Aggregation and Labor Supply Elasticities

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Motivation

- aggregate Frisch wage-elasticity of labor supply matters for business cycle analysis and policy advise

- many DSGE models rely on it as a key structural parameter

- aggregate Frisch elasticity difficult to quantify since it depends on

  – distribution of observables and unobservables within population

  – hours adjustment of stayers and movers in the labor market

Objective and Contribution

- derive unified framework to qualify and quantify role of intensive and extensive margin of hours' adjustment for aggregate Frisch-elasticity

- modify aggregation approach in Hildenbrand & Kneip (2005) to allow for corners in individual labor supply decision

main advantage: requires neither specific preferences nor distributional assumptions on explanatory variables

applicable to <u>any</u> model of individual labor supply

Related Literature

i. modern business cycle analysis (Lucas and Rapping, 1969)

Hansen (1985), Rogerson (1988)   employment lotteries
Chang and Kim (2005, 2006) incomplete markets
Gourio and Noual (2009) marginal workers
Fiorito and Zanella (2012)

ii. micro literature on individual Frisch wage-elasticity of labor supply

MaCurdy (1981, 1985), Altonji (1986)
Blundell et al. (1999)
Chetty et al. (2012)

A Dynamic Model of Individual Labor Supply (MaCurdy 1985)

Worker's problem: $$\max_{\{c_t, l_t, a_{t+1}\}_{t=0}^{\infty}} E_0 \sum_{t=0}^{\infty} \beta^t U(c_t, l_t; X_t, Z_t)$$

$$\text{s.t.} \quad T_t \geq l_t + h_t \tag{1}$$

$$c_t + a_{t+1} \leq w_t h_t + (1 + r_t) a_t \quad \forall t \tag{2}$$

$$c_t > 0, l_t \geq 0, h_t \geq 0 \tag{3}$$

$$a_0 \ given, \quad \lim_{T \to \infty} \lambda_T a_T = 0. \tag{4}$$

λ_t is Lagrange multiplier associated with (2). Assume r_t doesn't vary stochastically

Individual labor supply function

$$h_t = \begin{cases} h(w_t, \lambda(w_t, \eta_t), X_t, Z_t) & if \;\; w_t > w_t^R \\ 0 & if \;\; w_t \le w_t^R \end{cases} \qquad \textbf{(*)}$$

reservation wage: $w_t^R \equiv \dfrac{U_l\left[(1+r_t)a_t - a_{t+1}, T, X_t, Z_t\right]}{U_c\left[(1+r_t)a_t - a_{t+1}, T, X_t, Z_t\right]}; \quad (1+r_t)a_t \ge a_{t+1}$

individual Frisch wage-elasticity:

$$\varepsilon_t = \partial_w h(w_t, \lambda_t, Y_t)\frac{w_t}{h_t} = \lim_{\Delta \to 0} \frac{\log h(w_t + \Delta, \lambda_t, X_t, Z_t) - \log h(w_t, \lambda_t, X_t, Z_t)}{\log(w_t + \Delta) - \log w_t}$$

Aggregation

· departs from individual labor supply $h \equiv h(w,\lambda,Y)\cdot I\left(w \geq w^R\right)$

· $\pi^t_{w,w^R,\lambda,Y}$ joint distribution of $\left(w_t, w_t^R, \lambda_t, Y_t\right)$ across population

· replace individual *h, w* in ***(*)*** by respective population means, $\overline{H}_t, \overline{W}_t$

Define: mean hours worked $\overline{H} = \int h(w,\lambda,Y)\cdot I\left(w \geq w^R\right) d\pi^t_{w,w^R,\lambda,Y}$

mean wages of workers $\overline{W} = \int w \cdot I\left(w \geq w^R\right) d\pi^t_{w,w^R}$

mean hours and mean wages corresponding to small, **unexpected and temporary** wage change Δ:

$$\overline{H}(\Delta) = \int h(w+\Delta,\lambda,Y)\cdot I\left(w+\Delta \geq w^R\right) d\pi^t_{w,w^R,\lambda,Y}$$

$$\overline{W}(\Delta) = \int (w+\Delta)\cdot I\left(w+\Delta \geq w^R\right) d\pi^t_{w,w^R}$$

Note: w^R remains unchanged due to i.i.d. shocks

type of wage change (percent vs. level) affects final result

Aggregate Frisch wage-elasticity: $$e_t = \frac{\overline{W}_t}{\overline{H}_t} \cdot \frac{\partial_\Delta \overline{H}_t(\Delta)|_{\Delta=0}}{\partial_\Delta \overline{W}_t(\Delta)|_{\Delta=0}}$$

$\partial_\Delta \overline{H}_t(\Delta)|_{\Delta=0}$ = mean Δh stayers + mean Δh new entrants $\equiv \tau_{h,t}^{\text{int}} + \tau_{h,t}^{ext}$

$\partial_\Delta \overline{W}_t(\Delta)|_{\Delta=0}$ = employ. ratio + mean Δw marginal workers $\equiv EPR_t + \tau_{w,t}^{ext}$

$$e_t = \frac{\overline{W}_t}{\overline{H}_t} \cdot \frac{1}{EPR_t + \tau_{w,t}^{ext}} \left(\tau_{h,t}^{\text{int}} + \tau_{h,t}^{ext} \right)$$

Observe: aggregate elasticity no simple function of individual elasticities

Econometric Modelling I (hours adjustment of stayers, $\tau_{h,t}^{\text{int}}$)

- linear panel data model of hours worked by individual $i=1,..,N^{w}$

$$\log h_{it} = \gamma_0 + \gamma_1 \log w_{it} + X'_{it}\beta + \lambda_{it} + z_{it}$$

$$= \gamma_0 + \gamma_1 \log w_{it} + X'_{it}\beta + \underbrace{\lambda_i + z_i}_{\mu_i} + \underbrace{\lambda_t + z_t}_{\mu_t} + \underbrace{\lambda_{it} - \lambda_i - \lambda_t + z_{it} - z_i - z_t}_{\xi_{it}}$$

Issues: heteroskedastic errors, possibly highly auto-correlated

endogenous wages

Needed: Instrumental variables for w_{it} that must be

correlated with w_{it} and possibly with μ_i, μ_t

uncorrelated with ξ_{it}

- IVs for w_{it} are FT work experience, time-varying regional unemployment rates

- estimate $\hat{\gamma}_1$ using fixed-effect estimation after instrumenting for w_{it}

Econometric Modelling II (Δh, Δw of new entrants, $\tau^{ext}_{h,t}$, $\tau^{ext}_{w,t}$)

- non-parametrically estimate densities of w, w^R conditional on X and expected hours worked conditional on $w = w^R$

  Step 1:regress w and w^R each on different set of explanatory variables

  Step 2:determine conditional densities from respective residuals

- $$\hat{\tau}^{ext}_{w,t} = \int \nu \left(\frac{1}{N_t} \sum_i \hat{f}^{\,t}_{w^R|X=X_i}(\nu) \cdot \hat{f}_{w|X=X_i}(\nu) \right) d\nu$$

  $$\hat{\tau}^{ext}_{h,t} = \int \hat{E}\left(h_t \mid w^R_t = w_t = \nu\right) \cdot \left(\frac{1}{N_t} \sum_i \hat{f}^{\,t}_{w^R|X=X_i}(\nu) \cdot \hat{f}_{w|X=X_i}(\nu) \right) d\nu$$

Data

- German Socio-Economic Panel (SOEP, analogous to US PSID)
- males from former West-Germany, 25-64 years old
- annual data from 2000 through 2009
- sample size: unbalanced panel of employed men (2,918 to 3,807)
between 91 and 140 non-employed men
- indirect info on net real **reservation wages** and desired work hours of unemployed; needed to determine adjustment along extensive margin

Reservation wage rate w^R is generated from answers to following questions posed to unemployed workers:

1. "How much would net pay have to be for you to consider taking job?"

2. "Are you interested in full-time (FT) or part-time (PT) employment?"

- prior to 2007, set FT equal to 40 hours per week, and PT equal to 20 hours per week

- since 2007 questionnaire also asks for "weekly hours you are willing to work"

- 2/3 of non-employed workers report input for their reservation wage

Estimation Results

Table 2: Panel Model Estimation

a. With IVs

log h	Coefficient
log w	.489***
Family	.0097
EXPFT	.00978
O1	.011
O3	.0065
O4	-.0204
const.	2.4016***

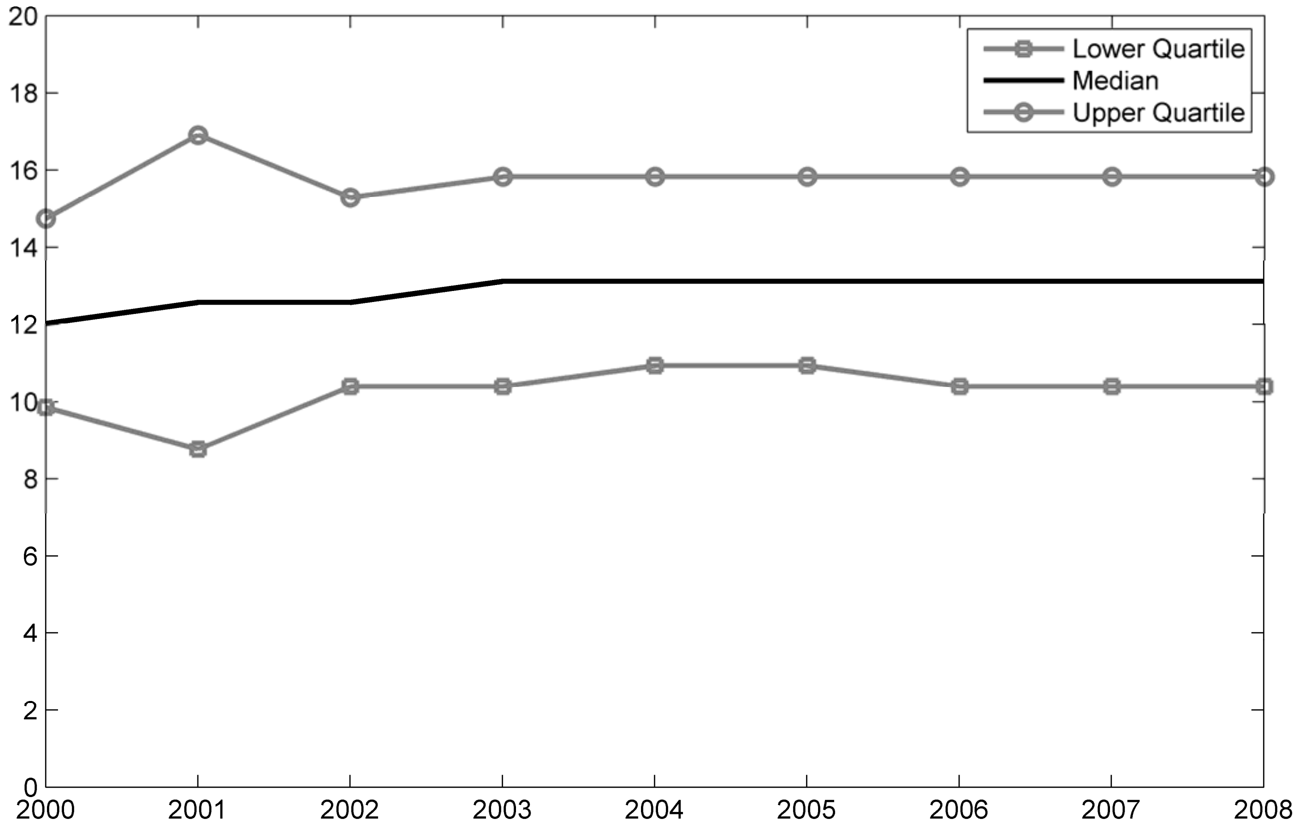
b. Without IVs

log h	Coefficient
log w	-.1826***
Family	.0563***
EXPFT	.030959***
O1	.005277***
O3	-.00655
O4	-.06803
const.	3.6609***

Note: White robust S.E. are used. $\rho\left(h_{i,t}, h_{i,t-1}\right) = .68$, $\rho\left(\hat{\zeta}_{i,t}, \hat{\zeta}_{i,t-1}\right) = .03$

Figure 1: Quartiles of the densities conditional on $X = \overline{X}$

(a) $\hat{f}^{t}_{w|\overline{X}}(\cdot)$



(b) $\hat{f}^{\,t}_{w^{R}|\bar{X}}(\cdot)$

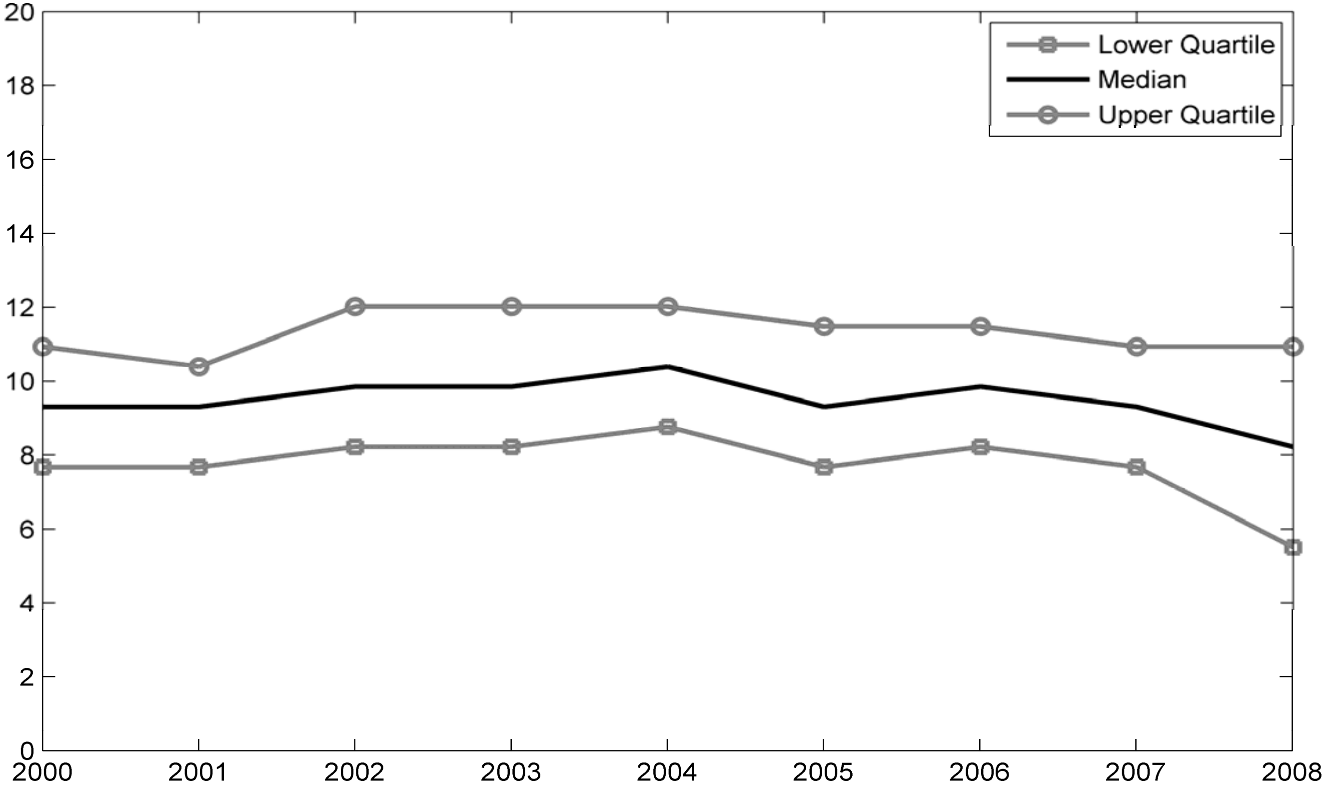


Table 5: Aggregate Frisch Wage-Elasticity and Weighted Components

Wave	$\boldsymbol{e_t}$	$\tilde{\tau}_{h,t}^{\text{int}}$	$\tilde{\tau}_{h,t}^{ext}$
2000	.82 (.02)	.37 (.02)	.45 (.01)
2001	.81 (.03)	.43 (.06)	.38 (.04)
2002	.82 (.02)	.37 (.02)	.45 (.01)
2003	.80 (.02)	.36 (.02)	.44 (.02)
2004	.82 (.02)	.35 (.02)	.47 (.01)
2005	.79 (.02)	.38 (.02)	.41 (.02)
2006	.78 (.02)	.36 (.02)	.42 (.01)
2007	.78 (.02)	.38 (.02)	.41(.02)
2008	.75 (.02)	.40 (.03)	.35 (.05)

Conclusions

- average individual Frisch wage-elasticity equals .489

- estimated aggregate Frisch wage-elasticity varies between .75 and .82

  more than 50 % of aggregate elasticity due to hours' adjustment of movers, hours' adjustment of stayers matter less

- findings are plausible vis-à-vis comparable evidence in Fiorito and Zanella (*RED* 2012), or Blundell, Borio, Laroque (*AER* 2011)

- using balanced panel of males reduces $\tilde{\tau}_{h,t}^{\text{int}}$