Labor Supply, Endogenous Wage Dynamics and Tax policy

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Preliminary

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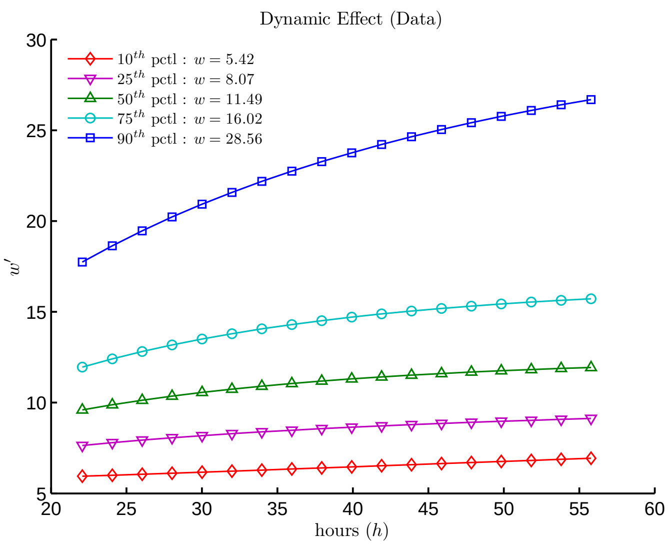
Motivation


Dynamic Effect (Data)
10^{th} pctl : $w = 5.42$
25^{th} pctl : $w = 8.07$
50^{th} pctl : $w = 11.49$
75^{th} pctl : $w = 16.02$
90^{th} pctl : $w = 28.56$
w'
hours (h)
5
10
15
20
25
30
20
25
30
35
40
45
50
55
60

Motivation

- Current hours do not only affect current earnings but also affect future earnings potential.
- In particular, current hours will affect the probability of wage growth (or drop) persistently.
- Life-cycle dimension. (Imai & Keane, 2004 and many others)
- We focus on (isolate) a different dimension: the effect of hours varies considerably across wage levels.
- Labor supply decision takes into consideration three components
  - static component
  - dynamic component
  - level of wealth

Introduction

- Static data is not sufficient to estimate labor supply elasticity.
- Dynamic effect is stronger for high wage agents $\rightarrow$ Frisch elasticity of labor supply is compressed.
  - This is exactly the opposite effect obtained from that of life-cycle models.
- Potentially, strong responses to changes in the progressivity of the tax system.
- To this end, we develop a GE model where both components of labor supply are included
- Heterogeneous agents (partially endogenous productivity, and endogenous asset position through incomplete markets).
- Two self-insurance mechanisms: precautionary savings and the labor supply decision.

Preview

- We find positive relationship between hours and wage growth that is getting stronger with the initial level of wages using simple OLS techniques.
- However, reduced form analysis may be misleading due to several biases and endogeneity issues:
  1. Correlated measurement error of hours and wages (division bias).
  2. Wages are determined by exogenous temporary and partially endogenous persistent shocks.
  3. Endogenous selection into non-employment.
  4. Endogenous wealth accumulation (omitted variable bias).
- We develop an estimation/calibration method to tackle these issues.
- The pure dynamic effect has the same basic qualitative properties as the reduced form estimate.

Related Papers

- Labor Supply in Dynamic Setting
  - Santos (2012), Bell & Freeman (2001)
  - Imai & Keane (2004), Elsby & Shapiro (2009), Hansen & Imrohoroglu (2009), Wallenius (2012), Naess-Torstensen (2013)
  - Pijoan-Mas (2006), Michelacci & Pijoan-Mas (2009)
- Tax Reform and Labor Supply
  - Prescott
  - Conesa, Kitao, Krueger (2009), Heathcote, Storesletten, Violante (2010)
  - Keane (2009), Guvenen & Kuruscu, and Ozkan (2013), Naess-Torstensen (2013)

Outline

1. Model

2. Calibration/Estimation
   - Estimation Strategy to Recover the Dynamic Effect
   - Data
   - Mixture of Indirect Inference and Calibration
   - Estimation Results
   - Decomposition

3. Conclusions and Outlook

The Model - Consumer/Worker

- Standard Intertemporal preferences

$$E_0 \sum_{t=0}^{\infty} (\beta s)^t u(c_t, h_t)$$

- Productivity in terms of efficiency unit (x_t)

$$x_t \in [\underline{x}, \overline{x}] \equiv \mathcal{X}$$

- Budget Constraint

$$\begin{aligned} c_t + a_{t+1} &= (1 + r_t)a_t + w_t x_t h_t - T(r_t a_t + w_t x_t h_t) + \phi \\ c_t &\geq 0 \\ a_{t+1} &\geq 0 \\ h_t &\in (\{0\} \cup [\underline{h}, \overline{h}]) \equiv \mathcal{H} \end{aligned}$$

The Model - Process of Productivity

- Productivity is composed of an exogenous temporary and a partially endogenous and persistent component.

$$\log(x) = \log(\theta) + \eta, \quad \eta \sim \text{i.i.d.} N(0, \sigma_\eta^2)$$

- Agents who work today (Dynamic Effect)

$$\log(\theta') = \Omega\left(\log(\theta), h\right) + \varepsilon', \quad \varepsilon' \sim \text{i.i.d.} N(0, \sigma_\varepsilon^2)$$

- Agents not employed last period

$$\log(x) = \log(\xi) + \eta, \quad \xi \sim \text{i.i.d.} N(\mu_{none}, \sigma_{none}^2)$$

- Agents born this period

$$\log(x) = \log(\xi) + \eta, \quad \xi \sim \text{i.i.d.} N(0, \sigma_{newb}^2)$$

- The great challenge: estimate/calibrate $\Omega\left(\log(\theta), h\right)$.

The Model - Production

- Production: $Y_t = AK_t^{\omega} N_t^{1-\omega}$

where

$$\begin{aligned} N_t &= \int x_t h_t d\mu_t \\ K_t &= \int a_t d\mu_t \end{aligned}$$

- Government

$$\overline{G} = T_t \equiv \int T(r_t a_t + w_t x_t h_t) d\mu_t$$

The Model - Recursive Problem

$$
\begin{aligned}
V(\theta,\eta,a) \quad = \quad & \max_{c,a',h\in\mathcal{H}} \quad u(c,h)+ \\
& +\beta s I_{h\geq \underline{h}} \int_{\theta'}\int_{\eta'} V(\theta',\eta',a')dF(\theta'|\theta,h)dF(\eta') \\
& +\beta s I_{h=0} \int_{\gamma'}\int_{\eta'} V(\gamma',\eta',a')d\Psi(\gamma')dF(\eta')
\end{aligned}
$$

subject to

$$
\begin{aligned}
& c+a' = (1+r)a + wxh - T(ra+wxh) + \phi \\
& x = \theta + \eta \\
& c \geq 0, \qquad a' \geq 0
\end{aligned}
$$

Equilibrium

- Workers maximize their lifetime utility
- The firm maximizes its profit
- Markets clear
- Gov't Budget Balance

Strategy of Recovering $\Omega\left(\log(\theta), h\right)$

Recall:

$$\log(x) = log(\theta) + \eta$$
$$\log(\theta') = \Omega\left(\log(\theta), h\right) + \varepsilon'$$

Issues:

- Even if θ were observable, wealth is correlated with θ and affecting labor supply as well (omitted variable bias) .
- Productivities can be only observed who are working (selection bias).
- However, we cannot observe θ only wages x. (errors are not independent of independent variables)
- Actually, we observe both wages and hours with measurement error and these measurement errors are known to be correlated. (division bias)

Strategy of Recovering $\Omega(\log(\theta), h)$: Indirect Inference

Parametrize $\Omega(\log(\theta), h)$ using a second order polynomial.

$$\Omega(\log(\theta), h) = \sum_{i=0}^{2} \sum_{j=0}^{2} \alpha_{ij} log(\theta)^i log(h)^j$$

- Step 1: We estimate the same functional form in the data for wages instead of θ using OLS.
- Step 2:
  - We solve our model for a given set of α's and simulate data.
  - Contaminate the simulated data with the correlated measurement error.
  - We run the same regression on contaminated/simulated data.
  - We match regression coefficients between data and model (in addition to other targets).

Data

- PSID 1992-1997
- Demographic criteria: white men, age $\in$ [25,65]
- (Weekly) Hours: $8 \leq h \leq 98$
- Employed: positive earnings, not in armed forces, $w \geq 0.5 \times$ minimum wage

Data

Intermediate regressions

- Step 1: obtain "clean" measure of wages

$$
\begin{aligned}
\log w_t &= \beta_0 + \beta X, \quad \text{for } t \text{ and } t+1 \\
w_t^* &= w_t / \widehat{w}_t
\end{aligned}
$$

- Step 2: obtain "clean" measure of hours

$$
\begin{aligned}
h_t &= \beta_0 + \beta X, \quad \text{for } t \text{ and } t+1 \\
h_t^* &= h_t / \widehat{h}_t
\end{aligned}
$$

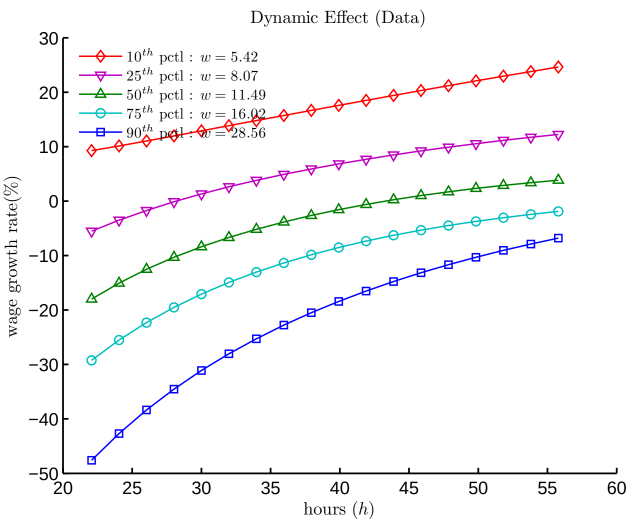
where $X \equiv (\text{age}, \text{age}^2, \text{D}_{edu}, \text{D}_{occ})$

Second Stage: Wage growth regression

$$\log(w^*_{t+1}/w^*_t) = \sum_{i=0}^{2}\sum_{j=0}^{2}\alpha_{ij}(\log w^*_t)^i(\log h^*_t)^j + u_t$$

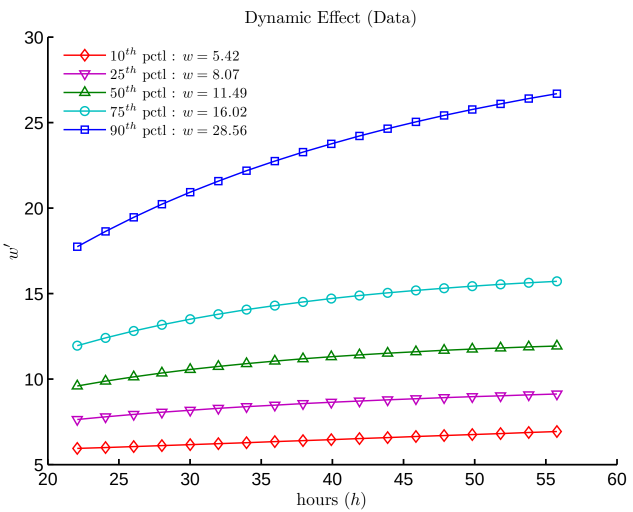
Wage Growth

(I) Dynamic Effect



Wage Level

(I) Dynamic Effect



Calibration

- Parameters
  - Model period: 1 year
  - Depreciation: $\delta = .08$
  - Capital Share: $\omega = .36$
  - Survival Prob: $s = .975$ (Average life span = 40 years)
  - Weekly Hours: $\mathcal{H} = [\underline{h}, \overline{h}] = [8, 98]$
  - Productivity: $\mathcal{X} = [\underline{x}, \overline{x}] = [1, 60]$

Calibration

- Preference

$$u(c,h) = \frac{c^{1-\sigma}}{1-\sigma} + B\frac{(1-h)^{1-\gamma}}{1-\gamma}$$

- Tax Function (Gouveia and Strauss (1994))

$$T(y) = \tau_0\left(y - (y^{-\tau_1} + \tau_2)^{-\frac{1}{\tau_1}}\right)$$

  - τ_0=.258
  - τ_1=.768
  - τ_2=1.61 to match G/Y=17%

Calibration - Productivity

- Working Continously

$$\log(\theta'/\theta) = \sum_{i=0}^{2}\sum_{j=0}^{2} \alpha_{ij}(\log(\theta)^i \log(h)^j + \varepsilon, \qquad \varepsilon \sim N(0, \sigma_\varepsilon^2)$$

- Newborn

$$\log(\theta) = log(\xi), \qquad \xi \sim N(0, \sigma_{newb}^2)$$

- After Non-Employment

$$\log(\theta) = log(\xi), \qquad \xi \sim \Gamma(\mu_{none}, \sigma_{none}^2)$$

- In all cases:

$$\log(x) = log(\theta) + log(\eta), \qquad \eta \sim N(0, \sigma_\eta^2)$$

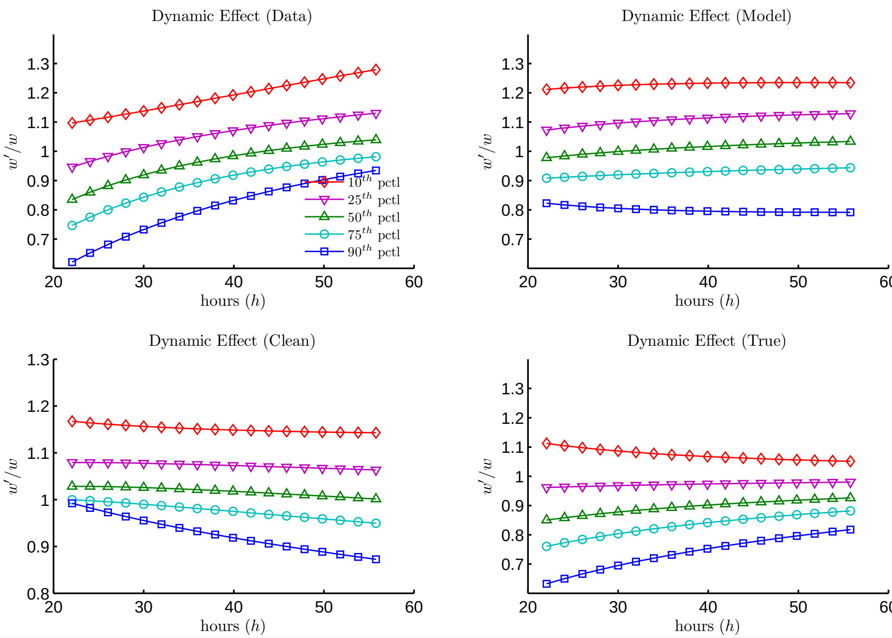
Calibration

- Measurement Error (From French (2004))
  - $\widehat{W} = \exp(e_w)wx, \quad e_w \sim N(0, .0207)$
  - $\widehat{h} = \exp(e_h)h, \quad e_h \sim N(0, .0167)$
  - $COV(e_w, e_h) = -0.0122$

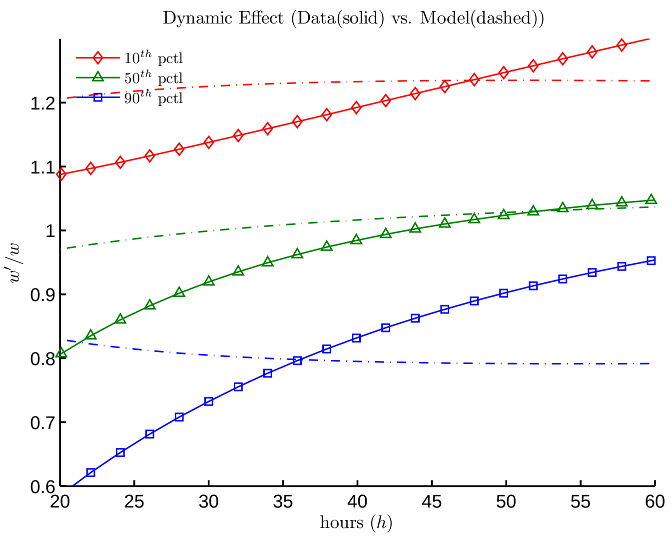
Calibration

Indirect Inference

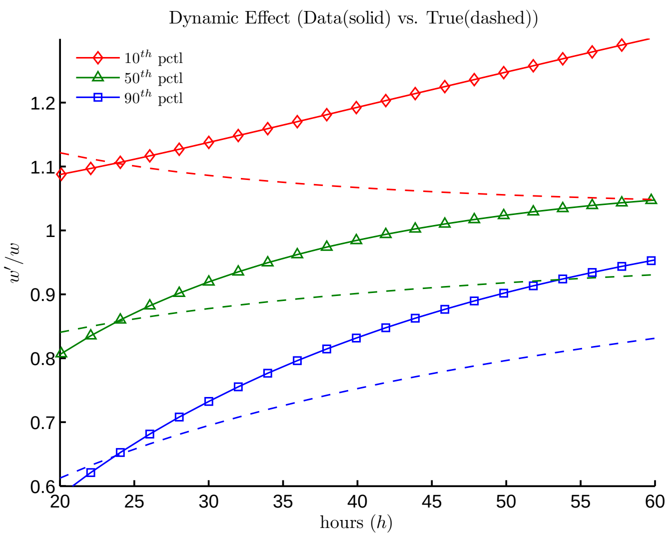
- Given $(\delta, s, \omega, \mathcal{H}, \mathcal{X}, \tau_0, \tau_1)$
- we iterate on $(\sigma, \gamma, B, \beta, \tau_2, G)$ and the true α's, σ_ε, σ_η, μ_{none}, σ_{none}, σ_{newb}.
- Match $\mu_{h^*}, \sigma_{h^*}, \mu_{w^*}, \sigma_{w^*}, \rho(w^*, h^*)$, K/Y and G/Y, the means and standard deviation of wages of people who were not employed last period, and those of young job market entrants, and the $\hat{\alpha}$'s and $\hat{\sigma}_u^2$ from the data estimation.
- For the latter we run a simulation and contaminate the simulated data with simulated e_h and e_w.
- Run the same dynamic regression as the one we did on real data on simulated data.
- Minimize $||\tilde{M}_{\text{data}} - \tilde{M}_{\text{model}}||$.
- This way we 'control' for both measurement error, selection, endogeneity of errors and omitted variables.


Dynamic Effect (Data)
Dynamic Effect (Model)
Dynamic Effect (Clean)
Dynamic Effect (True)
w'/w
hours (h)
10^{th} pctl
25^{th} pctl
50^{th} pctl
75^{th} pctl
90^{th} pctl
0.7
0.8
0.9
1
1.1
1.2
1.3
20
30
40
50
60

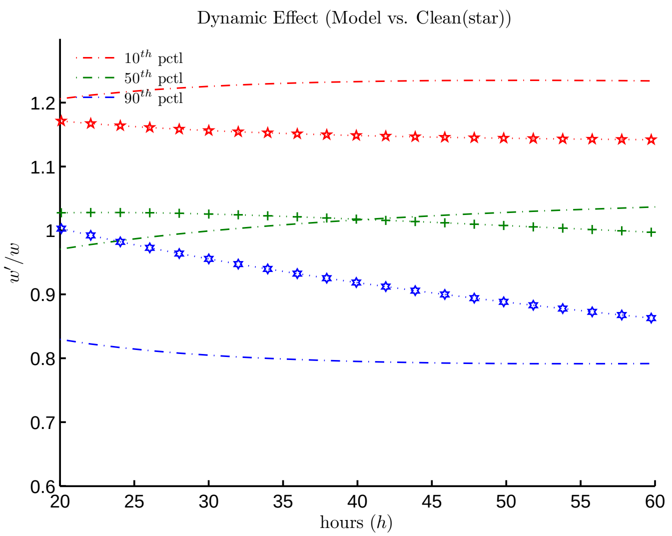
The Fit of the Dynamic Effect



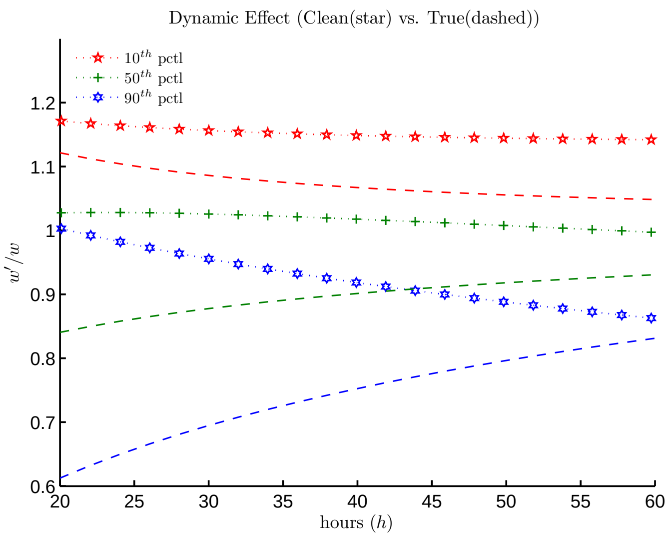
The True vs. Estimated Dynamic Effect



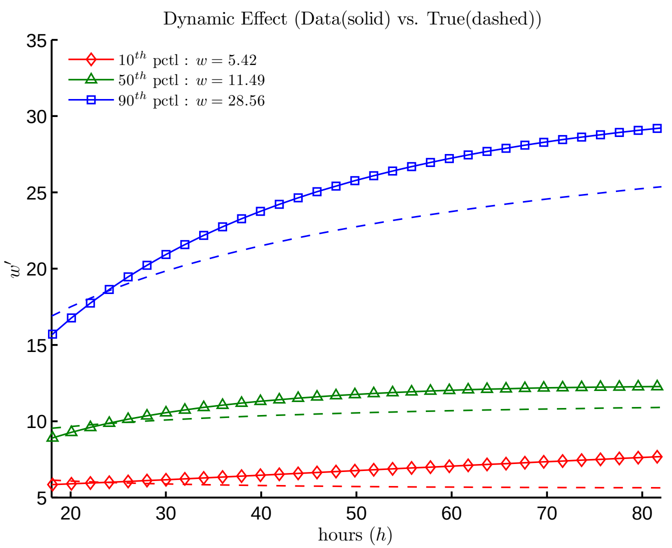
The Effect of Contamination



The Effect of Selection



The True vs. Estimated Dynamic Effect (level)



Conclusion

- We show that current hours do affect future earnings potential.
- In order to establish this result we need to control for selection bias, measurement error and the endogeneity of the error term.
- We develop a structural estimation approach and show that the dynamic effect is getting stronger with current wages.

Outlook - Elasticity of Labor Supply

- Dynamic effect should be taken into account to correctly measure the labor supply elasticity.
- When a similar dynamic effect is studied in a life-cycle framework the elasticity of substitution increases. (see Imai and Keane (2004), Wallenius (2012), Naess-Torstensen (2013))
  - Intuition: The total return on hours across age groups becomes flatter.
- In our environment, the total return on hours across wage groups becomes steeper.
  - This implies that, when the dynamic effect is taken into account, the elasticity is reduced.
  - Preliminary results confirm this intuition.

Outlook - Progressive Taxation

- The aggregate response of hours and human capital to changes in the tax code will depend on the dynamic effect.
- Similar mechanism in a life-cycle model by Guvenen, Kuruscu and Ozkan (2012).
- A permanent increase in progressivity reduces the future gains of hours at most wage levels.
- We expect labor supply reduction even at those wage levels which are not affected by the change in progressivity currently if the dynamic effect of hours is positive.

Model Fit

Moments	Target	Model
K/Y	3.00	3.18
G/Y	0.17	0.18
mean(h)	0.25	0.25
sd(h)	0.062	0.148
mean(x^*)	1.21	1.44
sd(x^*)	1.18	0.95
mean(x^*_{none})	0.96	0.53
sd(x^*_{none})	1.06	0.45
mean(x^*_{newb})	0.96	0.91
sd(x^*_{newb})	0.56	0.75
$\hat{\sigma}_u$	0.336	0.596

Parameters

Parameters	
β	0.9728
σ	1.2790
γ	1.3278
B	1.2558
σ_ϵ	0.7957
σ_η	0.0515
σ_{none}	0.6261
σ_{newb}	1.2330
μ_{none}	0.9901
τ_2	1.6100