Labor Supply, Endogenous Wage Dynamics and Tax policy

Árpád Ábrahám — EUI
Jay H. Hong — Rochester
Ricardo Santos — Trinity

Preliminary

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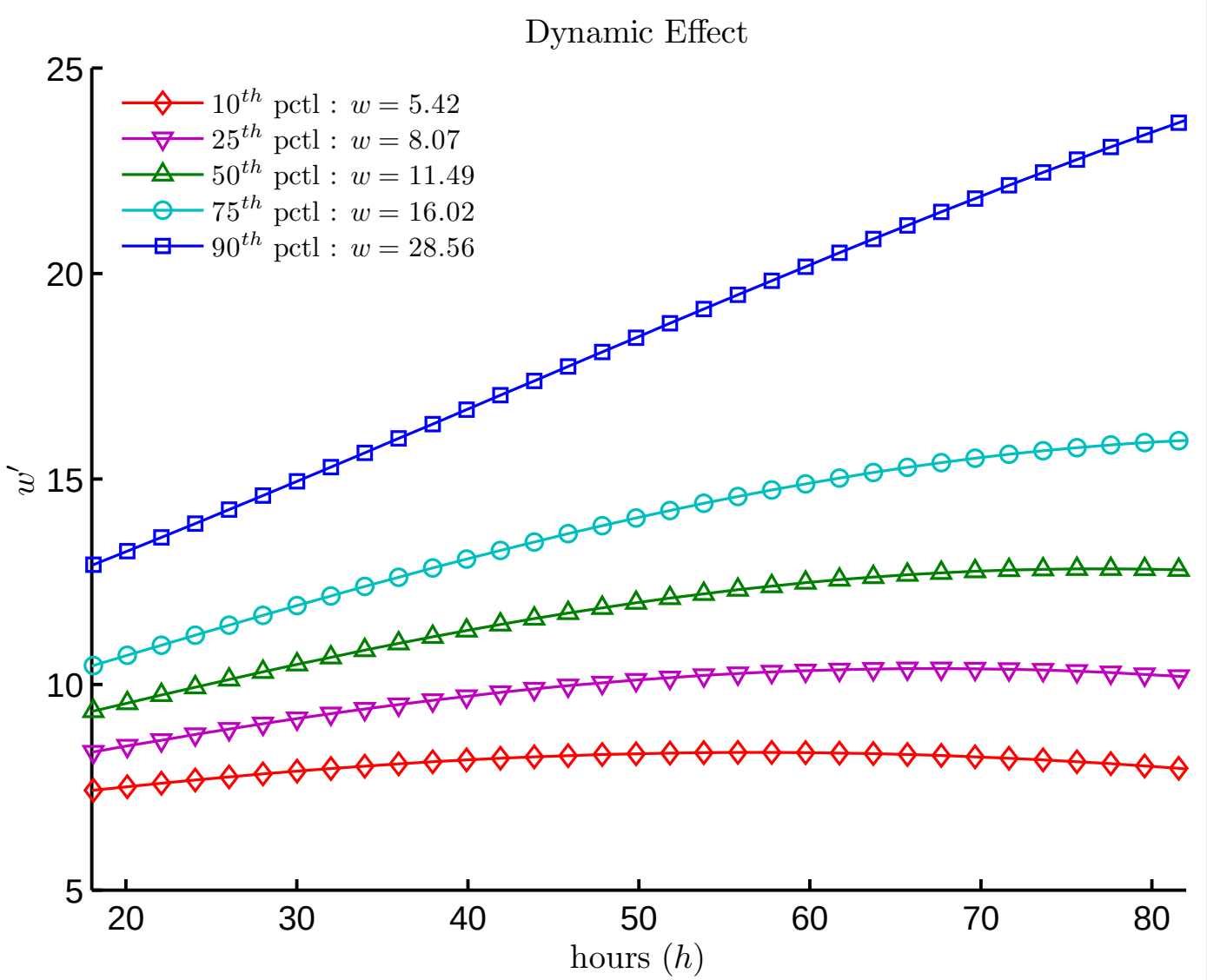
Motivation


Dynamic Effect
10th pctl : $w = 5.42$
25th pctl : $w = 8.07$
50th pctl : $w = 11.49$
75th pctl : $w = 16.02$
90th pctl : $w = 28.56$
w'
25
20
15
10
5
20
30
40
50
60
70
80
hours (h)

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).
- The work of Santos (2009) shows that this effect of current hours on future wages is significant and varies considerably across income quintiles.
- labor supply decision takes into consideration three components
  - static component
  - dynamic component
  - level of wealth
- Possible interpretations: on-the-job human capital accumulation, learning-by-doing, tournament-type labor contract.

Introduction

- 'Static' labor supply elasticity can be misleading when the dynamic effect is present.
- Implication on aggregate response to changes in tax system.
- To this end, we develop a GE model where both components of labor supply are included
- Heterogeneous agents (productivity, and asset position)
- The presence of incomplete markets.
- Two self-insurance mechanisms: precautionary savings and the labor supply decision

Related Papers

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

Outline

1. Data
   - Isolating the dynamic component in the data
   - Empirical Results
2. Model
   - Environment
   - Definition of the competitive equilibrium
   - Mechanism
3. Numerical Exercise
   - Calibration/Estimation
   - Results
   - Tax Changes
4. Conclusions

Data

- Current Population Survey (CPS) - March
- 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
- Matched 1 year panel
- 2004-2006 (28,714 obs)

Data

Key Statistics

- (h, w)

	2004-2006		
quintile	h_i	w_i	corr
1	41.29	4.61	0.02
2	43.01	7.73	0.00
3	42.92	10.57	-0.02
4	43.09	14.39	0.02
5	42.96	31.64	-0.04
q5/q1	1.04	6.87	
all	42.67	13.88	0.01
(std)	(10.43)	(14.95)	
cv	0.24	1.08	

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

Data

First Stage: Wage Regression

$$\log w = \beta_0 + \beta X$$

	$\widehat{\beta}$	S.E.	t-stat
cons (Managerial,<HS)	.995	.06697	14.86
age	.050	.00303	16.50
age^2	−.0005	.00003	−14.32
edu2 (HS)	.245	.01502	16.33
edu3 (Some College)	.354	.01629	21.73
edu4 (College)	.504	.01584	31.81
edu5 (Post College)	.761	.01875	40.57
occ2 (Professional)	−.124	.01179	−10.56
occ3 (Sales)	−.219	.01356	−16.11
occ4 (Administrative)	−.392	.01746	−22.45
occ5 (Services)	−.490	.01519	−32.24
occ6 (Transportation)	−.384	.01533	−25.04
occ7 (Operatives, Farming, etc)	−.296	.01159	−25.51

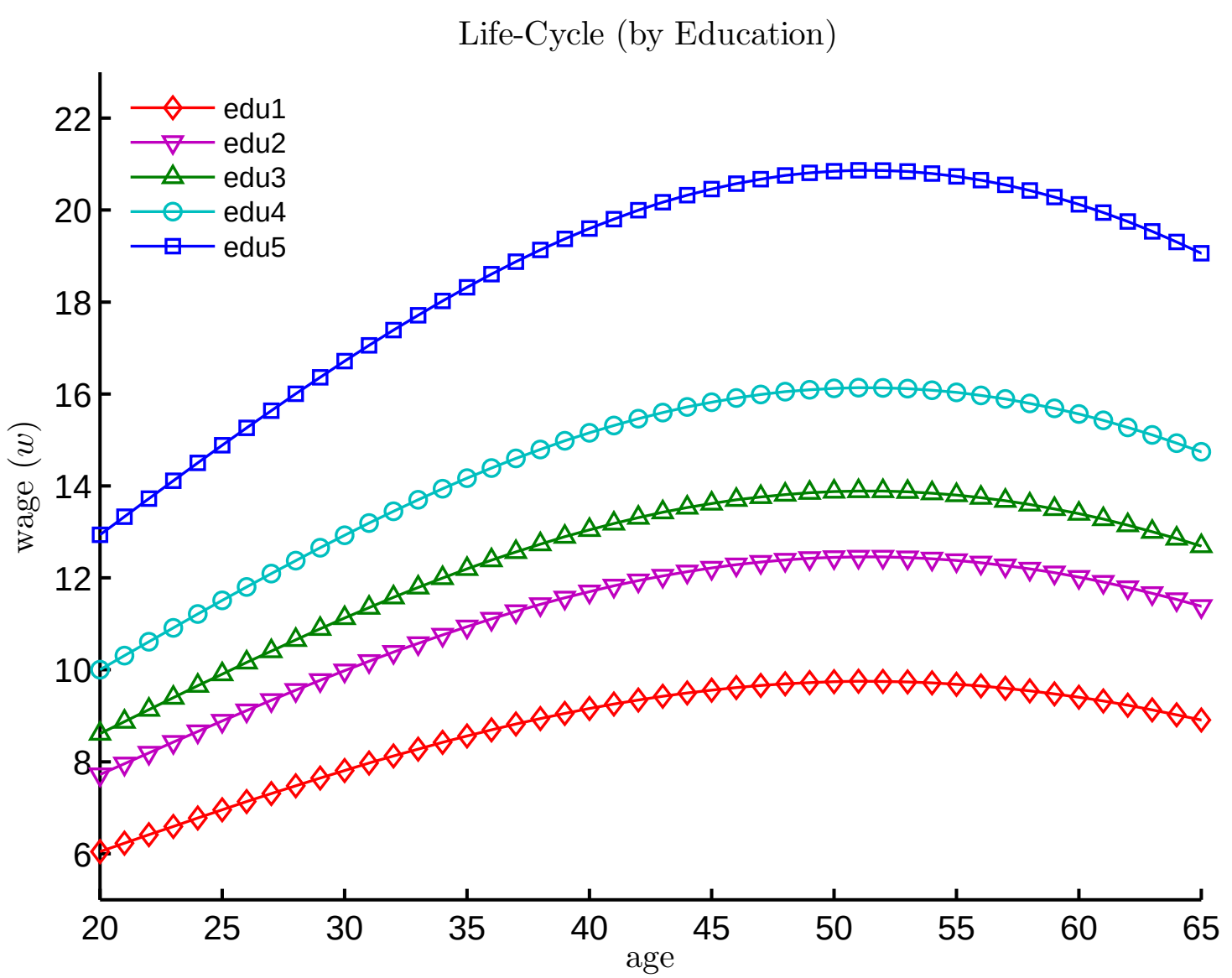
Data

First Stage: Hours Regression

$$h = \beta_0 + \beta X$$

	$\widehat{\beta}$	S.E.	t-stat
cons (Managerial,<HS)	29.870	1.1974	24.95
age	0.672	0.0541	12.51
age^2	−0.008	0.0006	−12.97
edu2 (HS)	1.394	0.2685	5.20
edu3 (Some College)	1.378	0.2912	4.76
edu4 (College)	1.646	0.2832	5.82
edu5 (Post College)	3.763	0.3353	11.21
occ2 (Professional)	−3.293	0.2108	−15.58
occ3 (Sales)	−1.428	0.2425	−5.91
occ4 (Administrative)	−4.939	0.3122	−15.84
occ5 (Services)	−4.687	0.2716	−17.24
occ6 (Transportation)	−1.798	0.2742	−6.53
occ7 (Operatives, Farming, etc)	−4.217	0.2072	−20.39

Life Cycle Wage Profile by Education Group



Data

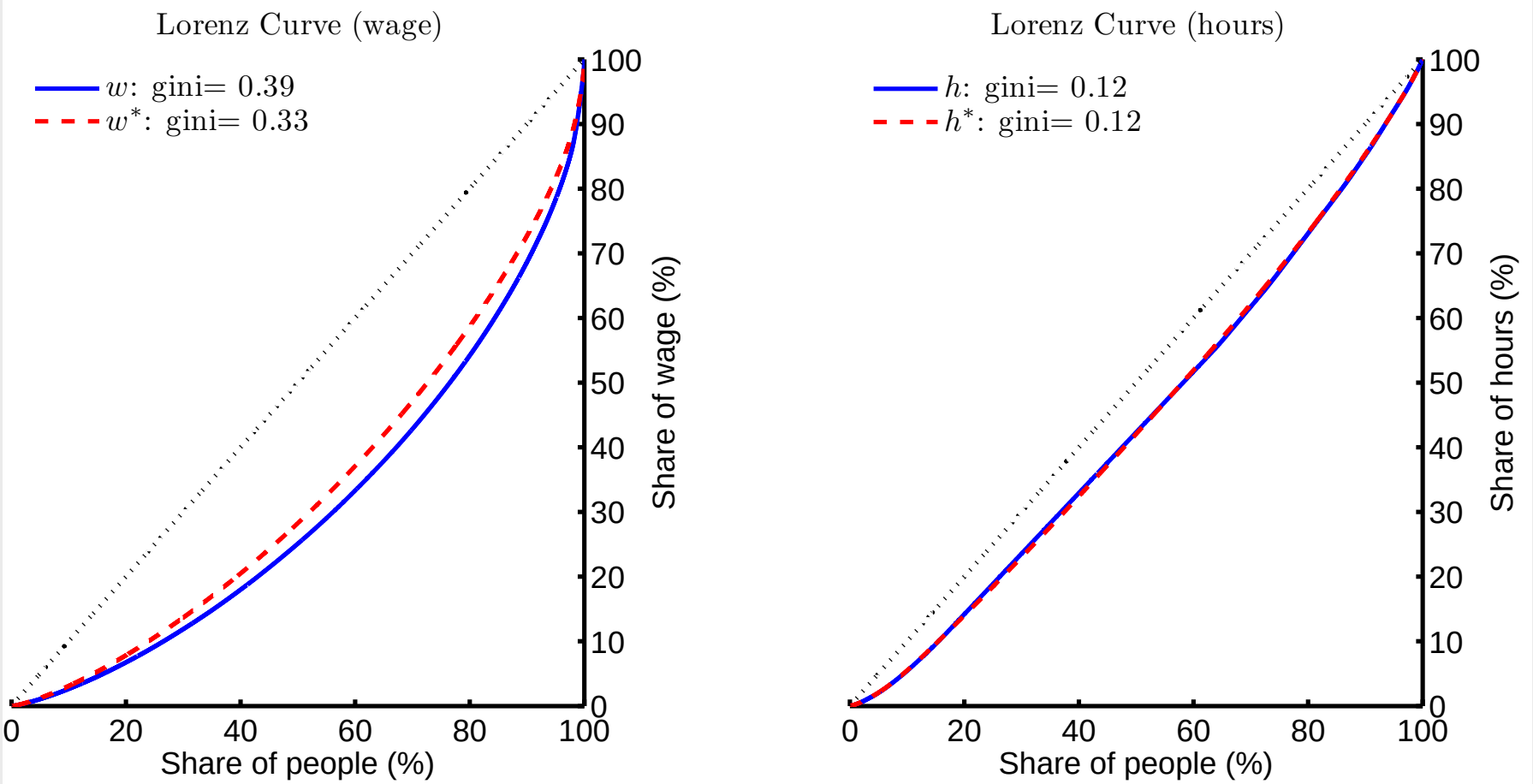
Key Statistics

- (h^*, w^*)

	2004-2006		
quintile	h_i^*	w_i^*	corr
1	1.01	0.48	0.01
2	1.01	0.77	0.04
3	1.02	1.01	0.01
4	1.01	1.31	0.00
5	0.99	2.51	-0.10
q5/q1	0.98	5.27	
all	1.01	1.22	-0.05
(std)	(0.24)	(1.22)	
cv	0.24	1.00	

Data

Distribution (Raw data vs. Cleaned data)



Second Stage: Wage growth regression

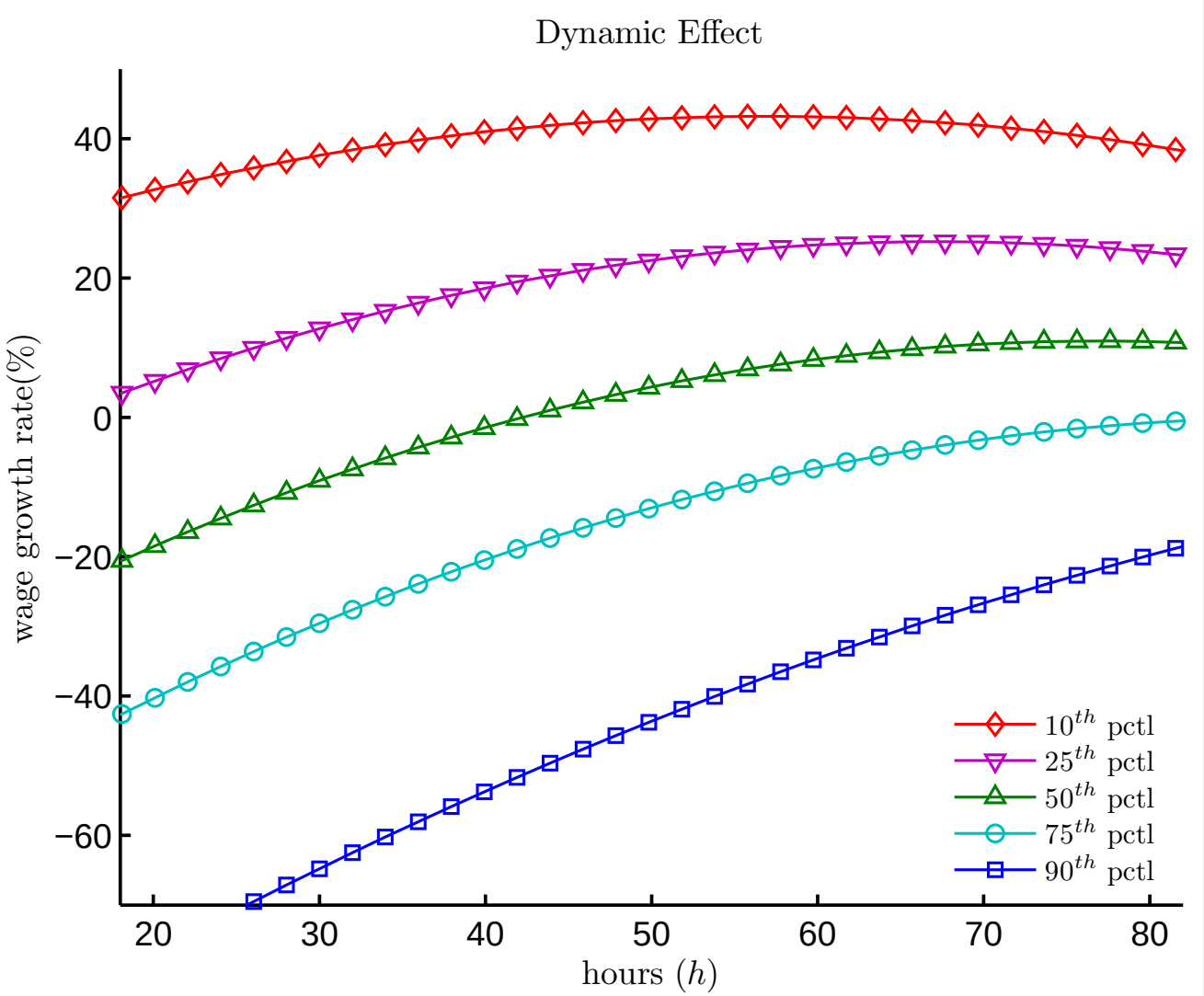
(I) Dynamic Effect

$$\log(w^*_{t+1}/w^*_t) = \sum_{i=0}^{2}\sum_{j=0}^{2}\theta_{ij}(\log w^*_t)^i h^{*j}_t + \varepsilon, \qquad \varepsilon \sim N(0, \sigma^2_\varepsilon)$$

	Coefficient	S.E.	t-stat
θ_{00}	-.422	.0492	-8.59
θ_{10}	-.752	.0536	-14.04
θ_{20}	.082	.0330	2.50
θ_{01}	.591	.0921	6.41
θ_{11}	.179	.1050	1.71
θ_{21}	-.153	.0706	-2.17
θ_{02}	-.163	.0437	-3.73
θ_{12}	.015	.0517	0.29
θ_{22}	.064	.0381	1.69

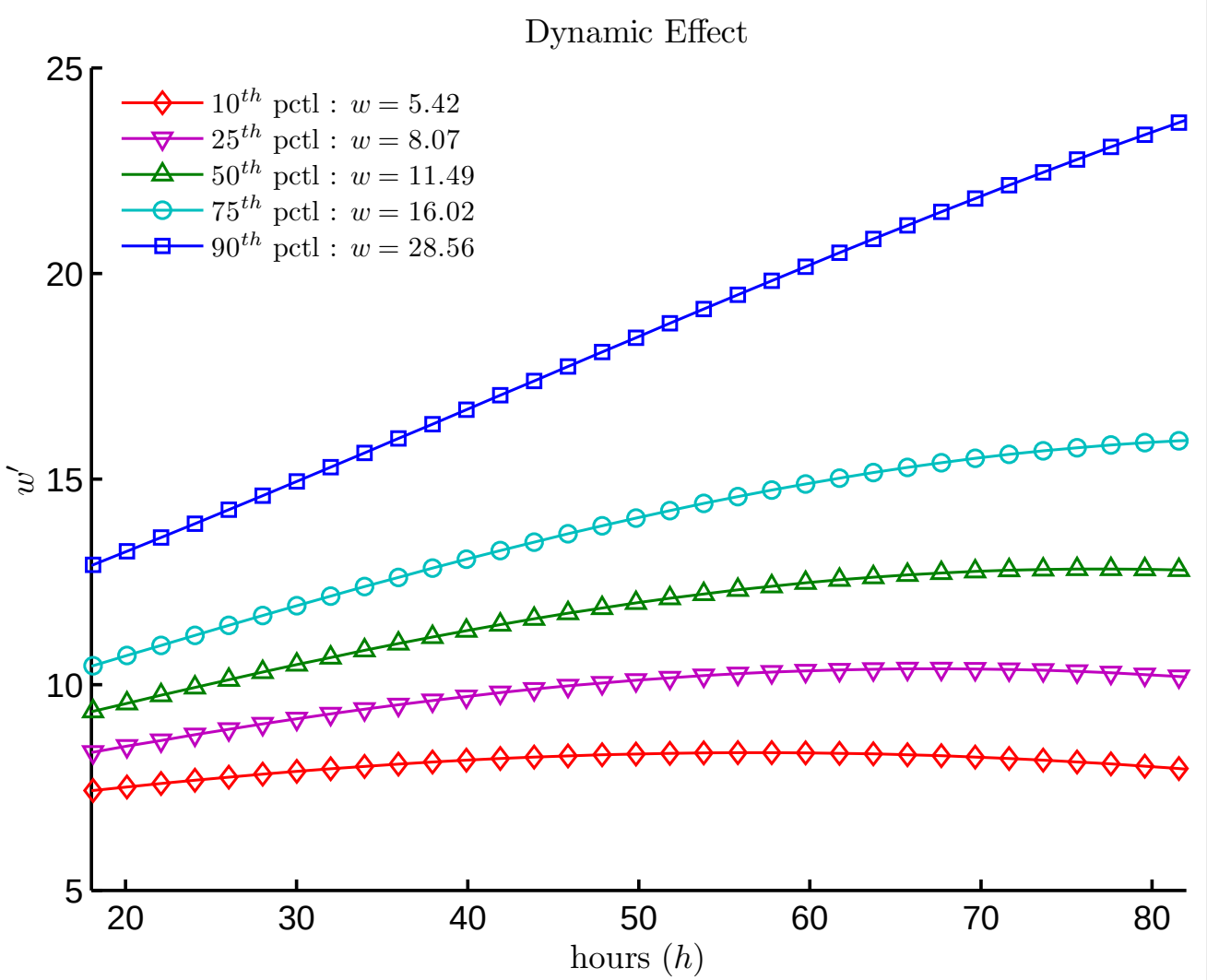
Wage Growth

(I) Dynamic Effect

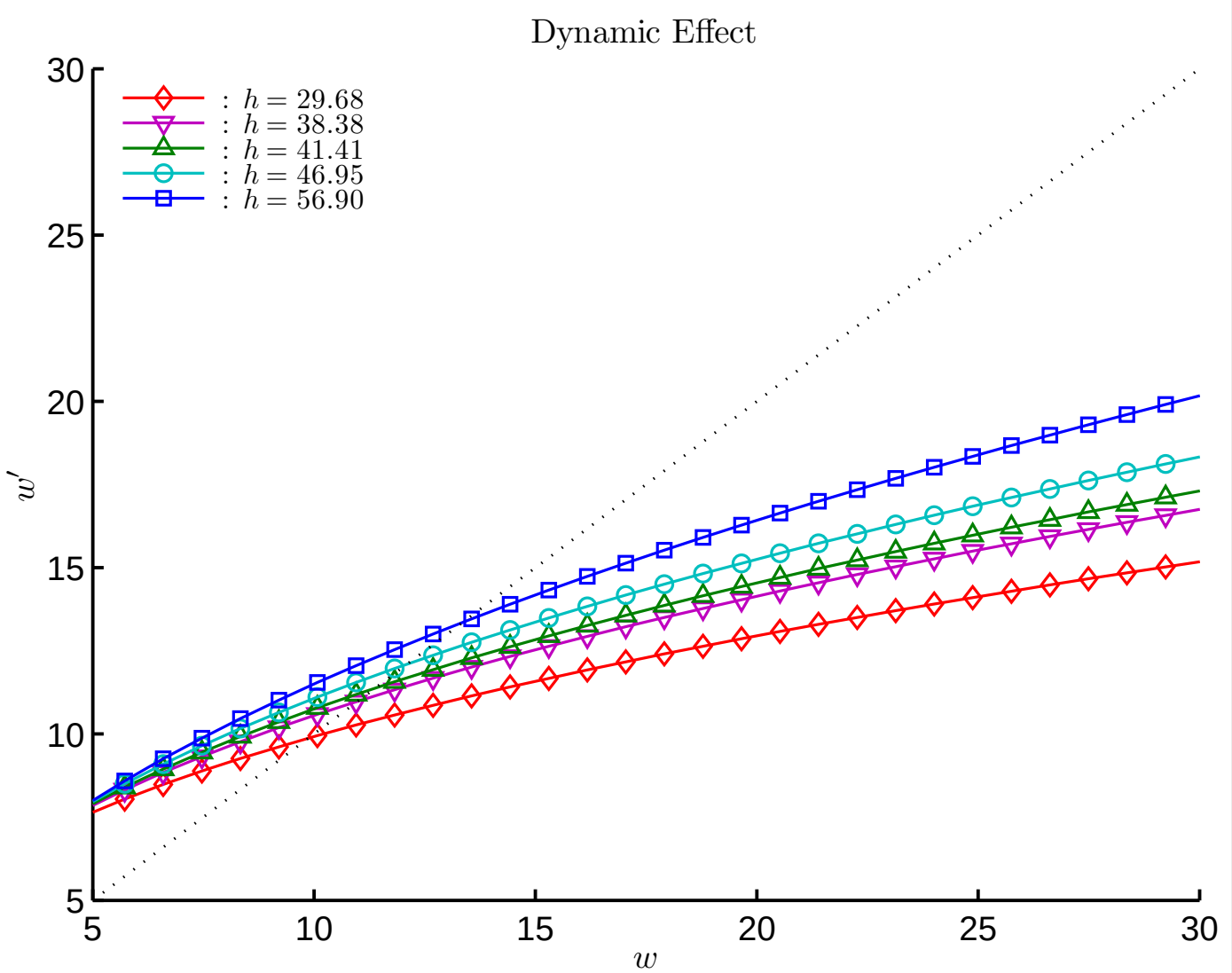


Wage Level

(I) Dynamic Effect



Dynamic Effect



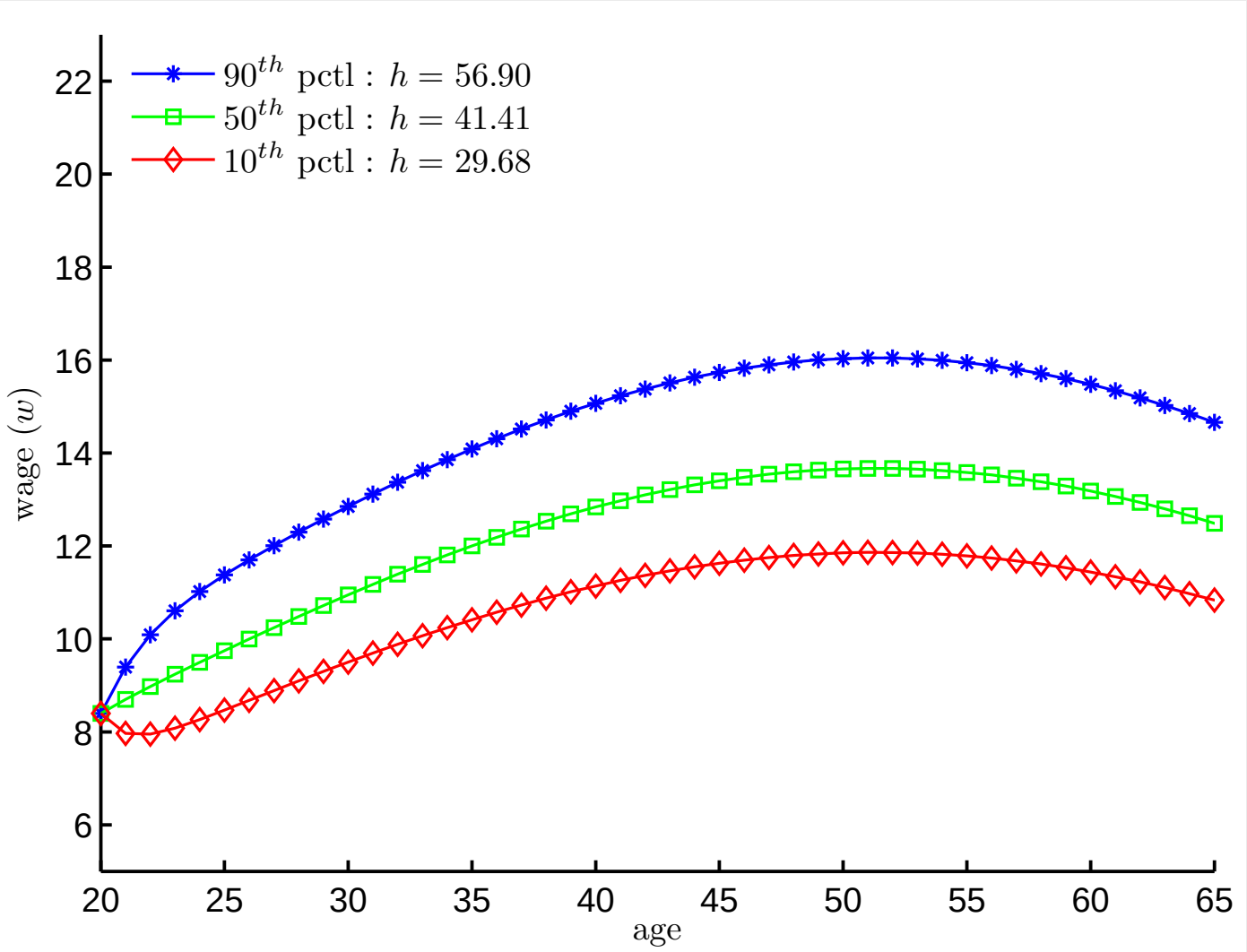
Interpretation: Wage growth regression

- **Working additional 5 hours/week** (one hour a day)

current wage (w)	$\Delta w'$	additional hourly wage	Annual Earnings
10th percentile ($5.5)	0.94%	7.73 cents	$170
25th percentile ($8.8)	2.23%	22.75 cents	$500
50th percentile ($11.5)	2.90%	33.48 cents	$735
75th percentile ($14.9)	3.59%	46.46 cents	$1021
90th percentile ($28.6)	5.18%	88.16 cents	$1937

Dynamic Effect

Predicted Wage over age



The Model - Consumer/Worker

- Standard Intertemporal preferences

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

- Productivity in terms of efficiency unit (x_t)

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

- Budget Constraint

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

The Model - Transition Process of Productivity

- Benchmark Model (Dynamic Effect)

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

- For comparison (No Dynamics) - Aiyagari with labor choice

$$\log x' = \Omega(\log x) + \varepsilon$$

The Model - Production

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

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

$$
\begin{aligned}
V(x,a) \quad = \quad & \max_{c,a',h\in\mathcal{H}} \quad u(c,h) + \beta s \int_{x'} V(x',a')dF(x'|x,h) \\
& \text{subject to} \\
& c + a' = (1+r)a + wxh - T(ra + wxh) \\
& c \geq 0, \qquad a' \geq 0
\end{aligned}
$$

Equilibrium

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

Self-Insurance Mechanism

- Standard precautionary savings.
- Static and Dynamic effect of working.
- Progressivity of taxes affecst labor supply:
  - usual static substitution and income effect
  - allocative efficiency: the timing of labor supply
  - changing incentives via dynamic effect
  - the role of labor supply as an insurance mechanism
  - general equilibrium effects

Calibration

- Parameters
  - Model period: 1 year
  - Depreciation: $\delta = .08$
  - Capital Share: $\alpha = .36$
  - 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

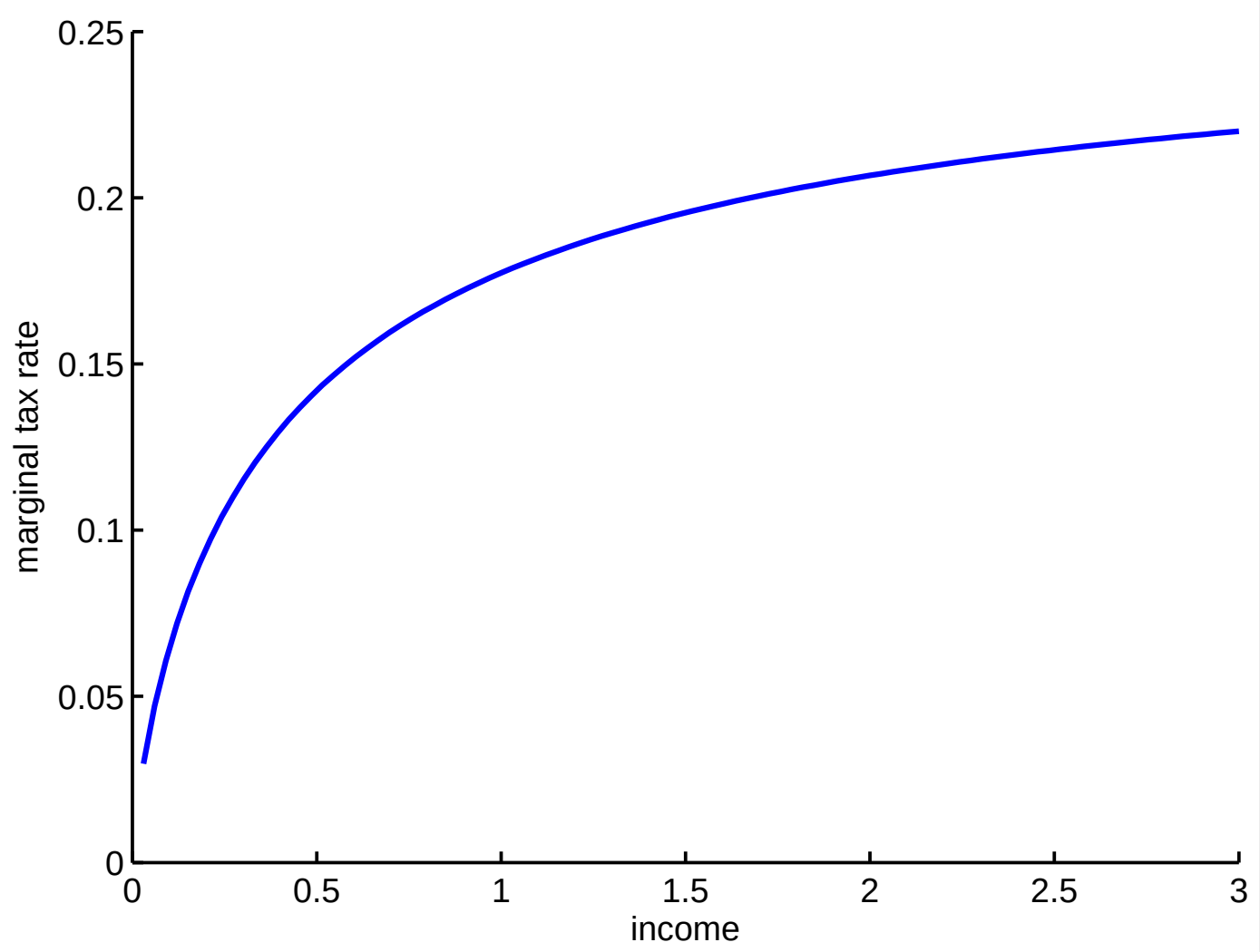
$$u(c,h) = \frac{c^{1-\sigma}}{1-\sigma} + B\frac{(1-h)^{1-\gamma}}{1-\gamma}$$

- Tax Function (Gouveia and Strauss (1994))

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

  - τ_0=.258
  - τ_1=.768
  - τ_2=2.097 to match G/Y=15%

Tax function



Calibration

- Productivity
  - Model with Dynamic Effect

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

  - Model without Dynamic Effect

$$\log(x'/x) = \sum_{i=0}^{2}\theta_i(\log x)^i + \varepsilon, \qquad \varepsilon \sim N(0, \sigma_\varepsilon^2)$$

  - Newborn (or someone who has chosen not to work in a given period)

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

Calibration

- Measurement Error (From French (2004) and HSV (2008))
  - $\widehat{W} = \exp(\varepsilon_w) wx, \quad \varepsilon_w \sim N(0, .207)$
  - $\widehat{h} = \exp(\varepsilon_h) h, \quad \varepsilon_h \sim N(0, .167)$

Calibration

Indirect Inference

- Given $(\delta, s, \alpha, \mathcal{H}, \mathcal{X}, \tau_0, \tau_1)$
- we iterate on $(\sigma, \gamma, B, \beta, \tau_2, G)$ and the true θ's, σ_ε^2, μ_η, σ_η.
- 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 the θ's and σ_ε^2 from the data estimation.
- For the latter we run a simulation
- Contaminate the simulated data with $(\sigma_{\varepsilon_w}^2, \sigma_{\varepsilon_h}^2)$
- Run the same dynamic regression as the one we did on real data with using simulated data.
- Minimize $||\tilde{\theta}_{\text{data}} - \tilde{\theta}_{\text{model}}||$.
- This way we 'control' for both measurement error and selection.

Model Fit

Moments	Target	Benchmark	No Dynamics
K/Y	3.2	3.20	3.17
G/Y	0.15	0.14	0.15
mean(h)	0.33	0.31	0.39
sd(h)	0.078	0.065	0.097
mean(x^*)	1.22	1.22	1.22
sd(x^*)	1.22	1.10	1.31
σ_ϵ	0.524	0.530	0.517

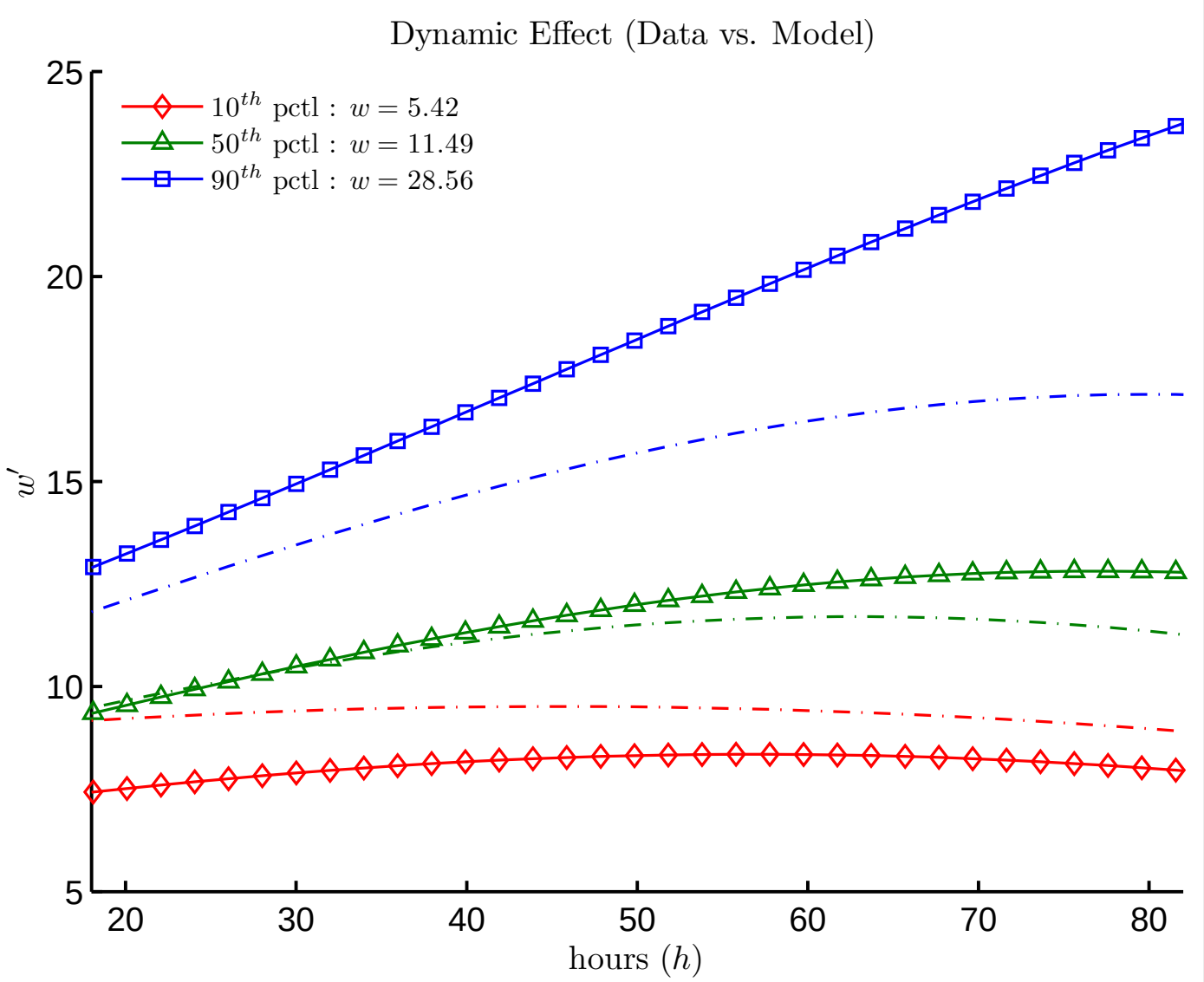
Model Fit

Moments	Benchmark	No Dynamics
Gini (Wealth)	0.316	0.394
Gini (Consumption)	0.044	0.052
Gini (Hours)	0.087	0.113
Gini (Wage)	0.338	0.312
Gini (Earnings)	0.405	0.407

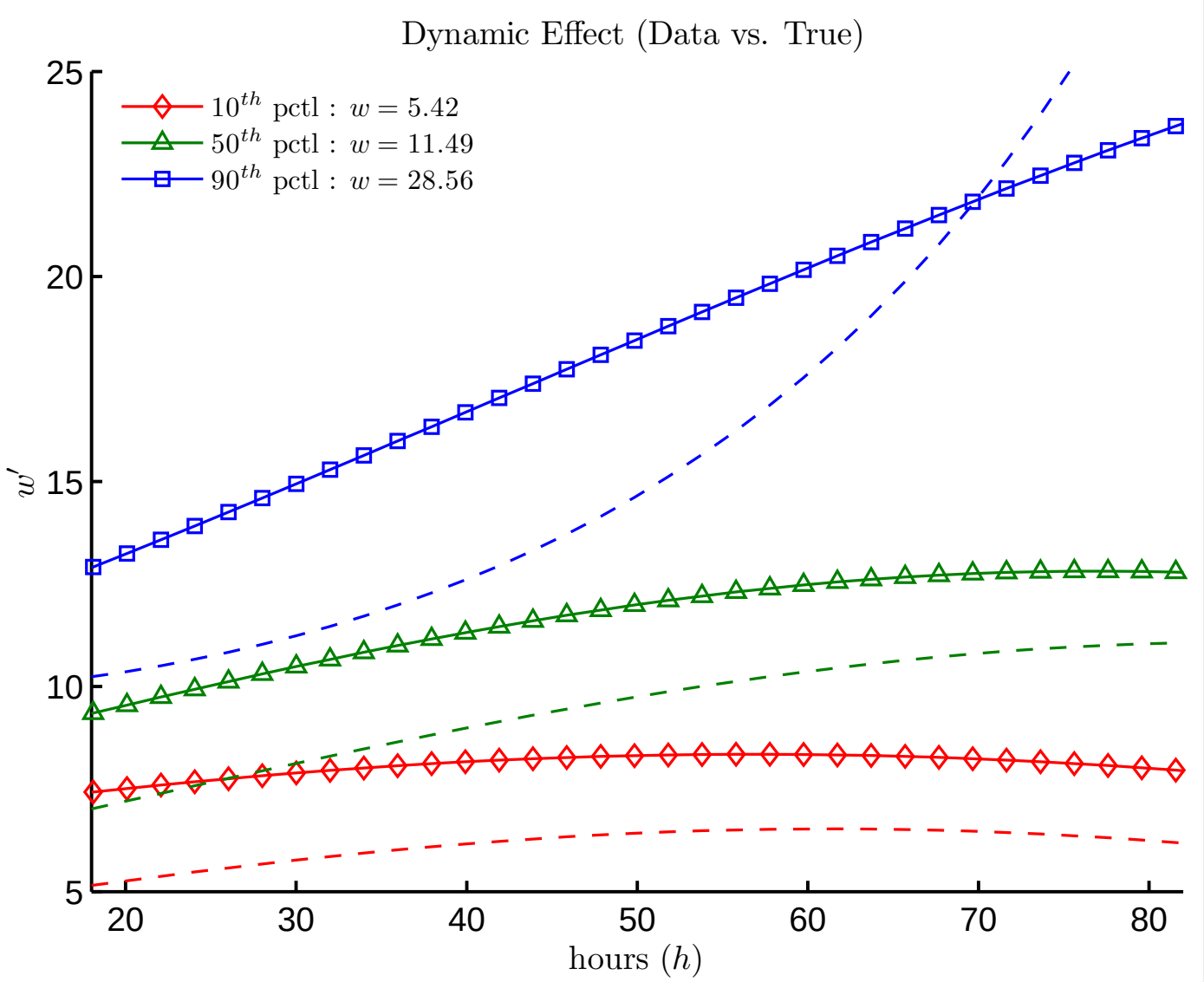
Parameters

Moments	Benchmark	No Dynamics
β	0.9806	0.9805
σ	7.1957	6.4297
γ	8.5652	4.5948
B	1.1345	0.7378
σ_ϵ	0.7520	1.068
τ_2	1.913	1.894

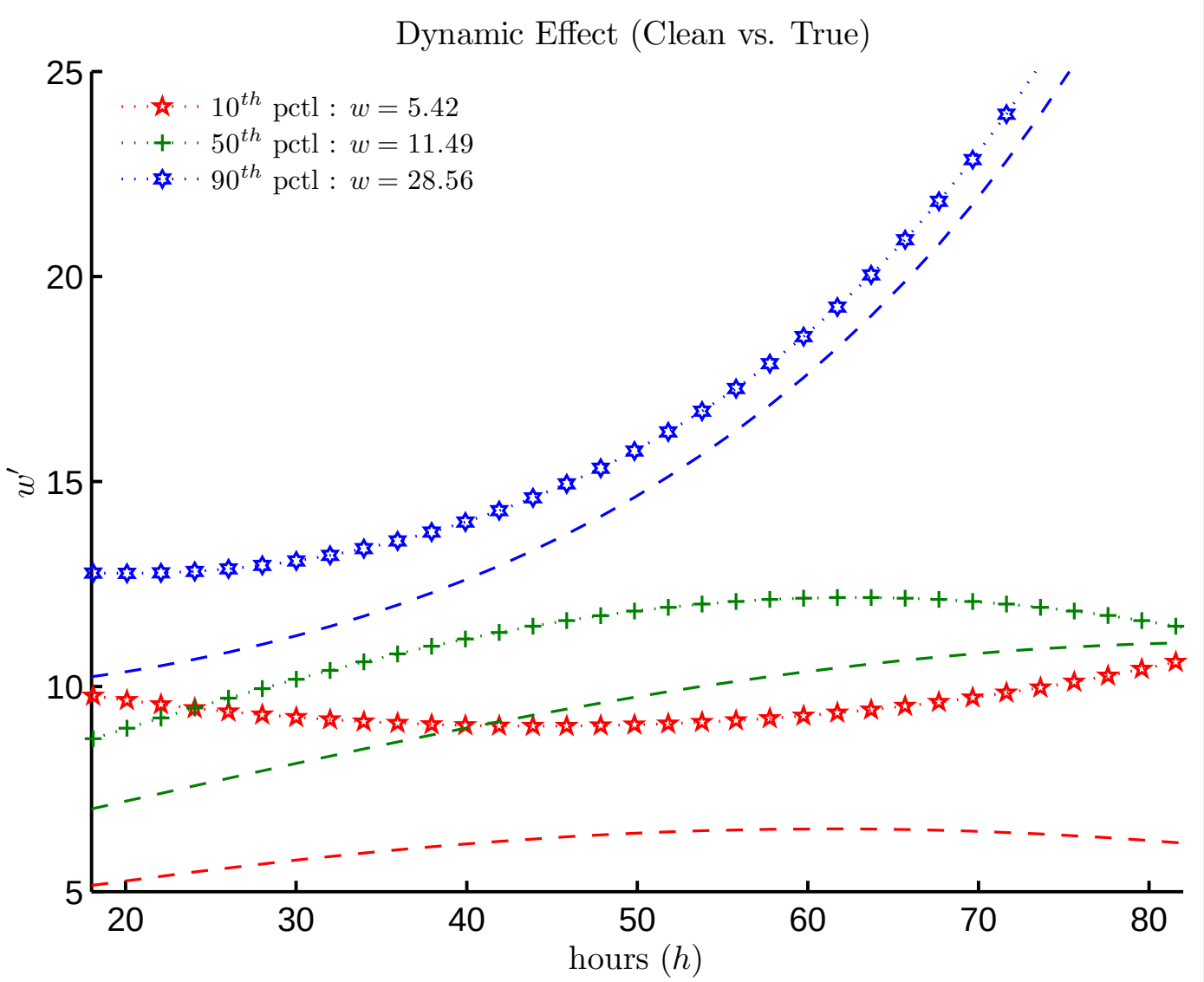
The Fit of the Dynamic Effect



The True vs. Estimated Dynamic Effect



The Effect of Selection

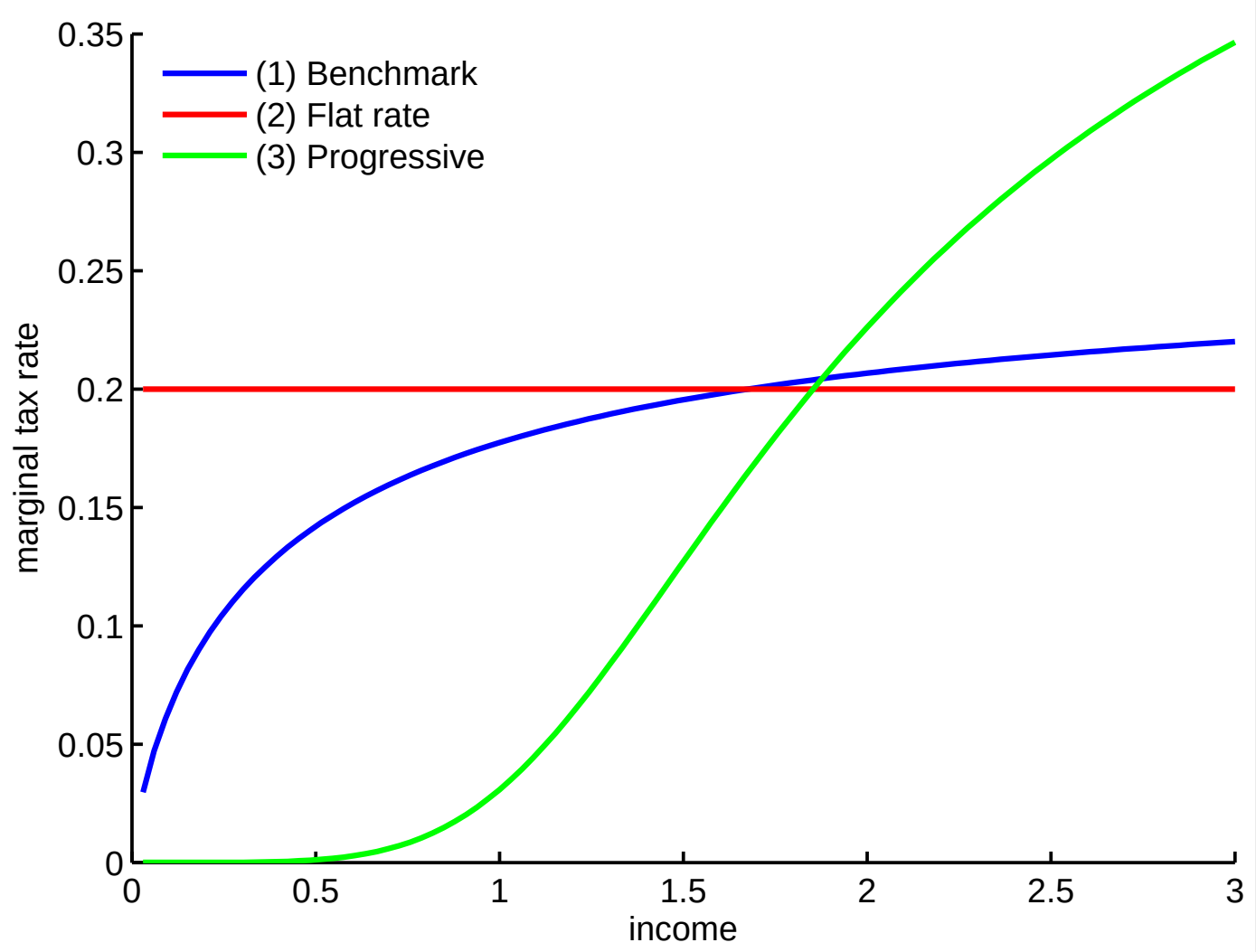


Hours and Asset Wealth

- Borrowing constrained agents (low productivity in particular) use hours to smooth consumption subject to the usual static income and substitution effect. $\Rightarrow$They may work less when they have a higher shock. $\Rightarrow$ More progressivity may reduce the need of such insurance, so low income agents may work less although their tax rate is reduced.
- Agents with high level of assets get good insurance through asset levels. $\Rightarrow$ So, similarly to first-best, they work more when they have high income. $\Rightarrow$ More progressivity reduces differences between pay-offs hence high income agents work less and low income agents work more.

Tax Policy

To be completed



Aggregate Effects of the Change in Tax system

Moments	Benchmark		
	(1)	(2)	(3)
Output	1.234	1.265	1.114
Consumption	0.719	0.724	0.699
Hours	0.319	0.315	0.307
Human Capital	0.619	0.623	0.578
Capital	4.206	4.458	3.582
G/Y	0.142	0.144	0.116
Moments	No Dynamics		
Output	1.266	1.307	1.205
Consumption	0.756	0.764	0.761
Hours	0.391	0.393	0.395
Human Capital	0.662	0.664	0.651
Capital	4.017	4.356	3.598
G/Y	0.147	0.147	0.130

Conclusion

- We show that current hours do affect future earnings potential.
- Dynamic effect varies considerably across income group.
- Dynamic effect should be taken into account to correctly measure the labor supply elasticity.
- The aggregate response of hours and human capital to tax code changes (to be confirmed).