women in couples is smaller than for single women and single mothers, though significantly different from zero. However, they also work less hours per week. Dividing by mean hours we obtain the intensive margin elasticity at the mean of 0.13, which is just below the elasticity calculated for single women. This result is at the lower bound of previous labour supply elasticities for women.

Table (**PM**) in the Appendix reveals that the education-cohort-period dummies, and hence the reform, play a significant role in the participation probability for women. We also see that the coefficient of the residual of the wage equation has a significant negative effect on hours worked for women. Hence, it is important to control for endogeneity of the wage in the hours equation. Table (**PM**) in the Appendix shows that we do not suffer from weak instruments. A joint F-test, reported below the Table, shows we clearly reject the null hypothesis that all education-cohort-period dummies are zero.

Next, consider the results for men in couples, column (2). The parameter esti-

Table 5: Hours per week: couples

	(1) Women	(2) Men
Log net wage	3.371**	0.322
	(1.669)	(0.390)
Residual wage equation	–11.06***	–1.183***
	(1.672)	(0.391)
Inverse Mills' ratio	10.50***	–1.599***
	(0.505)	(0.602)
Lower educ partner	0.743***	1.318***
	(0.130)	(0.0397)
Medium educ partner	0.765***	0.877***
	(0.0779)	(0.0265)
Youngest child 0-3	–11.48***	–0.172***
	(0.220)	(0.0189)
Youngest child 4-11	–9.333***	–0.0369**
	(0.130)	(0.0182)
Youngest child 12-17	–4.086***	0.193***
	(0.0462)	(0.0234)
Observations	399811	461268
F-test instruments wage equation	63.99	336.81
Mean hours per week	25.3	37.1
Intensive elasticity	0.13**	0.01
	(0.066)	(0.011)

Robust standard errors in parentheses, ***p<0.01, ** p<0.05, * p<0.1.
Complete set of cohort-education and time dummies included.

mate for the log net wage for men in couples is much smaller than for women in couples and for single men. Furthermore the parameter estimate is not signficantly different from zero. The uncompensated wage elasticity at the mean equals just 0.01. However, it is still important to control for endogeneity of wages and selection into participation. Furthermore, Table (**PM**) in the Appendix shows that most education-cohort-period dummies are significant, and according to Table (**PM**) in the Appendix our instruments are not weak (see joint F-test, reported in Table 5).

Finally, consider the coefficients for the demographics are used to control for heterogeneity among men and women. Those with lower educated partners work more hours than those with higher educated partners. Women with (young) childeren work less hours than those without childeren. Fathers and men without children work on average more or less the same hours.

5.3 Robustness analysis

Next we present a number of robustness checks.

5.3.1 Singles

Table 6 gives a number of robustness checks for single women. When we use annual cohort-education-period dummies, as in Blundell et al. (1998), we obtain quite similar results as in the base specification, with a slightly higher elasticity. However, the F-test reveals that these annual dummies are weaker as an instrument. We observe wages for about 40% of workers. When we drop workers for which we do not observe a wage from the participation equation, the elasticity rises quite a bit, to 0.384. Also, when we control for selection using individual fixed effects instead of the inverse Mills' ratio, the elasticity rises to 0.396.

(**PM Investigate further.**)

Table 7 gives a number of robustness checks for single men. When we use annual cohort-education-period dummies, as in Blundell et al. (1998), we obtain quite similar results as in the base specification, now with a slightly lower elasticity. However, again the F-test reveals that these annual dummies are weaker as an instrument. When we drop workers whose wage is not observed from the participation equation, we obtain a somewhat larger elasticity. Introducing individual fixed effects leads to a similar elasticity as the base specification for single men.

Table 6: Sensitivity analysis: single women

	Base[a]	Instrument 2[b]	Excluding employed without wage[c]	Fixed effects[d]
Log net wage	4.913**	5.901***	12.75***	13.35***
	(2.402)	(2.255)	(2.348)	(2.176)
Residual wage equation	−10.36***	−11.37***	−18.20***	−23.10***
	(2.404)	(2.260)	(2.349)	(2.254)
Inverse Mills' ratio	−22.90***	−15.03***	−8.351***	
	(2.188)	(2.302)	(1.025)	
Observations[e]	84936	84936	84936	31552
F-test instruments wage equation	47.03	13.59	47.03	29.82
Mean hours per week	33.22	33.22	33.22	33.74
Intensive elasticity	0.148**	0.178***	0.384***	0.396***
	(0.072)	(0.068)	(0.071)	(0.064)

Standard errors in parentheses, ***p<0.01, ** p<0.05, * p<0.1. Complete set of cohort-education and time dummies included. [b]Instrument 2 are cohort-education-period dummies as in Blundell *et al.* (1998).. [c]Excluding employed individuals with missing wages in probit. [d]The wage and hours equation includes individual fixed effects and we drop the inverse Mills' ratio in the hours equation. Hours equation only includes individuals working in all observed periods, and observed before and after 2001. [e] Observations in hours equation.

Table 7: Sensitivity analysis: single men

	Base[a]	Instrument 2[b]	Excluding employed without wage[c]	Fixed effects[d]
Log net wage	7.029***	6.444***	9.804***	6.390***
	(1.291)	(1.108)	(1.339)	(1.222)
Residual wage equation	−9.560***	−8.976***	−12.32***	−13.41***
	(1.296)	(1.117)	(1.341)	(1.358)
Inverse Mills' ratio	−13.92***	−9.831***	−5.150***	
	(1.755)	(1.594)	(0.758)	
Observations[e]	91605	91605	91605	29441
F-test instruments wage equation	60.27	13.66	60.27	31.44
Mean hours per week	35.99	35.99	35.99	36.23
Intensive elasticity	0.195***	0.179***	0.272***	0.176***
	(0.036)	(0.031)	(0.037)	(0.033)

Standard errors in parentheses, ***p<0.01, ** p<0.05, * p<0.1. Complete set of cohort-education and time dummies included. [b]Instrument 2 are cohort-education-period dummies as in Blundell *et al.* (1998).. [c]Excluding employed individuals with missing wages in probit. [d]The wage and hours equation includes individual fixed effects and we drop the inverse Mills' ratio in the hours equation. Hours equation only includes individuals working in all observed periods, and observed before and after 2001. [e] Observations in hours equation.

Table 8: Sensitivity analysis: single mothers

	Base[a]	Instrument 2[b]	Excluding employed without wage[c]	Fixed effects[d]
Log net wage	6.233***	–8.410***	5.054**	1.320
	(2.228)	(1.593)	(2.137)	(2.830)
Residual wage equation	–17.10***	–2.380	–15.91***	–8.405***
	(2.240)	(1.607)	(2.148)	(2.848)
Inverse Mills' ratio	6.419***	6.870***	6.077***	
	(1.460)	(1.337)	(1.092)	
Observations[e]	36289	36289	36289	13749
F-test instruments wage equation	27.67	11.31	27.67	13.34
Mean hours per week	30.36	30.36	30.36	31.18
Intensive elasticity	0.205***	–0.277***	0.166**	0.042
	(0.073)	(0.052)	(0.070)	(0.091)

Standard errors in parentheses, ***p<0.01, ** p<0.05, * p<0.1. Complete set of cohort-education and time dummies included. [b]Instrument 2 are cohort-education-period dummies as in Blundell *et al.* (1998).. [c]Excluding employed individuals with missing wages in probit. [d]The wage and hours equation includes individual fixed effects and we drop the inverse Mills' ratio in the hours equation. Hours equation only includes individuals working in all observed periods, and observed before and after 2001.
[e] Observations in hours equation.

Table 8 gives a number of robustness checks for single mothers. When we use annual cohort-education-period dummies, as in Blundell et al. (1998), we now obtain quite different results as in the base specification. The elasticity turns significantly negative. However, again the F-test reveals that these annual dummies are weaker as an instrument. (**PM Investigate further.**) When we drop workers whose wage is not observed from the participation equation, we obtain a somewhat smaller elasticity. Introducing individual fixed effects leads to a small insignificant elasticity for single mothers. (**PM Investigate further.**)

5.3.2 Couples

Table 9 reveals that the instrument choice - either cohort-education dummmies for each year or before or after 2001 - does not chance our results. However, excluding those workers whose wages are unobserved (due to the data collection) increases the elasticity. In our baseline specification we include the education level of the partner. If we furthermore include the wage of the husband, sensitivity to the wage effect becomes much higher. The reason for inclusion of the partner's net wage is that his wage is also affected by the tax reform. Still, the net wage can suffer from reserved causality and/or endogeneity problems and it might be a good idea to instrument the net wage of the partner as well.
The wage elasticity of men in couples seems to be highly robust to the different specifications (see Table 10).

5.4 Comparison with structural discrete choice model

Table 11 compares the intensive margin elasticities in our base specifications, obtained using quasi-experimental methods, with the intensive margin elasticities simulated in Mastrogiacomo et al. (2011) using a structural discrete choice model estimated on the same data set.[7] The results generally line up quite well. The intensive margin elasticities are relatively small. The elasticities obtained for singles with

[7]The elasticities in Mastrogiacomo et al. (2011) are simulated with a 10% increase in gross wages. These numbers are not fully comparable to the estimates here, because here we calculate responses to changes in net wages. Non-linearities in the tax system can create a wedge between both elasticities.

Table 9: Sensitivity analysis: Women in couples

	Base[a]	Instrument 2[b]	Excluding employed without wage[c]	Wage husband[d]
Log net wage	3.371**	3.790***	6.960***	11.18***
	(1.669)	(1.017)	(1.859)	(3.185)
Residual wage equation	–11.06***	–11.49***	–14.65***	–15.32***
	(1.672)	(1.020)	(1.860)	(3.188)
Inverse Mills' ratio	10.50***	10.52***	5.304***	10.55***
	(0.505)	(0.486)	(0.335)	(0.845)
Lower educ partner	0.743***	0.773***	1.037***	–0.442***
	(0.130)	(0.0836)	(0.142)	(0.125)
Medium educ partner	0.765***	0.784***	0.763***	–0.0672
	(0.0779)	(0.0552)	(0.0871)	(0.0618)
Youngest child 0-3	–11.48***	–11.53***	–11.25***	–11.61***
	(0.220)	(0.176)	(0.255)	(0.322)
Youngest child 4-11	–9.333***	–9.359***	–9.250***	–9.288***
	(0.130)	(0.109)	(0.154)	(0.164)
Youngest child 12-17	–4.086***	–4.083***	–4.177***	–3.850***
	(0.0462)	(0.0438)	(0.0514)	(0.0832)
Observations	399811	399811	697045	232719
F-test instruments wage equation	63.99	27.26	63.99	21.76
Mean hours per week	25.3	25.3	25.3	24.1
Intensive elasticity	0.13**	0.15***	0.28***	0.46***
	(0.066)	(0.040)	(0.074)	(0.132)

Standard errors in parentheses, ***p<0.01, ** p<0.05, * p<0.1. Complete set of cohort-education and time dummies included. [b]Instrument 2 are cohort-education-period dummies as in Blundell *et al.* (1998).. [c]Excluding employed individuals with missing wages in probit. [d]The wage and hours equation includes wage husband Hours equation only includes individuals working in all observed periods, and observed before and after 2001. [e] Observations in hours equation.

Table 10: Sensitivity analysis: Men in couples

	Base[a]	Instrument 2[b]	Excluding employed without wage[c]	Wage husband[d]
Log net wage	0.322	0.189	0.646*	1.083
	(0.390)	(0.357)	(0.364)	(1.002)
Residual wage equation	–1.183***	–1.051***	–1.507***	–1.809*
	(0.391)	(0.359)	(0.365)	(1.003)
Inverse Mills' ratio	–1.599***	–1.258**	–0.801**	–0.893
	(0.602)	(0.639)	(0.361)	(1.509)
Lower educ partner	1.318***	1.290***	1.340***	0.927***
	(0.0397)	(0.0361)	(0.0467)	(0.0543)
Medium educ partner	0.877***	0.877***	0.900***	0.693***
	(0.0265)	(0.0265)	(0.0222)	(0.0424)
Youngest child 0-3	–0.172***	–0.173***	–0.168***	–0.452***
	(0.0189)	(0.0190)	(0.0195)	(0.0318)
Youngest child 4-11	–0.0369**	–0.0313*	–0.0390**	–0.263***
	(0.0182)	(0.0177)	(0.0182)	(0.0355)
Youngest child 12-17	0.193***	0.204***	0.195***	0.201***
	(0.0234)	(0.0233)	(0.0244)	(0.0528)
Observations	461268	461268	522042	216242
F-test instruments wage equation	336.81	71.95	336.81	70.52
Mean hours per week	37.1	37.1	37.1	36.6
Intensive elasticity	0.01	0.01	0.02*	0.03
	(0.011)	(0.010)	(0.010)	(0.027)

Standard errors in parentheses, ***p<0.01, ** p<0.05, * p<0.1. Complete set of cohort-education and time dummies included. [b]Instrument 2 are cohort-education-period dummies as in Blundell *et al.* (1998).. [c]Excluding employed individuals with missing wages in probit. [d]The wage and hours equation includes wage of the wife
Hours equation only includes individuals working in all observed periods, and observed before and after 2001.
[e] Observations in hours equation.

Table 11: Comparison findings quasi-experimental and structural model

	This paper Quasi-experimental		Mastrogiacomo et al. (2011) Structural model	
	Women	Men	Women	Men
Singles	0.15	0.20	0.08	0.06
Single parents	0.21	PM	0.18	0.11
Couples without children	0.13	0.01	0.05	0.00
Couples with children	0.13	0.01	0.12	0.01

children and couples with children are remarkably close. The elasticities for singles without children are somewhat larger according to the quasi-experimental method, and the same is true for women in couples without children.(**PM Significantly different?**)

6 Conclusion

There is considerable interest in the size of the extensive (persons) and intensive (hours per week) elasticity of labour supply with respect to financial incentives, both in academia and in the policy arena. Should in-work subsidies be targeted at the decision whether or not to work, or on the number or hours that people work? In this paper we have provided new empirical evidence on the size of the intensive margin elasticity, for a large number of subgroups, using a large tax reform in 2001 in the Netherlands. Despite the large size of the reform, we find rather small intensive margin elasticities for all groups. Using the same data set, Mastrogiacomo et al. (2011) estimate a structural discrete choice model, and find similar small intensive margin effects. Indeed, the analysis in Mastrogiacomo et al. (2011) suggests that the extensive margin is far more important than the intensive margin, in particular for single mothers, mothers in couples and lower educated singles. This suggests that employment policy should be mostly targeted at the participation margin, and to a much lesser extent of the intensive margin, *e.g.* trying to make mothers work more hours.

In future research we want to widen the scope of the intensive margin analysis, looking beyond labour supply. Indeed, via effort, education and other variables partly under the control of workers, marginal tax rates may have an impact on the tax base on top of the effects on labour supply. This seems particularly relevant for higher income workers. Hence, in the future we plan to study the impact of marginal tax rates on taxable income, following the seminal work of *e.g.* Feldstein (1995), Gruber and Saez (2002) and the growing body of literature summarized in Saez et al. (2012). Furthermore, we continue our hunt for interesting natural experiments in the Netherlands to study the response of labour supply to changes in financial incentives.

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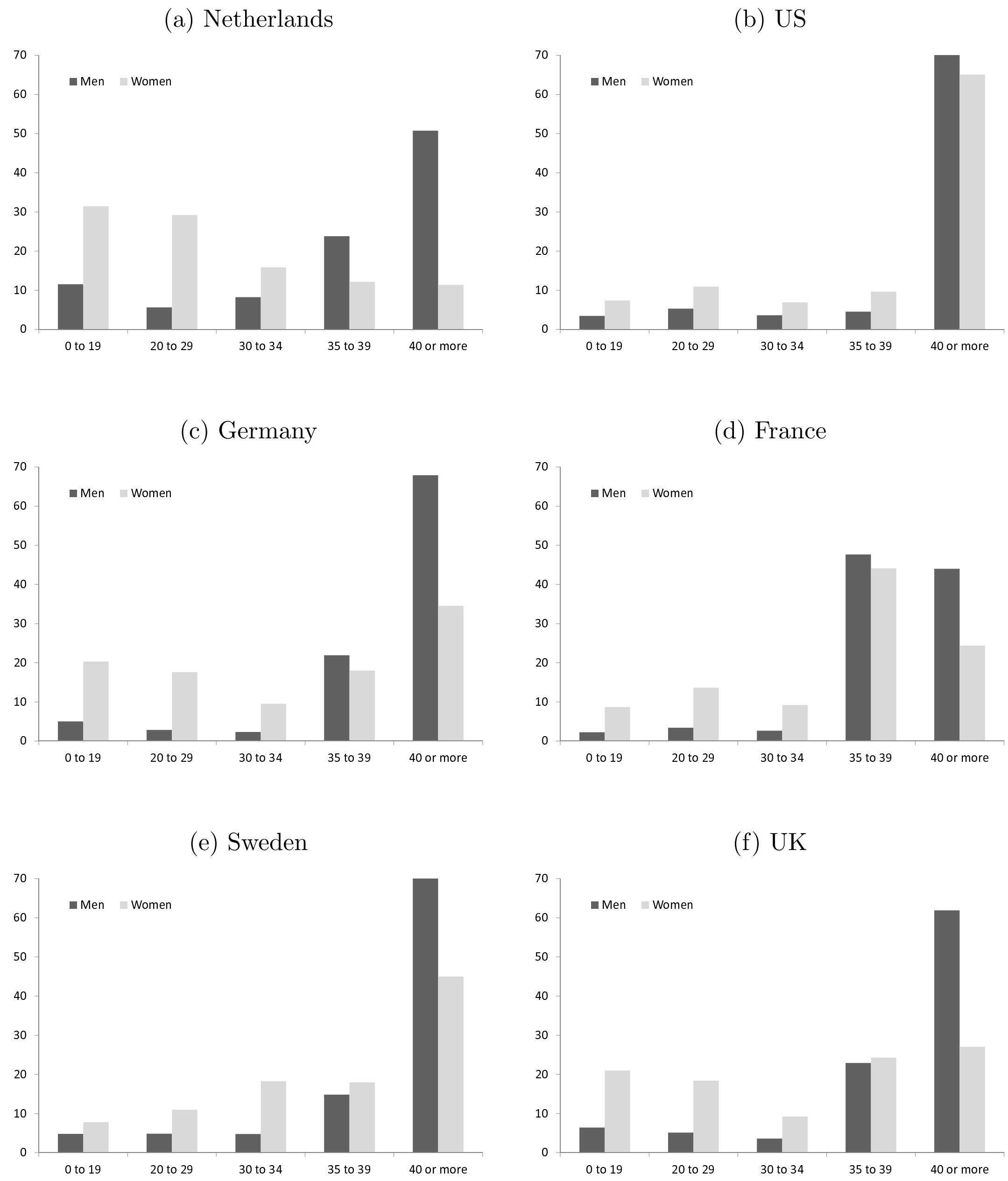
Figure 3: Distribution of workers over hours classes



Source: OECD Family database.