Population Policy through Tradable Procreation Entitlements

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Optimal Fertility (1)

In many countries,
fertility $\neq$
perceived optimal fertility

$\longrightarrow$ natalistic policies
(e.g. family benefits)
in Europe.

Optimal Fertility (2)

→ population control in China - one-child policy

[Sweet Achievement]

Optimal Fertility (3)

We do not question the notion of optimal fertility.

Assumption: It is meaningful to aim at a fertility rate that would be judged optimal.

Question: How to reach such a desired level.

We suggest tradable procreation rights.
Let us explore this idea.

Tradable quotas, not a new idea

Widely implemented to combat
– air pollution [Clean Air Act Amendments]
– overproduction [milk quotas in the EU]
– overexploitation of natural resources [individual fishing quotas].

Proposed in other areas - not implemented:
– inflation control (Lerner & Colander, 1980)
– asylum policy (Schuck & Hathaway and Neve, 1997)
– deficit control (Casella, 1999).
– airport noise reduction (Bréchet & Picard 2006)
– population control (Boulding, 1964)

What we do

- Review of the literature on population entitlements
- Benchmark model with endogenous fertility and education
- Introduce tradable procreation entitlements
- Will tradability impoverish the poor further ? + education
- Move from the country level to the global level + grandfathering

Boulding's proposal

Context: Anxiety that earth may not be able to sustain an ever increasing population.

Proposal (1964: 135-136):

> *I think in all seriousness, however, that a system of marketable licenses to have children is the only one which will combine the minimum of social control necessary to the solution to this problem with a maximum of individual liberty and ethical choice...We would then set up a market in which the rich and the philoprogenitive would purchase licenses from the poor, the nuns, the maiden aunts, and so on.*

Other aspects

- long-run tendency toward equality in income: the rich would have many children and become poor and the poor would have few children and become rich.
- The price of the certificate would reflect the general desire in a society to have children.

Literature review

Two authors propose amendments or complements.

Heer (1975, Social Biology)
Daly (1991, book)

Issues:
– the need for continuous adjustments of the birth rate target,
– shifting up the reproduction age through the system,
– early mortality,
– definition of the license beneficiaries.

The model without procreation rights

heterogeneous agents: A and B
–skilled and unskilled households
–poor and rich countries

Benchmark: de la Croix and Doepke (AER, 2003):
– fertility is inversely related to parents' income [well documented empirical fact]

Total output: $Y_t = \omega^A L_t^A + \omega^B L_t^B$.

Endogenous fertility and education.

Overlapping generations: children and adults.

No procreation rights.

Preferences

Utility of household/country i:

$$\ln[c_t^i] + \gamma \ln[n_t^i \pi(e_t^i)]. \tag{1}$$

Probability of becoming skilled/rich:

$$\pi^i(e) = \tau^i \ (\theta + e)^\eta, \quad \eta \in (0, 1).$$

The budget constraint:

$$c_t^i = \left[\omega^i(1 - \phi n_t^i) - n_t^i e_t^i\right]. \tag{2}$$

Definition (Equilibrium)

Given initial population sizes N_0^A and N_0^B, an equilibrium is a sequence of individual quantities (c_t^i, e_t^i, n_t^i) and group sizes (N_t^i) such that

- *Consumption, education and fertility maximize households' utility (1) subject to the budget constraint (2);*
- *Group sizes evolve according to:*

$$\begin{bmatrix} N_{t+1}^A \\ N_{t+1}^B \end{bmatrix} = \begin{bmatrix} n_t^A(1-\pi^A(e_t^A)) & n_t^B(1-\pi^B(e_t^B)) \\ n_t^A\pi^A(e_t^A) & n_t^B\pi^B(e_t^B) \end{bmatrix} \begin{bmatrix} N_t^A \\ N_t^B \end{bmatrix} \tag{3}$$

- *Labor market clears, i.e. $N_t^i(1-\phi n_t^i) = L_t^i \ \forall i$.*

Solution to the individual problem

If $w > \theta/(\eta\phi)$ [interior regime],

$$e = \frac{\eta\phi w - \theta}{1-\eta}, \qquad \text{and:} \tag{4}$$

$$n = \frac{(1-\eta)\gamma w}{(\phi w - \theta)(1+\gamma)}. \tag{5}$$

If $w \leq \theta/(\eta\phi)$ [corner regime],

$$e = 0, \qquad \text{and:} \tag{6}$$

$$n = \frac{\gamma}{\phi(1+\gamma)} \tag{7}$$

Mothers/countries with little education and low income prefer many children and low education [quantity-quality tradeoff]

Dynamics and long run

$$z_t = \frac{N_t^A}{N_t^B}.$$

First-order recurrence equation

$$z_{t+1} = f(z_t).$$

Single positive steady state which is globally stable.

Introducing procreation rights

Fertility objective: ν children per person on average in the economy.

The objective should be biologically feasible:

Assumption

$$0 < \nu < \frac{1}{\phi}. \tag{C1}$$

Implementation Sequence

	Allowances (price $g_t \geq 0$)	Exemptions (price $q_t \geq 0$)
At majority	receives ν rights	
At each birth	cedes back one right	if number births $> \nu$ receives 1 right
At menopause		if $n_t < \nu < 0$ gives back $\nu - n_t$ rights
Over complete life	Procreation and exemption rights can be sold and purchased	

The budget constraint for an adult becomes:

$$c_t^i = \left[\omega^i(1-\phi n_t^i) - n_t^i e_t^i\right] + g_t(\nu - n_t^i) + q_t(n_t^i - \nu). \qquad (8)$$

Only the difference $g_t - q_t$ matters. We call this difference "procreation price":

$$p_t = g_t - q_t.$$

p_t positive $\longrightarrow$ $g_t > 0$ and $q_t = 0$, fertility is discouraged
p_t negative $\longrightarrow$ $g_t = 0$ and $q_t > 0$, fertility is promoted.

Definition (Equilibrium with Procreation Rights)

Given initial population sizes N_0^A and N_0^B, an equilibrium is a sequence of individual quantities (c_t^i, e_t^i, n_t^i), group sizes (N_t^i), and prices (p_t) such that

- *Consumption, education and fertility maximize households' utility (1) subject to the budget constraint (2);*
- *Group sizes evolve according to (3).*
- *Labor market clears, i.e. $N_t^i(1 - \phi n_t^i) = L_t^i \ \forall i$;*
- *Asset market clears, i.e.*

$$\sum_i (n_t^i - \nu) N_t^i = 0 \tag{9}$$

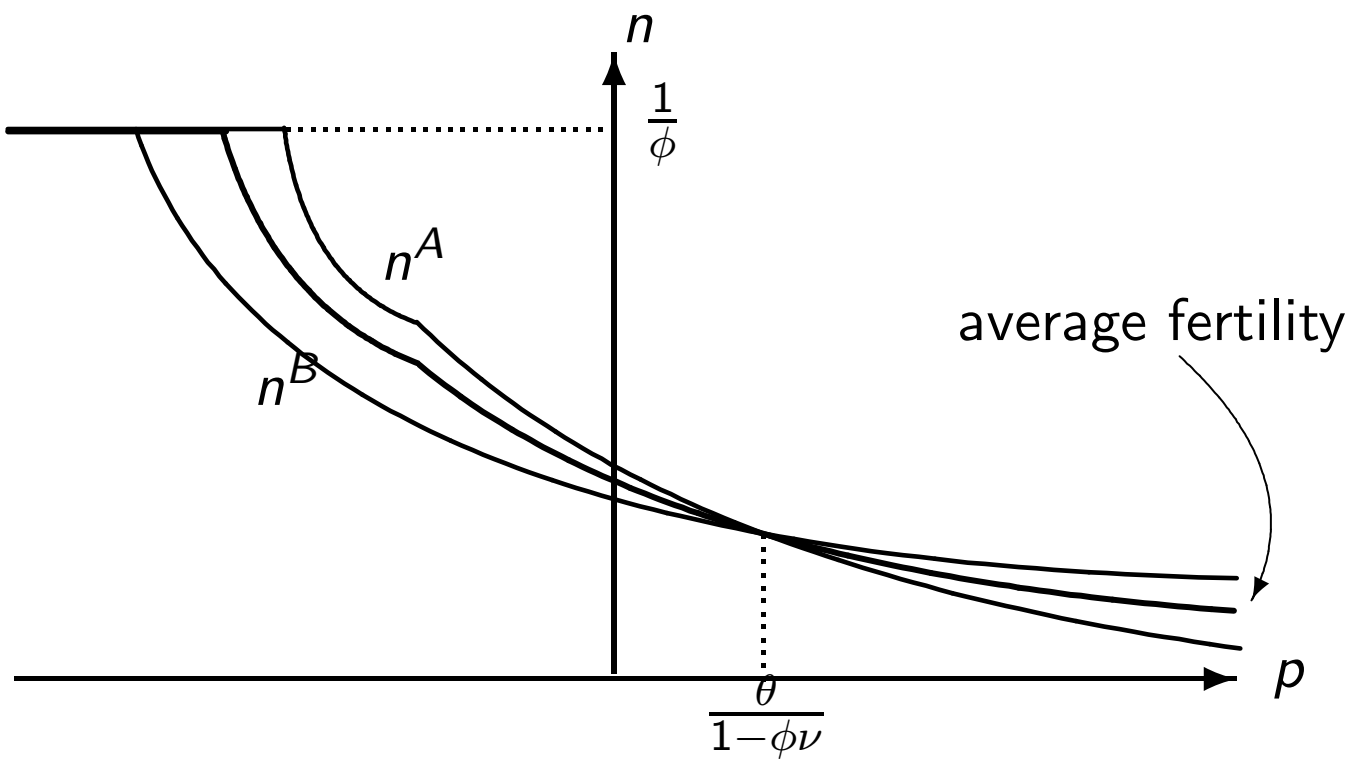
Fertility and Education Choices

Effect of income:
– for procreation price below a threshold, rich parents have fewer children
– if procreation is sufficiently taxed, rich parents have more children
– rich parents spend more on education

Effect of procreation price:
– fertility rates are decreasing function of procreation price.
– Investment in education is increasing in procreation price.

Proposition (Fertility and Procreation Price)

The individual fertility rate n is a decreasing function of procreation prices $p \in (-1/\nu, +\infty[$.



Because fertility is a decreasing function of p, we can use a fixed point argument to show:

Proposition (Existence and Uniqueness of Equilibrium)

If $\tilde{p}(\omega^B) > -1/\nu$ the equilibrium procreation price exists and is unique.

Tradable entitlements implement the target population level.

Inequality

How does the introduction of procreation rights affect inequality?

Resource gap between skilled and unskilled in the benchmark model:

$$\Delta^B = \omega^B(1 - \phi\tilde{n}^B) - \omega^A(1 - \phi\tilde{n}^A).$$

with fixed quotas:

$$\Delta^F = \omega^B(1 - \phi\nu) - \omega^A(1 - \phi\nu).$$

with tradeable quotas:

$$\Delta^T = \omega^B(1 - \phi n^B) - \omega^A(1 - \phi n^A) + p(n^A - n^B).$$

From benchmark to fixed quotas

For population control:

$$\frac{\Delta^F - \Delta^B}{\phi} = \underbrace{(\hat{n} - \nu)(\omega^B - \omega^A)}_{\text{productivity effect}>0} + \underbrace{\omega^B(\hat{n}^B - \hat{n}) - \omega^A(\hat{n}^A - \hat{n})}_{\text{differential fertility effect}<0}$$

From benchmark to tradable quotas

$$\frac{\Delta^T - \Delta^B}{\phi} = \underbrace{(\hat{n} - \nu)(\omega^B - \omega^A)}_{\text{productivity effect } >0} +$$

$$\underbrace{\Big[\omega^B(\hat{n}^B - \hat{n}) - \omega^A(\hat{n}^A - \hat{n})\Big] - \Big[\omega^B(n^B - \nu) - \omega^A(n^A - \nu)\Big]}_{\text{differential fertility effect}}$$

$$+ \underbrace{\frac{p}{\phi}(n^A - n^B)}_{\text{tradability effect}} \qquad (10)$$

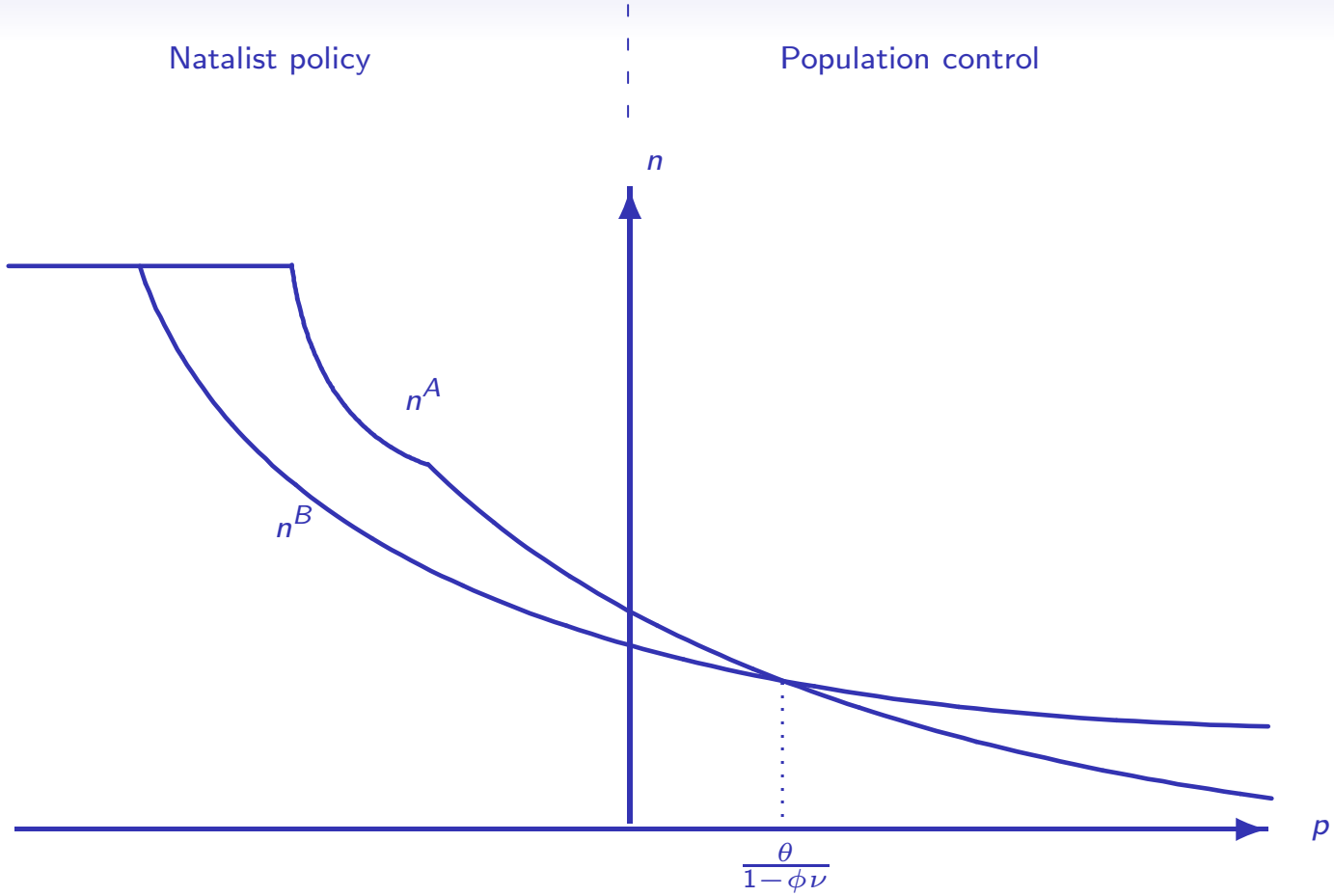
Redistributive aspect of tradability

Proposition

(i) If $\theta > 0$*, tradability is redistributive* ($\Delta < 0$) *if and only if*

$$p < 0 \text{ or } p > \min\left\{\frac{\theta}{1-\phi\nu}, \hat{p}(\omega^A), \tilde{p}(\omega^A)\right\}.$$

(ii) If $\theta = 0$ *tradability always redistributive.*


Natalist policy
Population control
n
n^A
n^B
p
$\frac{\theta}{1-\phi\nu}$
$p < 0$, $n^A > n^B$
Redistributive policy
$p > 0$
$n^A > n^B$
Anti-redistributive
$p > 0$, $n^A < n^B$
Redistributive policy

Education, social mobility and long-run income

Proposition (Education and Procreation Price)

Investment in education e is increasing in procreation price p.

Pro-natalist policy reduces long-run average income

While being redistributive for generation P (parents), it will tend to increase income inequalities between generations P and C (children)

Need for education policy, e.g. public education

Utility

Impact on welfare inequalities?

Keeping income inequality constant, an increase in the price of children will hurt the unskilled more.

Because their opportunity cost of having children is lower.

The income inequality reducing effect of strong anti-natalist policies is mitigated by this relative price effect as far as welfare inequalities are concerned.

Poor people may end up relatively richer while becoming relatively less happy, being more affected by the high price of children.

Global Level

First, a global demographic target should be set.

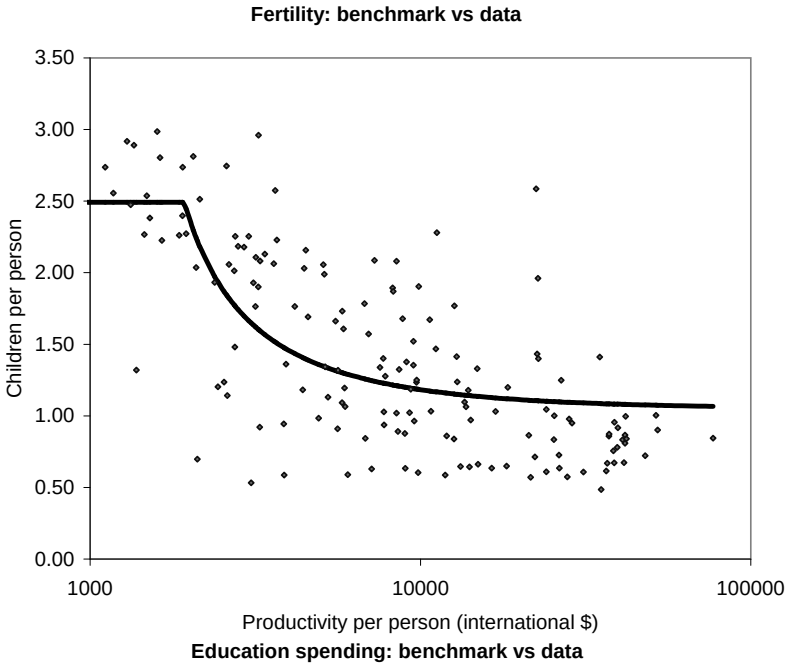
Second, we would need to decide about an initial allocation rule to distribute the quotas to each of the countries.

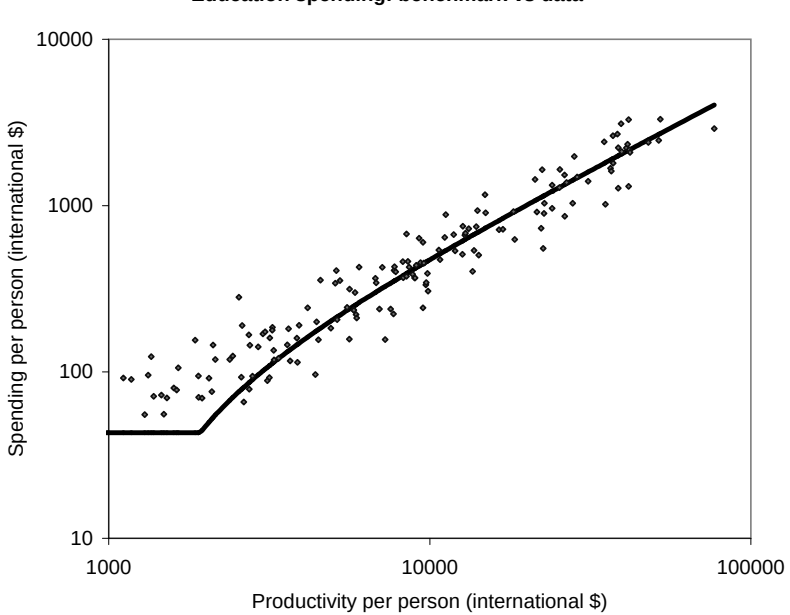
Consider a situation with a uniform distribution of entitlements

All the results developed above can be applied at the global level.

Numerical illustration.

Estimated relationships

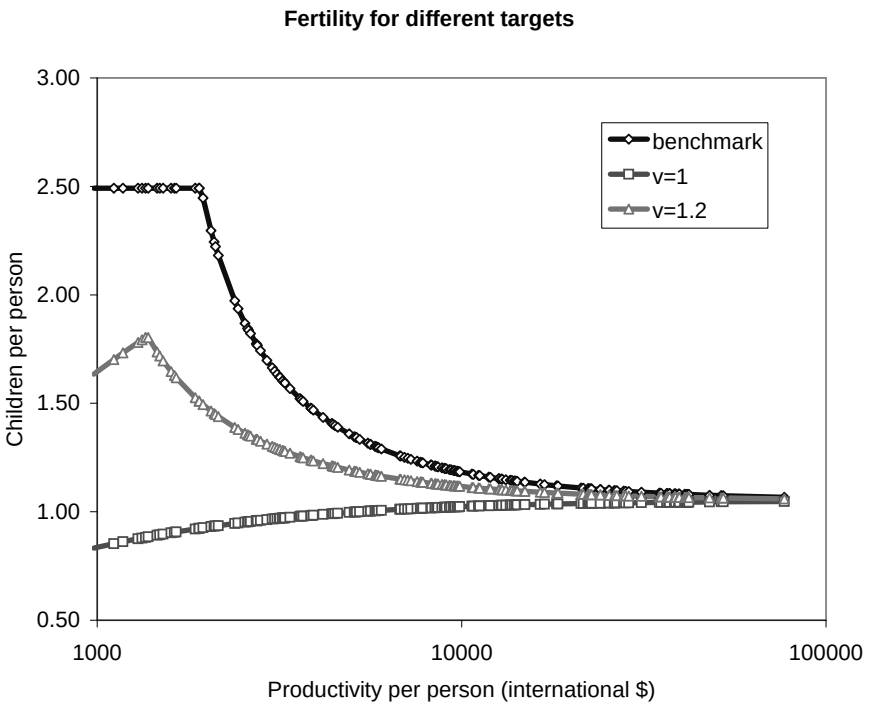


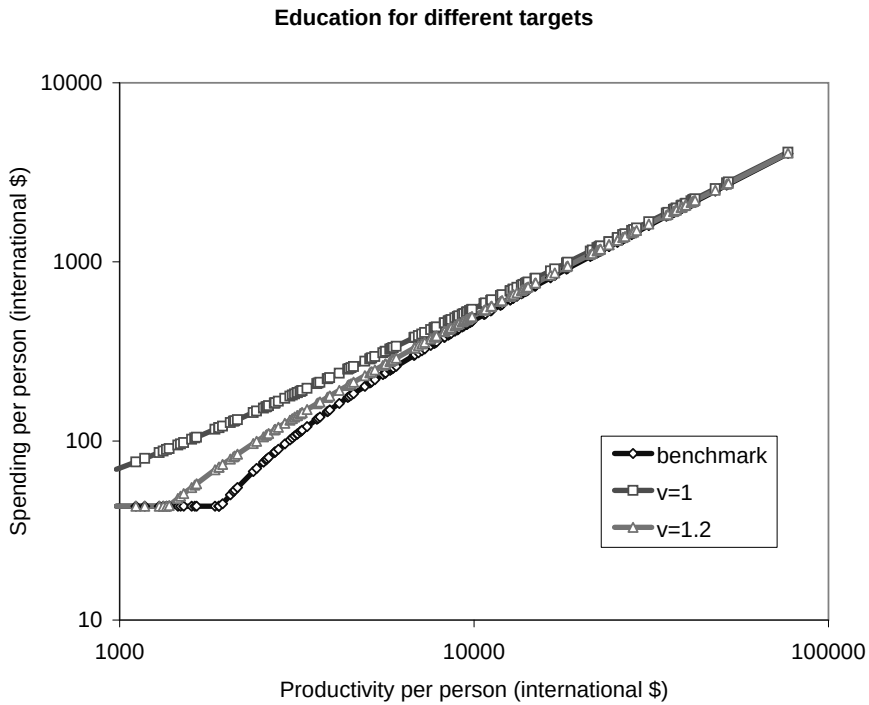


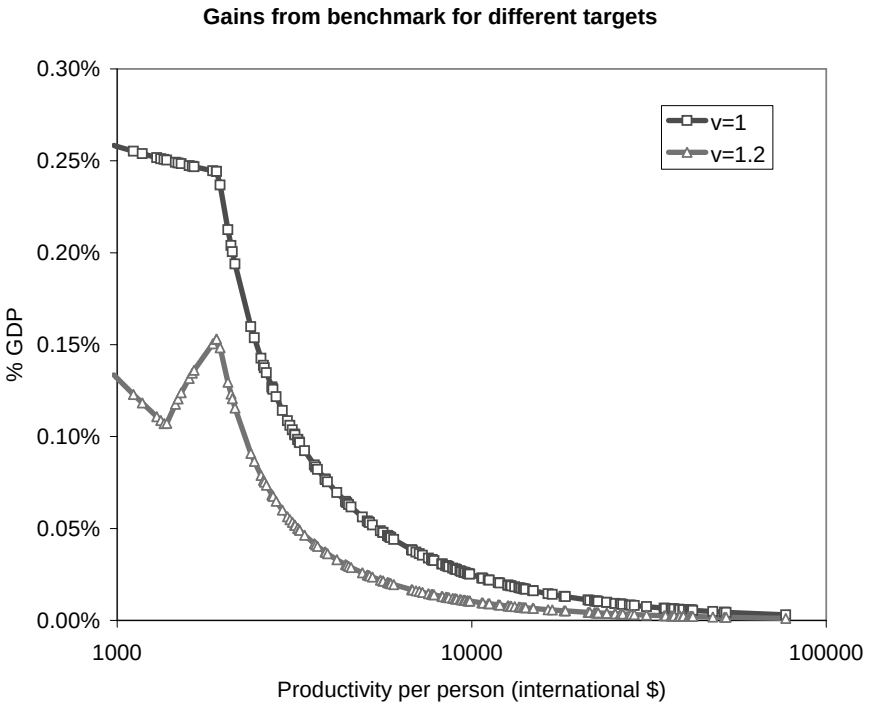
Parameter	Estimate	Standard Error
η	0.578	0.0356
ϕ	0.039	0.0057
θ	43.18	4.9365
γ	0.107	0.0127
Equation	education	fertility
R-squared	0.88	0.50

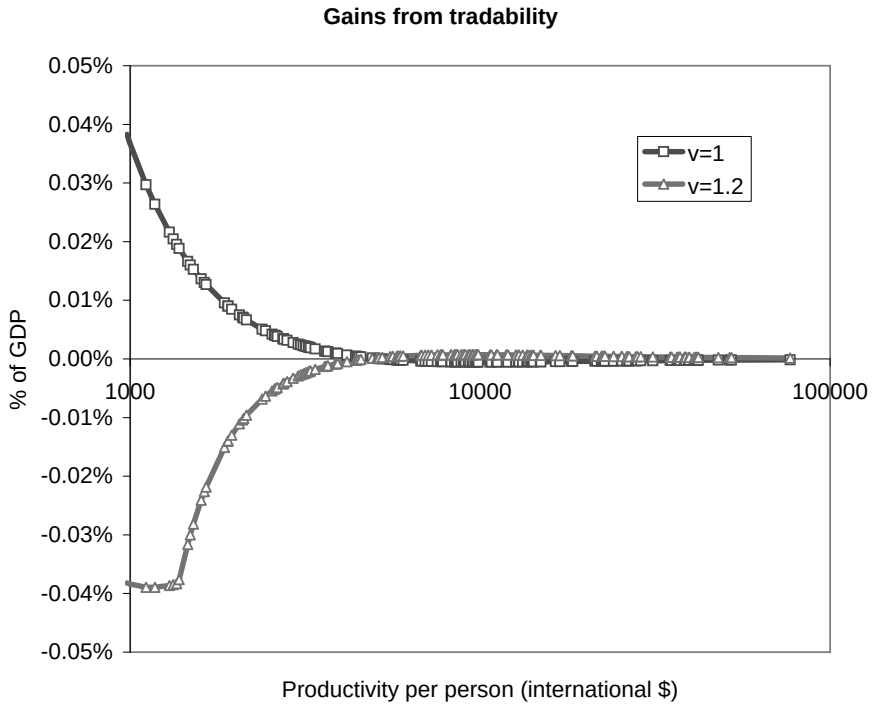
Number of observations = 158

Simulation Results






Gains from benchmark for different targets
0.30%
0.25%
0.20%
0.15%
0.10%
0.05%
0.00%
% GDP
v=1
v=1.2
1000
10000
100000
Productivity per person (international $)


Gains from tradability
0.05%
0.04%
0.03%
0.02%
0.01%
0.00%
-0.01%
-0.02%
-0.03%
-0.04%
-0.05%
% of GDP
v=1
v=1.2
1000
10000
100000
Productivity per person (international $)

Grandfathering

Alternative to equal allocation of procreation quotas.

Applicable for countries, not for individuals.

Conditioning on the past:
Those whose grandfather or father was already enfranchised would be exempted from poll tax and/or literacy requirements to vote.

For pollution permit: grants larger shares of emission rights to those who already emit more : anti-redistributive because larger polluters are richer.

In the procreation case, countries with high fertility are poorer. Grandfathering can be redistributive.

Grandfathering: redistribution

$$\frac{\Delta^G - \Delta^B}{\phi} = \underbrace{(\hat{n} - \nu)(\omega^B - \omega^A)}_{\text{productivity effect } >0} +$$

$$\underbrace{\left[\omega^B(\hat{n}^B - \hat{n}) - \omega^A(\hat{n}^A - \hat{n})\right] - \left[\omega^B(\tilde{n}^B - \nu) - \omega^A(\tilde{n}^A - \nu)\right]}_{\text{differential fertility effect}}$$

$$+ \underbrace{\frac{p}{\phi}(\tilde{n}^A - \tilde{n}^B)}_{\text{tradability effect}}$$

$$\underbrace{-\frac{p\mu}{\phi}(\hat{n}^A - \hat{n}^B)}_{\text{grandfathering effect}} \qquad (11)$$

Grandfathering: redistribution

The first three effects are almost unchanged because Grandfathering has little impact on fertility.

It is simply a lump-sum transfer from the rich to the poor in the case of population control.

Grandfathering has a redistributive effect simply by implementing a redistributive initial allocation of rights.

Conclusion

Idea of tradable procreation permits + generalization to procreation exemptions.

At the country level and at the global level

Anti-redistributive ? Tradability is in general redistributive except with cheap procreation allowances.

Human capital: natalist policy would be bad for education, while population control would be good.

Grandfathering can make population control more redistributive at the Global level.