

14.471: Fall 2012: Recitation 3: Labor Supply: Blundell, Duncan and Meghir EMA (1998)

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Questions: How big is the labor supply elasticity? How should estimation deal with changing composition of taxpayers?

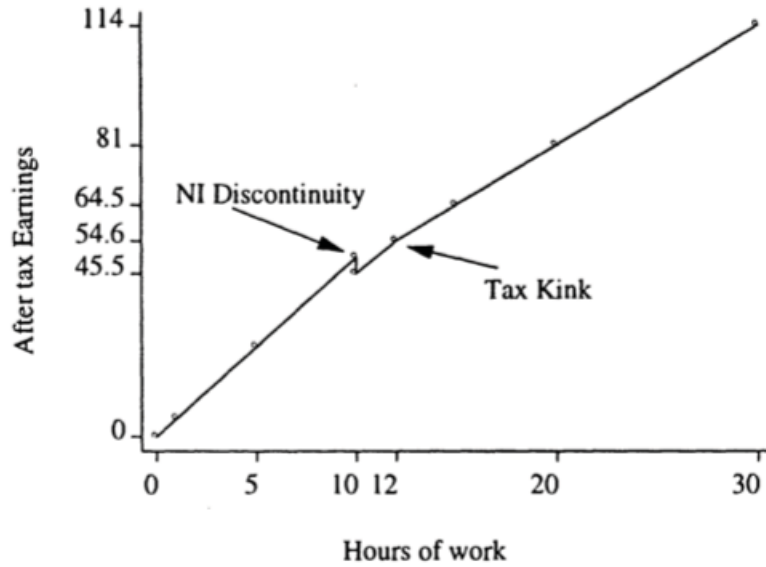
1 Introduction

- Estimation of labor supply elasticity is difficult (e.g. downward wage bias if hard workers face higher marginal tax rates and lower hourly wages)
- Distribution of weekly hours of work for married women is high
- Combine a structural approach and instrumental variables, exploiting tax reforms and changing wage structure (e.g. increase in return to education), to overcome estimation problems.
- Data: repeated cross-sections of UK Family Expenditure Survey over 1978-1992 (including consumption)
- Main result: Using taxpayer status as grouping instrument gives negative elasticities (because of systematic change in composition in taxpayer groups over time)

2 UK tax policy reforms

- Tax kink: Tax is paid only on earnings above allowance (30% married women pay no taxes)
- NI Discontinuity: Since individuals pay national insurance (NI) contributions on the **entire** income above a threshold (LEL), the after tax earnings decrease locally in the number of hours of work.
- 2 sources of identifying information:
 - Several tax reforms (rate reductions, phasing out of NI discontinuity, fall of earnings threshold in real terms, ...) trigger differential tax rate changes across groups
 - * 33% of variation in tax rate explained by cohort-education * time interactions
 - * 67% of variation: cohort-education and time effects
 - Large increase in wage dispersion

Figure 1: Budget constraint



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3 Identifying labor supply responses from tax policy reforms

- Specification for hours of work w as additive function of “unobserved taste variation” α , the post tax hourly wage w and other income $\mu = c - wh$.

$$h_{it} = a_i + b \ln w_{it} + \gamma \mu_{it} + u_{it} \quad (1)$$

- Challenges with estimating (1):
 - Common shocks (tax reforms based on expected labor shifts, source of bias if limited number of periods: “boom period”, ...)
 - Correlation of w_{it} with u_{it}
 - Selection into employment
- Grouping estimators to tackle these challenges. Suppose there are two groups $g = \{u, d\}$. $P_{it} = 1$ if individual i is working at t . For any variable x_{it} (e.g. wage w_{it}), define D_x^{gt} as the part of the mean of variable x for the workers in group g at time t which cannot be explained by the (permanent) “workers in group g ”- effect and the (group-invariant) “workers at time t ”- effect:

$$D_x^{gt} = E(x_{it} | P_{it}, g, t) - E(x_{it} | P_{it}, g) - E(x_{it} | P_{it}, t)$$

3.1 Permanent group effects

- Make 2 assumptions:
 - Unobserved differences in average labor supply across groups can be summarized by a permanent group effect a_g and an additive time effect m_t

$$E(u_{it} | P_{it}, g, t) = a_g + m_t \quad (2)$$

- Wages grow differentially across groups (“rank condition for identification”):

$$E(D_w^{gt})^2 \neq 0 \quad (3)$$

* After having taken away time and group effects, still some variance in wages left (e.g. tax reform affecting 1 group but not another)‘

- With assumptions (2) and (3), we can implement the generalized Wald Estimator (Heckman and Robb (1985)) for grouping estimators. Define $\tilde{x}_{gt} = \bar{x}_{gt} - \tilde{x}_g - \tilde{x}_t$ as teh sample counterpart of D_x^{gt} . We have:

$$\hat{b} = \frac{\sum_g \sum_t [h_{gt}][\ln \tilde{w}_{gt}]/n_{gt}}{\sum_g \sum_t [\ln \tilde{w}_{gt}]^2/n_{gt}} \quad (4)$$

- Simple estimation:
 - group data for workers by cell (group g and time t)
 - regress by WLS the group average of hours of work on the group average of the log wage
 - include time dummies and group dummies
- Note: for 2 groups and 2 periods, we have a simple DD estimator.

3.2 Time-varying group effects

- So far we assumed that composition effects in participation can be accounted for by additive time and group effects. But m_t will cause entry/exit. $E(u_{it} | P_{it}, g, t)$ can be a general function of time and group and does not have to be additive as in (2).
- 2 less restrictive assumptions:
 - Composition changes affect differences in labor supplies across groups in a linear way:

$$E(u_{it} | P_{it}, g, t) = a_g + m_t + \delta \lambda_{gt} \quad (5)$$

* Where λ_{gt} is the inverse Mill’s ratio evaluated at $\phi^{-1}(L_{gt})$, ϕ^{-1} being the inverse function of the normal distribution and L_{gt} being the proportion of group g working in period t .

* This is Heckman (1976) ’s correction remedy to the OLS-bias when dependent variable is censored (GM violation: non-zero correlation between independent variables and error term) in 2 steps:

- Probit for positive outcomes -> calculate inverse Mills Ratio (Remember that the inverse Mills Ratio equals $\frac{\phi(\frac{\alpha-\mu}{\sigma})}{1-\Phi(\frac{\alpha-\mu}{\sigma})}$ and shows up in the expression for the truncated mean of a normal distribution $E(X | X > \alpha) = \mu + \sigma \frac{\phi(\frac{\alpha-\mu}{\sigma})}{1-\Phi(\frac{\alpha-\mu}{\sigma})}$)

• Add Inverse Mills Ratio as additional explanatory variable in OLS

- Wages must vary differentially across groups over time and above any observed variation by changes in smaple composition:

$$[D_w^{gt} - \delta_w \lambda_{gt}]^2 = 0 \quad (6)$$

- The following wald Estimator for grouping estimators generalizes (4):

$$\hat{b} = \frac{\sum_g \sum_t [h_{gt} - \delta_h \hat{\lambda}_{gt}][\ln \tilde{w}_{gt} - \delta_w \hat{\lambda}_{gt}]/n_{gt}}{\sum_g \sum_t [\ln \tilde{w}_{gt} - \delta_w \hat{\lambda}_{gt}]^2/n_{gt}} \quad (7)$$

3.3 Time-varying or permanent group effects?

- To determine wheter to use (4) or (7), test the null that $E(D_\lambda^{gt})^2 = 0$ (“ group- and time affects do control for composition changes”)

3.4 Discontinuities

- Ignoring downwards biases the wage effects: We would attribute the inertia of people on the kink to their preferences rather than to the structure of the budget constraint.
 - Condition out on observations close to the kink (in a range of 5 hours)
 - Add additional selectivity term
 - Ordered probit: working non-taxpayers, those close to kink and those above the kink
 - λ_{gt} is a vector with two stepwise regression coefficients

3.5 Identifying assumptions

- Let us define 8 groups whose post-tax wages (and other income) have changed differentially over time
 - 4 cohorts
 - minimum vs. higher education
- Identifying assumptions:
 - Average differences in labor supply (given wage, other income and demographics) between the groups defined above are constant over time.
 - Post tax wages and other incomes of groups do change differentially over time (why? cohort effects on wages and returns to education)

3.6 Implementation of estimator:

- Four reduced forms (“1st stage”):
 - Example to control for endogeneity of log wage (Table IX in paper)
- $$\ln w_{it} = \beta_0 Time + \beta_1 Time * Group + AgeKids + \hat{v}_{it}^w$$
- Similarly, generate residuals from reduced form to control for endogeneity of other income (\hat{v}_{it}^μ), participation (\hat{v}_{it}^P), an inverse Mills Ratio) and selection away from the tax and NI kink (\hat{v}_{it}^T , a generalized residual from an ordered probit)
 - Intuition: several instruments (e.g. Do you belong to cohort x education y) predicting wages but not hours through another channel than via wages

- Estimation of labor supply equation using OLS (“2nd stage”)

$$h_{it} = a_g + m_t + \theta DK_{it} + \beta \ln w_{it} + \gamma \mu_{it} + \delta^w \hat{v}_{it}^w + \delta^\mu \hat{v}_{it}^\mu + \delta^P \hat{v}_{it}^P + \delta^T \hat{v}_{it}^T + e_{it} \quad (8)$$

- Gives identical results to grouping but provides direct tests of exogeneity!
- 2nd stage: you include wages and residual from the 1st stage. Then the coefficient on wages is your actual estimated effect. Testing the null on residual is the endogeneity test (e.g. Working hard will trigger a higher wage -> positive residual and also higher hours -> hence delta will be positive and significant)

4 Labor supply responses

4.1 Data

- Non-taxpayers bridge part of the “hours gap” with taxpayers

Figure 2: Differences of female hours of work between taxpayers and non-taxpayers over time

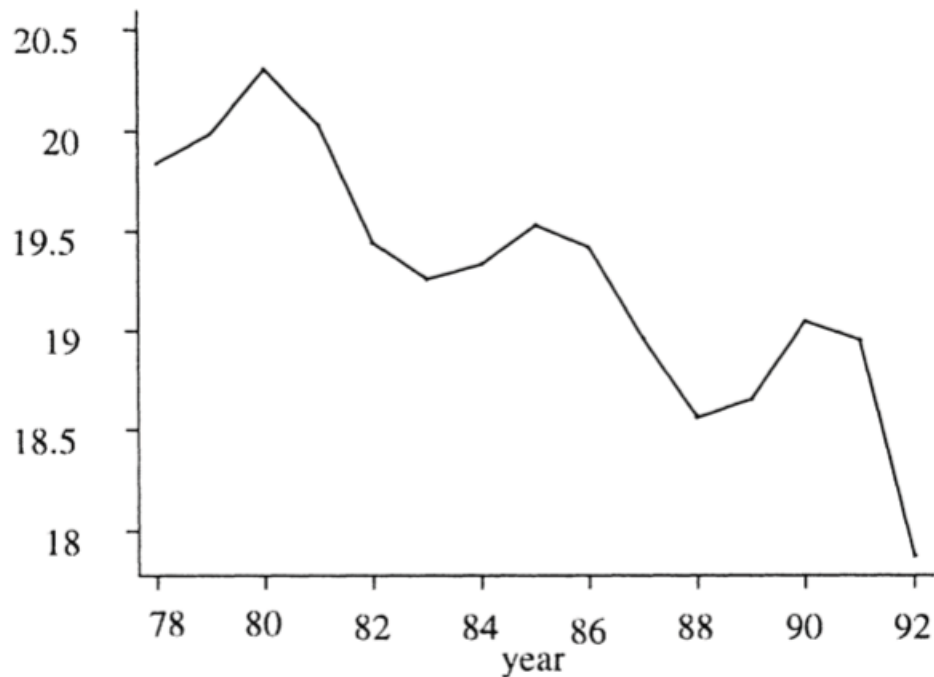
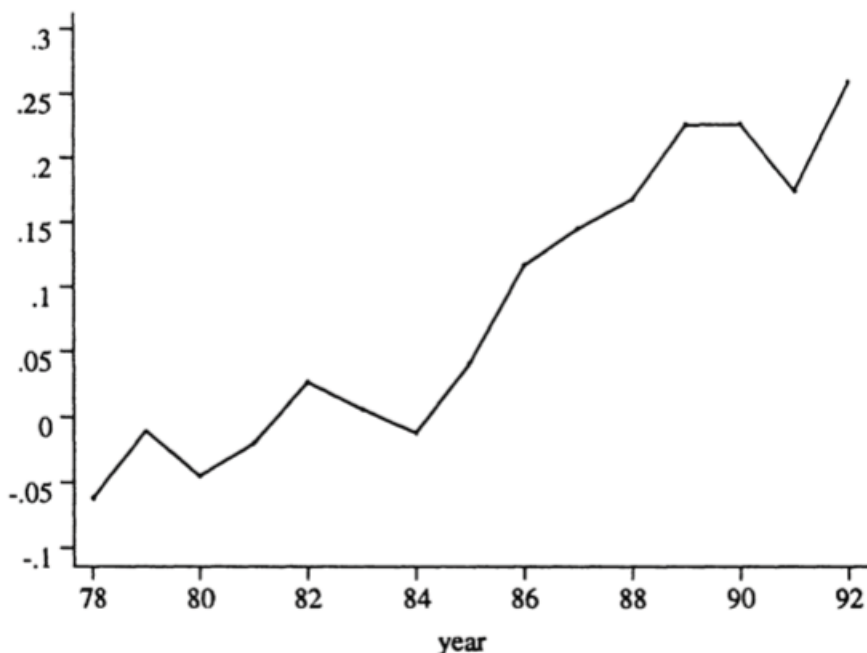


FIGURE 4.—Differences of female hours of work between taxpayers and non-taxpayers over time.

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- Wage increases more for taxpayers

Figure 3: Differences in female log wages between taxpayers and non-taxpayers over time



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- A simple DD inferred from figures (4.1) and (4.1) would imply a negative wage effect on labor supply! But only justified if assume that the composition of the 2 groups, vis a vis tastes for work, has remained constant over time.

4.2 Reduced forms and validity of instruments

- Null: Endogenous variable has not been changing differentially over time across education and cohort groups
- Results:
 - Log wage: rejected
 - Other income: rejected
 - Ordered probit: borderline
 - Participation: no rejection (“**composition effects due to changes in participation are explainable by time and group effects**”)
- We can drop participation from regression
- We have a larger number of groups*time periods than parameters to estimate (overidentification)

4.2.1 Estimates

- Table IV:
 - small positive uncompensated elasticities (around 0.15)
 - positive compensated wage elasticities (highest for children at pre-school age): around 0.2 (because small, negative income effects)
- Table V

- Column (i):
 - * Correct for endogeneity of wage, other income, participation and selection away from kink
 - * Wage effect of 4.5
- Column (ii):
 - * drop correction for participation
 - * Wage effect almost unchanged of 4.6
- Column (iii):
 - * drop correction for selection away from kink
 - * Wage effect drops to 2.8
- Column (iv):
 - * Use OLS
 - * Large **negative** wage elasticities and more negative income elasticities
 - * This reflects the large and negative coefficient on the wage residual in the first 3 columns
- Column (v)
 - * Compared with (i), we drop tax kink correction
 - * Wage effect drops slightly (those who are on the kink are less likely to react to policy changes according to the labor supply model)

Figure 4: Parameter Estimates
PARAMETER ESTIMATES—GROUPS DEFINED BY COHORT AND EDUCATION

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Constant	33.147 3.439	33.339 3.362	32.261 3.022	40.947 0.693	29.635 3.843	29.558 3.280
DK02	-11.797 1.971	-11.684 1.939	-12.055 1.916	-10.138 1.706	-11.394 1.754	-11.424 1.645
DK34	-15.960 2.217	-16.012 2.214	-16.597 2.168	-15.048 1.941	-15.412 1.812	-15.402 1.701
DK510	-8.466 1.381	-8.531 1.364	-9.196 1.240	-8.132 0.897	-9.242 1.410	-9.231 1.300
DK110	-3.164 1.187	-3.183 1.180	-3.889 1.086	-3.198 0.991	-3.808 1.165	-3.810 1.074
Wage Effects						
No Children	4.493 2.390	4.579 2.364	2.795 2.082	-2.377 0.400	4.196 2.745	4.155 2.336
DK02	4.105 2.558	4.110 2.531	2.976 2.267	-2.148 1.134	1.766 2.809	1.749 2.419
DK34	6.686 2.707	6.739 2.683	5.467 2.405	1.314 1.109	4.185 2.912	4.158 2.533
DK510	2.777 2.448	2.841 2.426	1.520 2.178	-3.661 0.606	1.338 2.781	1.309 2.383
DK11 +	3.260 2.685	3.337 2.664	1.992 2.430	-3.230 0.655	2.308 3.001	2.275 2.629
Other Income						
No Children	0.000 0.015	0.000 0.015	0.013 0.013	-0.008 0.001	0.018 0.015	0.018 0.013
DK02	-0.028 0.016	-0.028 0.016	-0.016 0.014	-0.037 0.005	-0.004 0.016	-0.004 0.014
DK34	-0.022 0.017	-0.021 0.017	-0.008 0.016	-0.030 0.009	0.002 0.016	0.002 0.015
DK510	-0.014 0.015	-0.014 0.015	-0.001 0.013	-0.023 0.003	0.010 0.015	0.011 0.013
DK11 +	-0.011 0.014	-0.010 0.014	0.002 0.012	-0.019 0.003	0.009 0.014	0.009 0.012
Residuals						
Wage	-6.699 2.482	-6.758 2.455	-5.246 2.204		-7.435 2.820	-7.405 2.426
Other Income	-0.008 0.015	-0.009 0.015	-0.021 0.013		-0.029 0.015	-0.029 0.013
Tax Kink	0.336 0.082	0.321 0.083				
Participation	0.258 0.450				-0.071 0.347	

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- Why do OLS results differ from IV?
 - Endogeneity of pre-tax wage or differential changes in composition of the taxpaying group i

- Reestimate (1) including taxpayer status as a grouping instrument
 - time effects, group effects (taxpaying status+chort+education)
 - DD estimator with non-taxpayers as control: we control for endogeneity of individual pre-tax ages by grouping
 - Results very similar to those obtained by OLS
 - Now, we again assume that taste differences btwn taxpyaers and non-taxpayers consist of a group FE and time effect
 - BUT in (4.2.1) we allow for changes in taste composition btwn the 2 groups over itme
- Why is this important?
 - Female LFP has increased from 0.62 in 82 to 0.76 in 92
 - Women entering in 1980’s are relatively well paid part-timers: “average unobserved taste for work falls among taxpayers”
 - * Decline of relative hours for taxpaying group and leads to negative wage elasticity in Table VII as well as for OLS
 - * Regrouping the data by groups **whose composition cannot change (date of birth, education received)** reverses the results and gives positive substitution elasticiteis

5 Conclusions

- Develop extensions of DD estimator that account for the effects of changs in labor force composition and for the discontinuities
- Moderataty sized and positive subsituiou elasticities and small and negative income elasticitiis
- We can explain participation with time and group effects.
- OLS results very different from IV
 - Changes in the composition of the taxpayer groups over time
 - **BUT changes in labor force participation can be explained by common time effects across all groups**
 - Once these are included no further correction is necessary
- Economic conclusion: major tax reform should take into account behavioral effects because sizeable compensated substitution effects
- Econometric conclusion:
 - compositional changes can bias estimates!
 - Chose groups whose composition does not change

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