Equilibrium Effects of Education Policies: a Quantitative Evaluation

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Motivation

- Increasing realization of importance to look at policy interventions within equilibrium frameworks
- Our aim: provide structure for analysis of aggregate and distributive effects of policies
- Crucial premise: heterogeneity exists and takes different shapes. One of them is ‘ability’
- However, youth’s ability is non-random: it depends on parents (mostly mother)
- Parents not only have ‘correlated’ ability. They also make inter-vivos transfers.
- Such transfers are a substantial source of education finance.

What We Do

- Develop heterogeneous agents framework with intergenerational ability persistence and transfers

- Evaluate effects of policy interventions in equilibrium: focus on education policies (college subsidies)

- Ask whether equilibrium effects induced by policy interventions are relevant. We find that such effects:

  1. are **quantitatively important** and **work through interesting mechanisms**, involving selection on ability

  2. can be **triggered by very small changes** in marginal returns

Policy Background: Evaluating Economic Interventions

- Policy evaluation widely used by governments/institutions: improve transparency and effectiveness, see JTPA(US), EMA(UK), PROGRESA(Mexico)

- Various techniques developed to evaluate the effects of interventions

- ‘Gold standard’ in evaluation literature is randomized, small-scale, field experiment in which treatment and control group are compared (ideally like medical literature)

- When field trials not feasible, quasi-experimental techniques used to identify effects of policy interventions, e.g. IV, Diff-in-Diff, Matching

Some Issues with Policy Evaluation

- **Long-term effects**: It takes time for effects to show up (e.g. distortions in life cycle choices)

- **Effects on Non-Treated**: (a) non-treated can change their behavior; (b) there can be concurring effects

- **Small scale field experiments as basis for evaluations**: bad proxy for larger scale interventions?

- Hard to separately **account for effects of known heterogeneity vis-a-vis genuine uncertainty** (see Cunha et al., 2005)

- **Equilibrium effects**: successful policies may affect prices!

Our Analysis and Some References

- Basic OLG, life-cycle model with **endogenous labor supply, education and inter-vivos transfer choices**.

- Agents' **heterogeneous** (in terms of wealth, ability and labor efficiency).

- Allow for **endogenous price responses** through aggregate production technology (heterogeneous labor inputs).

- Design **numerical experiments** to compare effectiveness of alternative **policies**

- Examine how a given policy **affects different people in different ways**

Public expenditure on Education - Selected Countries

	% of GNP		% of Gov. Expend.		Av. annual growth rate (%)
	1990	*1996*	*1990*	*1996*	*1990-96*
US	5.2	5.4	12.3	14.4	2.2
Canada	6.8	6.9	14.2	12.9	1.4
UK	4.9	5.3	...	11.6	3.1
Germany	...	4.8	...	9.6	...
France	5.4	6.0		10.9	2.9
Australia	5.3	5.5	14.8	13.5	3.9

What We Find

- Policy outcomes **sensitive to small changes in marginal returns**

- Subsidies change aggregate education distribution in P.E.; but **aggregate effects nearly disappear in G.E.**

- Results hold with high **degree of substitutability** among labor inputs

- **Composition effects**: Substantial effects of subsidies on ability composition in G.E.

- **Crowding out of inter-vivos transfers**: subsidies crowd out inter-vivos transfers in equilibrium and are associated to more sorting (and inequality)

Education Choices: Benefits vs Costs

Education as outcome of rational choice trading off expected benefits versus cost. Incentives matter.

- **Costs**: education costs money, time and effort
- **Returns**: access to a labor spot-market with higher wages.
- **Heterogeneity**: individual returns depend on ex-ante (ability) and ex-post (labor shocks).
- Model **3 education levels** (HS drop-outs, HS grads, College grads). Education as a way to smooth lifetime marginal utility. Agents can also use physical capital (risk free) to achieve same objective

Economic Environment (I) : Demographics and Preferences

- Basic framework: **neoclassical model**

- **Discrete, finite life-time** (16-95). Perfect annuity markets. Population stationary. Retired agents get pension flow.

- $u_t = u(c_t, l_t)$. Strictly increasing, concave and with Inada conditions. Future discounted at rate β

- Schooling implies (additive) **utility cost** $\kappa(\theta)$ which varies with agent's ability

- **Intergenerational ability transmission**: ability of youths depends on parental ability and luck

Economic Environment (II): Choices and Technology

- Agents choose consumption, education, transfers and labor supply
- Separate **spot-markets by education**. Wage rates set competitively
- Aggregate (efficiency weighted) individual labor supplies by education-type, denoted as H_e, are inputs to aggregate technology.
- Aggregate production function:

$$Y = F(K, \mathcal{H}) = MK^{\phi}H^{1-\phi} = MK^{\phi}\left(s_{1t}H_1^{\rho} + s_{2t}H_2^{\rho} + s_{3t}H_3^{\rho}\right)^{\frac{1-\phi}{\rho}}$$

Economic Environment (III): Endowments and Wages

- **Initial resources**. Youth start life with intervivos transfers chosen by parents

- **Labor efficiency**: (Log) wage of agent i, aged j, in education e is

$$\ln w_{ei} = w_e + \lambda \ln \theta_i + \xi_j^e + z_{ij}^e$$

- w_e is marginal return to labor type e; λ is gradient of ability (θ_i) in wages; ξ_j^e is education-specific age-earning profile; z_j is persistent labor shock.

Economic Environment (IV) : Markets and Government

- **Competitive markets**. Uninsurable income risk. Workers can self-insure by holding risk-free asset a

- Exogenous **borrowing limit**. During college, means-tested availability of subsidized loans (Stafford-like)

- Government: revenues from **proportional taxation of labor and assets income** at τ_{n^e} and τ_k rates. Non-valued expenditure G and **subsidies to education** via transfers $g(a_j, \theta)$ or discounted loan. No gov. debt.

Individual Problem in Recursive Form: Stages of the Life Cycle

Work stage after inter-vivos transfer:

$$
\begin{aligned}
W_j(e, a_j, \theta, z_j) &= \max_{c_j, l_j} u(c_j, l_j) + \beta \mathbb{E}_z W_{j+1}(e, a_{j+1}, \theta, z_{j+1}) \\
& s.t. \\
(1+\tau_c) c_j + a_{j+1} &= (1-\tau_w) w^e \varepsilon_j^e(\theta, z_j) + [1 + r(1-\tau_k)] a_j \\
a_{j+1} &\geq \underline{a} \\
z_{j+1} &\sim \Gamma_z^e(z_{j+1}, z_j)
\end{aligned}
$$

Work stage in period of inter-vivos transfer:

$$
\begin{aligned}
W_j\left(e, a_j, \theta, z_j, \hat{\theta}\right) &= \max_{c_j, l_j \hat{a}_1} \; u\left(c_j, l_j\right) + \beta[\mathbb{E}_z W_{j+1}\left(e, a_{j+1}, \theta, z_{j+1}\right) + \\
&+ \quad \omega_0 \mathbb{E}_{\hat{z}} V^*\left(\hat{a}_1, \hat{\theta}, \hat{z}_1\right) + \\
&+ \quad \frac{\omega_1}{1-\omega_3}\left(1 + \frac{\hat{a}_1}{\omega_2}\right)^{1-\omega_3}]
\end{aligned}
$$

$s.t.$

$$
\begin{aligned}
\left(1+\tau_c\right) c_j + a_{j+1} + \hat{a}_1 &= \left(1-\tau_w\right) w^e \varepsilon_j^e\left(\theta, z_j\right)\left(1-l_j\right) + \left[1 + r\left(1-\tau_k\right)\right] a_j \\
a_{j+1} &\geq -\underline{a}, \quad \hat{a}_1 \geq 0 \\
z_{j+1} &\sim \Gamma_z^e\left(z_{j+1}, z_j\right)
\end{aligned}
$$

Work stage before inter-vivos transfer:

$$
\begin{aligned}
W_j\left(e, a_j, \theta, z_j, n_j\right) &= \max_{c_j, l_j} u\left(c_j, l_j\right) + \beta \mathbb{E}_{z, \hat{\theta}} W_{j+1}\left(e, a_{j+1}, \theta, z_{j+1}, \hat{\theta}\right) \\
& \quad s.t. \\
\left(1+\tau_c\right) c_j + a_{j+1} &= \left(1-\tau_w\right) w^e \varepsilon_j^e\left(\theta, z_j\right) + \left[1 + r\left(1-\tau_k\right)\right] a_j - \pi \cdot I_{\left\{n_j > 0\right\}} \\
a_{j+1} &\geq \underline{a} \\
z_{j+1} &\sim \Gamma_z^e\left(z_{j+1}, z_j\right) \\
n_{j+1} &= \max\left\{n_j - 1, 0\right\}
\end{aligned}
$$

Initial period of the work stage: In first period of working life, value function is the same as for other workers. However we define total government loan as:

$$b = \begin{cases} 0 & \text{if } e \in \{LHS, HSG\}\,, \text{ or } e = COL \text{ and } \hat{a}_{j^{COL}+1} \geq 0 \\ \hat{a}_{j^{COL}+1} & \text{if } e = COL \text{ and } 0 \geq \hat{a}_{j^{COL}+1} > -\underline{b} \end{cases}$$

Private assets or liabilities a_j are determined as

$$a_j = \begin{cases} \hat{a}_j & \text{if } e = LHS \text{ and } j = 1 \\ \hat{a}_j & \text{if } e = HSG \text{ and } j = j^{HSG} + 1 \\ \hat{a}_j - b & \text{if } e = COL \text{ and } j = j^{COL} + 1 \end{cases}$$

College decision:

$$V_j\left(COL, a_j, \theta\right) = \max_{c_j}\ u\left(c_j, \overline{l}\right) - \kappa\left(\theta\right) + \beta V_{j+1}\left(COL, a_{j+1}, \theta\right)$$

$$V^{**}\left(a_j, \theta, z_j\right) = \max\ \left\{V_j\left(COL, a_j, \theta\right), W_j\left(HSG, a_j, \theta, z_j\right)\right\}$$

subject to:

$$\left(1+\tau_c\right)c_j + \hat{a}_{j+1} =$$

$$= \begin{cases} \left[1 + r\left(1-\tau_k\right)\right]\hat{a}_j - \phi + g\left(\hat{a}_j, \theta\right) & \text{if } \hat{a}_j \geq 0 \\ \hat{a}_j - \phi + g\left(\hat{a}_j, \theta\right) & \text{if } 0 > \hat{a}_j > -\underline{b} \end{cases}$$

$$\hat{a}_{j+1} \geq -\underline{b}$$

- Here ϕ are per-period tuitions and $g\left(a_j, \theta\right)$ is means-tested government grant.

- Composite budget constraint reflects fact that if individual is borrowing from government, then she does not repay interests until after employment
- While if she borrows from private markets, she starts repaying market interest rate right away.

If student is rich enough (large family transfers!) she does not qualify for subsidized government loan, and $b = 0$. Budget constraint is:

$$(1+\tau_c)\,c_j + \hat{a}_{j+1} = [1 + r\,(1-\tau_k)]\,(\hat{a}_j) - \phi + g\,(\hat{a}_j, \theta)$$

$$\hat{a}_{j+1} \geq -\underline{a}^{PVT}$$

High School decision similar to College decision (but no borrowing in HS!)

Stationary Equilibrium

stationary recursive competitive equilibrium (Stokey & Lucas, 1989) such that

1. Firms maximize profits

2. Agents maximize lifetime expected utility as price-takers

3. government balances budget in every period

4. Prices are market-clearing

Details and derivation in the paper

Parametrization (I): Different U.S. data sources (PSID,CPS,NLSY79,NLSY97).

Proceed in two stages. First, some parameters are assigned or estimated outside model:

1. separate wage equations for each education group (PSID,NLSY79).

2. distribution of ability and intergenerational transition law for ability (NLSY79)

3. aggregate technology: shares and substitution elasticities among aggregate inputs (CPS,PSID) (Note: we use highest estimated elasticity 3.1 – least favorable to GE effects!)

4. basic features of distribution of inter-vivos transfers between age 16 and 22 (NLSY97)

Parametrization (II)

Given parameters set in first stage, model is simulated so to match variety of targets through SMM

Quantitative Analysis (I)

Given fully parameterized model:

- (i) we compute benchmark steady-state equilibrium;

- (ii) we validate the benchmark in different ways (life-cycle profiles, short-term enrollment responses);

Quantitative Analysis (II)

- Experiments: benchmark is perturbed by
  - (1) increasing conditional grants by equal amount for all income groups (resulting in \$1000 average increase). Link to crowding out table Link grant experiments
  - (2) increasing subsidization of gov. loans, matching cost of policy (1) above: (i) interest rate paid on gov. student loans drops by 3.5%; (ii) maximum wealth to qualify rises (by roughly $2/3$, from \$31,347 to \$54,000); (iii) borrowing limit for student loans increases by one third (from \$16,740 to \$22,302). Link loan experiments

Conclusions

- PE: subsidies increase college enrolment (and output)

- In G.E., subsidies are quite ineffective: post-intervention little changes in terms of aggregate schooling choices

- Looking at aggregate outcomes alone can be misleading! Price changes induce improvements in ability composition among college graduates in G.E.

- Results robust to specification of aggregate technology, and to alternative policy interventions

- Substantial crowding out of private savings by the subsidy, especially among the rich

Extensions

1. Pre-school intervention: Allow for ability (permanent characteristics) of children to depend on ability of parents. How effective would intervention at this stage be and what are equilibrium effects? (Perry Pre-School Experiment, intervention at family level)

2. experimenting with policies which give hand-outs to parents before the "intervivos" decision is made: how does this differ from a conditional subsidy to education paid directly to the kids?

3. Importance of means-testing.

4. look at effects of earned income tax credits: how effective is intervention at later stages of the life cycle?

Rybczynski Theorem

- The Rybczynski Theorem of the Heckscher-Ohlin trade theory describes how regions can absorb endowment shocks via changes in output mix without any changes in relative regional factor prices

- This theorem is important for policy analysis in general equilibrium: in its most extreme form it would imply that factor prices equalization rules out any price effect from a policy

- For the theorem to apply, there must be at least as many output goods as factors

- In the U.S. the value of exports as a share of GDP was 10.2% in 2001 (OECD Economic Outlook 2005).

- We assume no factor price equalization in our work. Even if Rybczynski Theorem holds, the model would still be valuable in 2 dimensions:

  1. Providing information on the long-term effects of (partial equilibrium) interventions
  2. Selection effects associated to changes in financing constraints of education

Context: this work builds on different strands of research

HC investment and value of education: Mincer(1958), Becker (1964), Ben-Porath (1967), Rosen (1977), Levhari and Weiss (1974), Eaton and Rosen(1980a,b), Blinder and Weiss(1976), Heckman and Carneiro (2002), Cunha and Heckman (2007)

HC in equilibrium computational models: Fernandez and Rogerson (1995,1998), Keane and Wolpin (1997)

G.E. models for education policy: Heckman,Lochner and Taber (1998a,b),Lee(2002), Lee and Wolpin (2006), Meghir(2007), Castro and Coen-Pirani (2011)

Optimal inter-vivos transfers: Gale and Scholz(1994), Rosenzweig and Wolpin(1994), Altonji,Hayashi and Kotlikoff(1992,1995,1996)

Inequality and education/skills: Juhn, Murphy and Pierce (1993), Katz and Autor (1999), Krusell-Ohanian-Rios Rull-Violante (2000)

Stationary Equilibria in OLG

- Prescott and Rios-Rull (2005) have proposed a different notion of equilibrium for stationary OLG economies, known as Organizational Equilibrium

- This equilibrium applied to environments where contractual arrangements outlive their founders

- In this paper we do not refine the notion of equilibrium to take into account issues discussed by Prescott and Rios-Rull

Our Sample

PSID

- Exclude individuals associated with Census Low Income sample, Latino sample or New Immigrant sample and focus on SRC core sample
- We are working on a new sample from which we exclude women, to take into account the fact that most of property crime is committed by male

CPS

- We use the March CPS yearly files and additional files from 1968 to 2001
- We use the CPI for all urban consumer (with base year 1992) to deflate the CPS earning data and drop all observations that have missing or zero earnings
- Since the earning data are top-coded for confidentiality issues until 1995, we have extrapolated the average of the top-coded values by using a tail approximations based on a Pareto distribution

Identifying HC Aggregates in the Economy

- The human capital aggregates H_1,H_2 and H_3 can be recovered using the time effects $\widehat{w_{e,t}}$ estimated by using the PSID panel dimension

- We use March CPS earnings data for 1968-2001 to compute aggregate wage bills (denoted as $WB_{e,t}$) for different education groups over time.

- The annual wage bill for a given education group is the total earning payments received by employed people of that education group in a given year.

- We use the time-series for prices of different labor types (interpreted as spot market prices for skills) to residually identify HC aggregates as

$$H_{e,t} = WB_{e,t}/w_{e,t}$$

Parameter	*Value*	*Moment to Match*
J	79	Max model age (between age 16 and age 95)
j^{RET}	50	Maximum years of working life
$\{\zeta_j\}$	-	Survival rates (from US Life Tables)
ϕ_{HS}		Direct cost of High School: 0
ϕ_{COL}		Direct cost of College: 31.5% of post-tax median income
α	0.35	Capital share in total output
δ	6.5%	Depreciation rate
p^e	16.4%	Pension replacement rate (same for all edu. groups)
t_l	27%	Labor income tax (flat)
t_K	40%	Capital income tax (flat)

Table 1: Assigned parameter values for benchmark

Income (from transfer)	Government	Private/Institution	Total
below 20 percentile	\$ 2,820	\$ 1,715	\$ 4,535
between 20 to 55 percentile	\$ 668	\$ 2,234	\$ 2,902
above 55 percentile	\$ 143	\$ 1,855	\$ 1,998

Table 2: Grant entitlements in the benchmark

Parameter	Value	Moment to Match	Data	Model
$\underline{a}^{PRV}$	-$34,535	Match fraction of households with net worth ≤ 0	0.09	0.09
β	0.9687	Match wealth-income ratio excluding top 1%	2.7	2.71
ι	0.0425	Percentage of students with private loan	0.049	0.051
r^b	0.03	Percentage of students with government loan	0.46	0.478
$\underline{b}$	16,470	Average government loan size	16,676	16,535
$glmw$	$31,347	Average private loan size	18,474	16,426
ω_0	0.0475	Average inter-vivos transfer	26,411	26,138
ω_1	55.75	Inter-vivos transfer of first income quartile	14,504	15,293
ω_2	3	Inter-vivos transfer of second income quartile	21,420	22,845
ω_3	18.5	Inter-vivos transfer of third income quartile	31,717	28,418
		Inter-vivos transfer of fourth income quartile	38,066	38,519
		Inter-vivos transfer of third wealth quartile	28,399	26,681

Table 3: Calibrated Parameter Values for Benchmark and Model Moments

Importance of endogenous labor supply

- Work and HC investment are jointly determined. Labor supply is utilization of HC, Eaton and Rosen (1980a)
- A host of interesting questions cannot be fully addressed by a life-cycle model which considers labor-leisure choices or labor-education choices but not both, e.g. effects of proportional wage taxation, Blinder and Weiss (1976)

Computing the intervivos decision

When computing the intervivos decision we solve for two Euler equations: one for the parental savings carried over next period, another for the continuation value of the child.

The solution first checks for possible corner solution in either of the Euler equations. If only one corner solution is found, the problem goes back to a standard one-asset form. If no corner solutions are found, an interior solution is found for both Euler equation: the solution is such that the discounted marginal utility of a child is equal to the discounted marginal utility of a parent.

Estimated Transition of permanent characteristics (ability)

Table 4: **Ability transition, probabilities by quintile**

	Children					
Mothers	1	2	3	4	5	Total
1	45.5	23.8	19.7	6.5	4.7	100.0
2	25.8	24.2	24.2	15.7	11.0	100.0
3	16.0	22.3	27.1	19.0	15.7	100.0
4	11.4	17.1	25.7	20.9	24.9	100.0
5	7.2	7.6	19.5	24.2	41.5	100.0

Each cell reports a conditional probability

Figure 1: Density of permanent characteristics (ability)

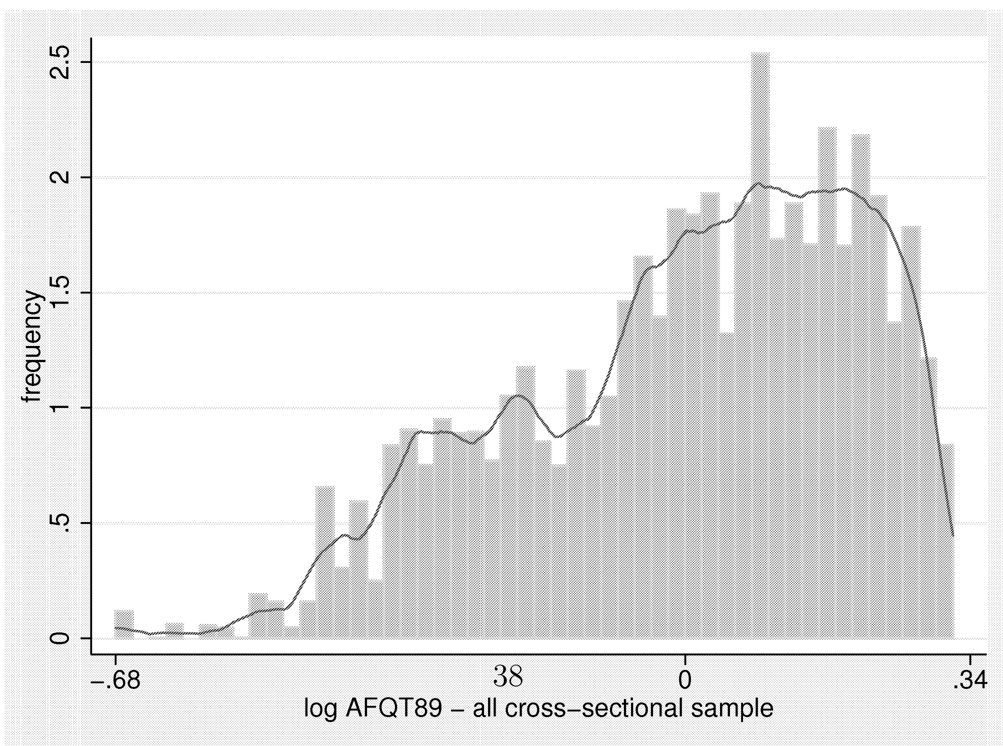
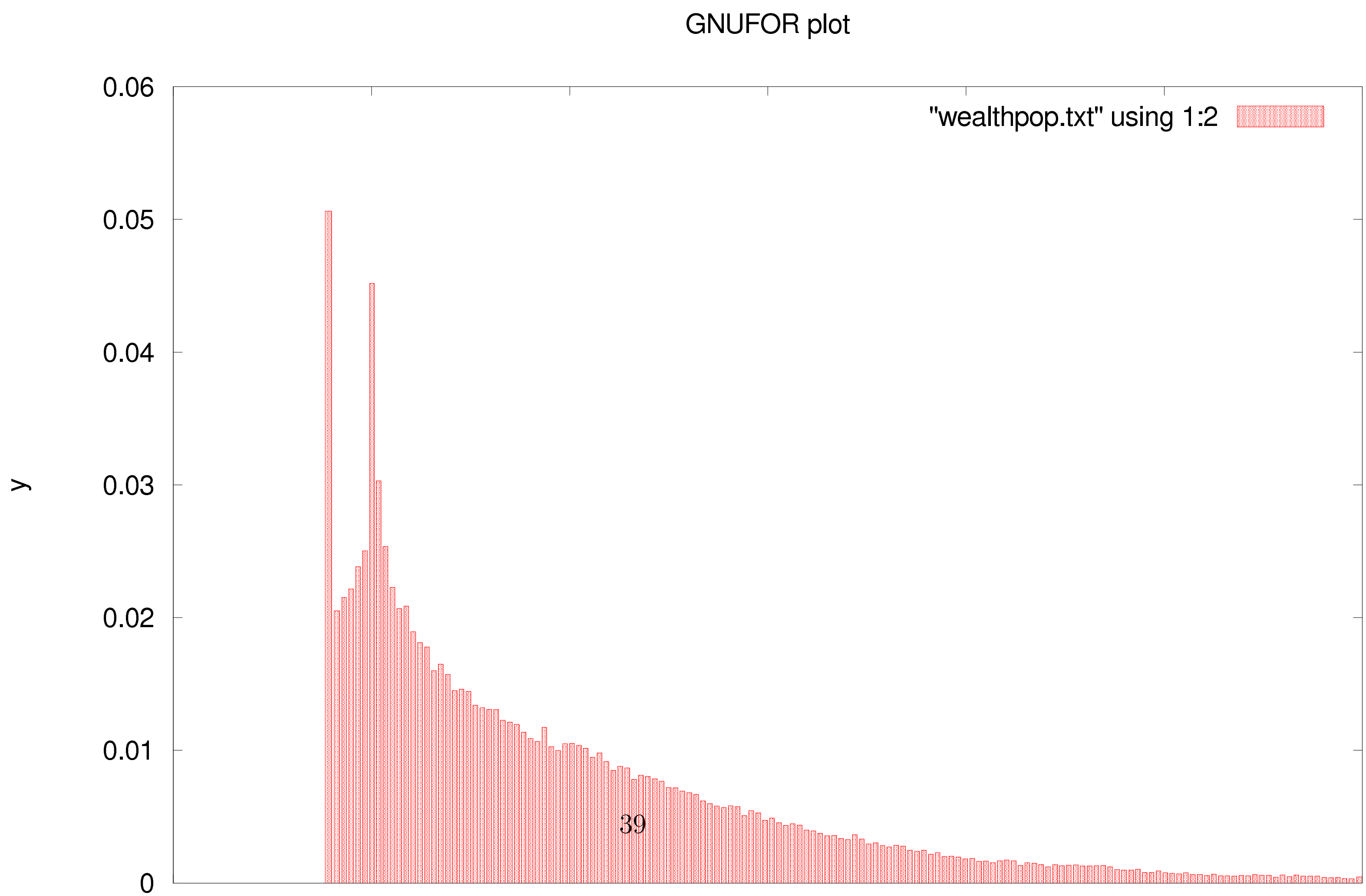


Figure 2: Distribution of assets in equilibrium



Education specific wage equations

- For each education group we estimate

$$\ln w_{ei} = w_e + \lambda \ln \theta_i + \xi_j^e + z_{ij}^e$$

where z_{ij}^e is an AR(1) process, w_t is a time effect, θ_i is a permanent error component and z_{it} is the idiosyncratic shock.

- We use PSID and NLSY79 data to estimate these equations (PSID for time effects and age profiles, NLSY79 for ability gradients).

- The parameters of the AR(1) process are identified through GMM.

Link: Estimates of Wage Parameters

Estimated Wage Parameters

Table 5: **Parameters of AR(1) processes by education**

	Group 1	**Group 2**	**Group 3**
ρ	0.936	0.951	0.945
Variance of innovation to z_{edu}	0.020	0.017	0.020

Table 6: **Estimated ability gradient. Sample 2: Wage = CPS-type**

Education group	Gradient (S.E.)	# of obs.	# of workers
LTHS	.36 (.06)	1,341	8,982
HSG	.54 (.03)	5,403	42,270
CG	.89 (.09)	1,206	8,719
pooled	.71 (.02)	7,954	60,009

Aggregate Technology Parameters (I): Estimation

- Aggregate output is defined as $Y = zK^{\alpha}H^{1-\alpha}$, with

$$H = [aH_1^{\rho} + bH_2^{\rho} + (1-a-b)H_3^{\rho}]^{1/\rho}$$

- HC aggregate inputs are not directly observable, so we estimate them combining information from CPS and PSID

- Aggregate inputs are endogenously determined: we use an instrumental variable method to estimate and test elasticity parameters

- Our specification identifies long-time trends in the shares of different human capital types (technological change)

- Exploit restrictions on data implied by this technology specification to obtain estimates of both shares and elasticity. Link: Tech Estimates

Aggregate Technology Parameters (II): Elasticity

- Tests for equality of ρ parameters between different education groups unable to reject the null hypothesis that aggregate technology is isoelastic

- Estimated value of ρ is between .36 and .68. Implied elasticity of substitution between 1.6 and 3.1.

- For skilled/unskilled groups Katz and Murphy estimate substitution elasticity of 1.41. Heckman, Lochner and Taber (1998a) favorite estimate of elasticity of substitution between skilled and unskilled equal to 1.44. Johnson (1970) suggests value of 1.50 Card and Lemieux find an elasticity between skilled and unskilled of 2.5, which can go up to 5 when not controlling for age.

	Specification : growth rates		Specification : levels	
	(1)	**(2)**	**(3)**	**(4)**
First stage IV	up to 4 lags	up to 3 lags	up to 5 lags	up to 4 lags
Number of obs.	75	78	75	78
	Coefficient (Std. Err.)	Coefficient (Std. Err.)	Coefficient (Std. Err.)	Coefficient (Std. Err.)
ρ	0.510	.357	0.677	.641
	(0.121)	(.170)	(0.079)	(.079)
$g_{2,1}$	0.023	.031	0.013	.016
	(0.009)	(.012)	(0.005)	(.005)
$g_{3,2}$	0.014	.017	0.012	.012
	(0.006)	(.007)	(0.002)	(.002)
$g_{3,1}$	0.036	.048	0.025	.028
	(0.011)	(.015)	(0.006)	(.006)
$s_{2,1}$			0.431	.419
			(0.027)	(.027)
$s_{3,2}$			-0.252	-.275
			(0.082)	(.085)
$s_{3,1}$			0.180	.143
			(0.068)	(.070)

Table 7: Estimation results : aggregate technology (isoelastic CES spec.), Restricted ρ

Table 8: Distribution of inter-vivos transfers by parental wage quartile.

Positive Transfers only								
	Rent				No Rent			
age	**mean**	**median**	**stand.dev.**	**obs**	**mean**	**median**	**stand.dev.**	**obs**
q1	5,113	5,014	1,473	923	949	317	1,812	382
q2	5,263	5,014	1,578	913	1,085	500	1,984	375
q3	5,341	5,027	1,629	896	1,070	500	1,978	373
q4	5,405	5,100	1,815	908	1,170	500	2,233	375
Overall	5,279	5,014	1,631	3,640	1,068	475	2,006	1,505
Whole sample								
	Rent				No Rent			
q1	4,578	5,014	2,103	974	316	0	1,108	974
q2	4,928	5,014	1,999	975	388	0	1,319	975
q3	5,093	5,014	1,938	959	454	0	1,384	959
q4	5,232	5,065	1,995	969	502	0	1,561	969
Overall	4,957	5,014	2,024	3,877	415	0	1,354	3,877

Table 9: Distribution of inter-vivos transfers by household income quartile.

Positive Transfers only								
	Rent				No Rent			
age	**mean**	**median**	**stand.dev.**	**obs**	**mean**	**median**	**stand.dev.**	**obs**
q1	4,091	5,014	2,688	3,116	1,186	479	2,333	1,408
q2	4,967	5,214	1,980	3,117	1,131	479	2,191	1,407
q3	5,473	5,368	1,613	3,105	1,119	486	1,982	1,416
q4	5,699	5,368	1,928	3,112	1,414	517	2,584	1,396
Overall	5,057	5,306	2,179	12,450	1,212	486	2,284	5,627
Whole sample								
	Rent				No Rent			
q1	2,072	146	2,785	4,205	372	0	1,403	4,205
q2	3,060	4,765	2,877	4,144	343	0	1,334	4,144
q3	4,531	5,114	2,514	4,167	397	0	1,334	4,167
q4	5,438	5,368	2,106	4,172	522	0	1,675	4,172
Overall	3,773	5,014	2,896	16,688	409	0	1,445	16,688

Table 10: Distribution of inter-vivos transfers by household net worth.

Positive Transfers only								
	Rent				No Rent			
age	**mean**	**median**	**stand.dev.**	**obs**	**mean**	**median**	**stand.dev.**	**obs**
q1	4,875	5,017	1,701	2,290	838	400	1,512	930
q2	4,893	5,014	2,000	1,977	974	414	2,029	930
q3	4,990	5,018	1,982	2,134	1,116	486	2,049	925
q4	5,175	5,086	2,083	2,133	1,300	500	2,437	928
Overall	4,983	5,014	1,945	8,534	1,057	479	2,039	3,713
Whole sample								
	Rent				No Rent			
q1	3,785	5,014	2,524	2,949	264	0	934	2,949
q2	3,913	4,976	2,619	2,357	318	0	1,230	2,357
q3	4,057	5,014	2,665	2,650	398	0	1,338	2,650
q4	4,295	5,014	2,716	2,651	505	0	1,645	2,651
Overall	4,009	5,014	2,636	10,607	370	0	1,308	10,607

Table 11: Distribution of inter-vivos transfers by maximum residential parent education.

Positive Transfers only								
	Rent				No Rent			
age	**mean**	**median**	**stand.dev.**	**obs**	**mean**	**median**	**stand.dev.**	**obs**
LHS	5,050	5,115	1,721	1,055	944	383	1,887	349
HSG	4,978	5,293	1,978	6,070	1,032	479	1,913	2,611
CG	5,108	5,293	2,353	8,744	1,383	500	2,613	3,889
Average	5,054	5,282	2,179	15,869	1,227	486	2,342	6,849
Whole sample								
	Rent				No Rent			
LHS	3,675	5,014	2,686	1,450	227	0	1,009	1,450
HSG	3,761	5,014	2,745	8,035	335	0	1,193	8,035
CG	3,833	5,014	3,007	11,651	462	0	1,645	11,651
Average	3,795	5,014	2,889	21,136	398	0	1,452	21,136

Table 12: **Intervivos response to transfers - GE**

	dependent var.: change in log(IVT)			
	(1)	(2)	(3)	(4)
log(grant) change	-.257	-.438	-.443	-.249
	(.010)	(.037)	(.037)	(.046)
constant	.079	.167	.158	.083
	(.003)	(.014)	(.015)	(.018)
dummy 1: wealth quart. 1			-.016	-.061
			(.016)	(.045)
dummy 2: wealth quart. 4			.022	.354
			(.005)	(.034)
interac. dummy 1 $\times$ log (grant) change				.149
				(.120)
interac. dummy 2 $\times$ log (grant) change				-.862
				(.088)

(1) All sample (including non college goers): 8538 observations
(2) to (4) College students only: 2659 observations

Table 13: **Grant Experiment**[1]

		Baseline	P.E. Surp.	P.E. Conv.	G.E. no tax	G.E. lab. tax
Enrolment		Share in each education group.				
Ability 1	HS	0.22	0.22	0.22	0.23	0.23
	COL	0.01	0.03	0.03	0.02	0.02
Ability 2	HS	0.71	0.67	0.64	0.80	0.80
	COL	0.05	0.09	0.10	0.00	0.02
Ability 3	HS	0.78	0.72	0.68	0.79	0.76
	COL	0.11	0.17	0.21	0.06	0.09
Ability 4	HS	0.73	0.65	0.58	0.68	0.69
	COL	0.24	0.32	0.39	0.29	0.28
Ability 5	HS	0.54	0.46	0.35	0.47	0.48
	COL	0.45	0.53	0.64	0.52	0.51
Aggregate	HS	0.58	0.55	0.50	0.59	0.59
	COL	0.17	0.23	0.27	0.18	0.18
Marginal returns		% change from baseline				
	LHS	n/a	n/a	n/a	+0.4%	+1.3%
	HS	n/a	n/a	n/a	+0.7%	+1.4%
	COL	n/a	n/a	n/a	-1.3%	-1.2%
Avg. Earnings[2]	LHS	10,770	10,771	10,816	10,866	10,951
	HS	21,423	21,486	21,490	21,401	21,615
	COL	41,023	40,704	40,768	41,447	40,988
Labour Tax		0.27	0.27	0.27	0.27	0.267
Agg. Output (change)		n/a	3.49%	6.10%	0.74%	1.11%
Avg. Ability (workers)		LHS	-0.1%	- 1.4%	-3.0%	-2.7%
(% change from baseline)		HS	-7.9%	-23.6%	-22.2%	-21.8%
		COL	-9.2%	- 9.0%	13.6%	8.0%

[1] Every college student is given an extra $1000 of grants

[2] Year 2000 U.S. Dollars

Table 14: **Loan experiment**[1]

		Baseline	P.E. Surp.	P.E. Conv.	G.E. no tax	G.E. lab. tax
Enrolment		Share in each education group.				
Ability 1	HS	0.22	0.22	0.22	0.23	0.23
	COL	0.01	0.04	0.04	0.02	0.02
Ability 2	HS	0.71	0.67	0.63	0.80	0.78
	COL	0.05	0.10	0.11	0.00	0.03
Ability 3	HS	0.78	0.71	0.68	0.78	0.75
	COL	0.11	0.21	0.22	0.06	0.11
Ability 4	HS	0.73	0.61	0.59	0.68	0.69
	COL	0.24	0.37	0.39	0.29	0.27
Ability 5	HS	0.54	0.40	0.38	0.47	0.49
	COL	0.45	0.60	0.61	0.52	0.49
Aggregate	HS	0.60	0.52	0.50	0.59	0.59
	COL	0.17	0.26	0.27	0.18	0.18
Marginal returns		% change from baseline				
	LHS	n/a	n/a	n/a	+0.5%	+1.4%
	HS	n/a	n/a	n/a	+0.7%	+1.4%
	COL	n/a	n/a	n/a	-1.3%	-1.1%
Avg. Earnings[2]	LHS	10,770	10,718	10,776	10,877	10,979
	HS	21,423	21,500	21,555	21,367	21,642
	COL	41,023	40,595	40,499	41,518	40,776
Labour Tax		0.27	0.27	0.27	0.27	0.266
Agg. Output (change)		n/a	5.70%	6.02%	0.83%	1.11%
Avg. Ability (workers)		LHS	3.7%	-0.7%	-2.9%	-2.9%
(% change from baseline)		HS	-19.3%	-19.3%	-21.6%	-18.5%
		COL	-11.7%	-12.7%	11.7%	3.5%

[1] The loan experiment costs as much as the grant in P.E. (surprise)

[2]Year 2000 U.S. Dollars