Anti-Lemons: School reputation and educational quality

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Outline

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Our Contribution

- We introduce a tractible model of a perfectly competitive market for educational services that provides both positive and normative implications for school system design.
- We then explore the consequence of adding school reputation in the spirit of Holmstrom (1982), Gibbons and Murphy (1992), Farber and Gibbons (1996) - market's assessment of an individual's skill is influenced by the school she attends.
- Our explicitly links signals as student performance, as measured by test scores, with future income.

Results

- When schools *cannot* select students based on innate ability:
  - Competition leads to efficiency
  - Vouchers are particularly beneficial to low income individuals
- When schools *can* use measures of innate ability to select students:
  - Competition lowers student effort and, in some cases, skill accumulation
  - Competition increases inequality
- The difference partially reflects that:
  - Without selectivity, schools can only develop good reputations by being productive in the generation of skill
  - With selectivity, they can also achieve this by excluding weak students

Anti-Lemons Effect

- When schools can screen students based upon ability this leads to an *anti-lemons effect* - the excessive entry of selective schools that crowd out non-selective public schools, increases inequality, and reduces overall performance of the school system.
- The Anti-lemons effect is one in which sellers enhance their quality by selecting high quality *buyers:* private clubs, exclusive neighborhoods and restaurants, law firms.
- As Groucho Marx said in a telegram to the Friar's Club of Beverley Hills: "Please accept my resignation, I don't want to belong to any club that will accept me as a member".

Outline

Timing

- Period 1a: Students/parents, with rational/correct expectations, choose between consumption good and a school that offers amenities as well as educational value added. Schools may or may not have admissions requirements
- Period 1b: Students choose between study and other leisure activities.
- Period 2a: Students write a graduation test.
- Period 2b: Students enter a competitive labor market where they earn a wage equal to the their expected skill.

Preferences

- Individual has a seperable utility function:

$$U_{is} = log(c_{is}^0) + \delta_i log(c_{is}^1) + \phi_i log(z_{is}) + \Psi(e_{is}, a_i)$$

$$c_{is}^0 = Y_i - p_s \, and \, c_{is}^1 = W_{is}$$

- c^0, c^1 - period 0 and period 1 consumption, respectively with discount rate δ.
- z - non-educational amenities, ϕ taste parameter.
- $\Psi(e, a)$ utility from non-academic effort where:
    - e - academic effort, $\Psi_e < 0$
    - a - taste for non-academic activities, $\Psi_a > 0$
- Y - exogenous income, p - tuition and W - second period wage.

Skill

- Individual skill, $\theta_{is} = log(W_{is})$, satisfies:

$$\theta_{is} = \alpha_i + e_{is} + \beta_s$$

$$\alpha_i \sim N(0, \rho^{\alpha}), \ \sigma_{\alpha}^2 = \frac{1}{\rho^{\alpha}}$$

- α - innate ability
- e - academic effort
- β - human capital acquired at school - more productive schools produce higher β - hence we also call β school productivity.

School characteristics

- Cost of amenities and school productivity:

$$C_s(\beta_{s,} z_s) = q_s C(\beta_s) + z_s, C(0) = 0$$
$$C(0) = 0, q_s \in \{q_L, q_H\}\, quality.$$

- School profit:

$$\Pi_s = tuition - costs$$
$$= p_s - (q_s C(\beta_s) + z_s)$$

$$I_s = p_s - z_s - \Pi_s = q_s C(\beta_s)$$

- Student population normalized to 1; $n > 1$ is the number of schools
- $\lambda \in (0,1)$ - proportion of high productivity schools, $\lambda n = n_H$.
    - When $n_H < n$ then high quality schools cannot serve all students.

The labor market and signals of skill

- Individuals are paid the market's best estimate of their skill, based on two signals:
  1. An individual-specific *graduation test* (e.g. graduation tests; job market papers)

$$t_{is} = \alpha_i + e_{is} + \beta_s + \varepsilon_{is}^t$$

$$\varepsilon_s^t \sim N(0, \rho^t)$$

  2. Their school's reputation

$$R_s = E\{\theta_i | i \in s\} = E\{\alpha_i | i \in s\} + \hat{e}_s + \beta_s,$$

  where $\hat{e}$ is average academic effort at school s

- We assume rational expectations and hence mean effort $\hat{e}$ and human capital β are known in equilibrium.

Key Assumptions

- Student academic effort affects graduation test: $\frac{\partial t}{\partial e} = 1$.
- Individual student effort does not affect school reputation (team problem): $\frac{\partial R}{\partial e} = 0$.

Wages and student effort

- Wage is equal to expected skill of individual:

$$\begin{aligned} w_{is} &= log(W_{is}) = E\{\theta_{is}|I_{is}\} \\ &= E\{\alpha_i + e_{is} + \beta_{is}|I_{is}\} \end{aligned}$$

- First order conditions determine effort choice:

$$-\Psi'(e_{is}) = \delta \frac{\partial E\{w_{is}|i \in s\}}{\partial e_{is}}$$

- First best benchmark:
  - If skill is observable, $w_{is} = \theta_{is} = \alpha_i + e_{is} + \beta_s$, and $\frac{\partial w}{\partial e} = 1$.
  - At any Pareto Efficient allocation:

$$-\Psi'(e^*) = \delta \frac{\partial w_{is}}{\partial e_{is}} = \delta.$$

Outline

Non-Selective Public System

- Non-selectivity: the distribution of innate ability, α, is the same at every school.
- No competition: expected school quality is $\overline{q} = \lambda q_H + (1-\lambda) q_L$
- Individuals differ only with respect to income, $Y \in (0, Y^{max})$; $F(Y^{max}) = n$;
- Parent income is uncorrelated with student ability

Equilibrium Wages

- Wages are based on two signals of ability:

$$R_s = E\{\theta_i | i \in s\} = \hat{e}_s + \beta_s$$
$$t_{is} = \alpha_i + \hat{e}_s + \beta_s + \varepsilon_{is}^t$$

- Using DeGroot (1972) we have:

$$\begin{aligned} w_{is} &= \pi^{(t)\alpha} t_{is} + \pi^{(\alpha)t} R_s \\ &= R_s + \pi^{(t)\alpha}(t_{is} - R_s) \end{aligned}$$

where $\pi^{(\alpha)t} = \frac{\rho^\alpha}{\rho^\alpha + \rho^t} \in [0,1]$ and $\pi^{(t)\alpha} = \frac{\rho^t}{\rho^\alpha + \rho^t} \in [0,1]$

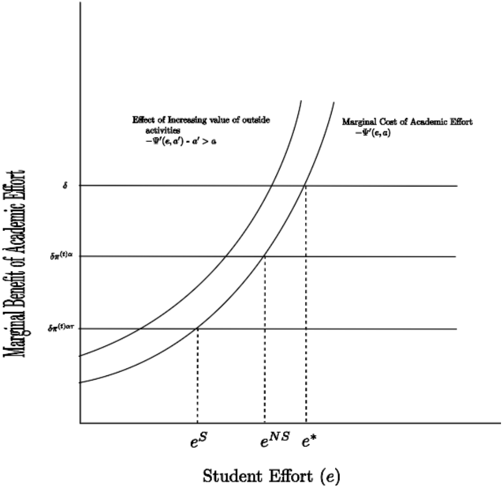
Effort in Non-Selective System

- Students therefore choose e^{NS} to satisfy:

$$-\Psi'(e^{NS}) - = \delta \frac{\partial w_{is}}{\partial e_{is}} = \delta \frac{\partial w_{is}}{\partial t_{is}} \frac{\partial t_{is}}{\partial e_{is}} = \delta \pi^{(t)\alpha}$$

- Academic effort is lower than the first best
$-\Psi'(e^{NS}, a_i) = \delta \pi^{(t)\alpha} < \delta = -\Psi'(e^*, a_i)$

Effect of Information on Effort



Effect of Graduation Tests

- Model predicts that increasing precision/importance of graduation test would Increase students' incentives to focus on academics as opposed to sports, student government, TV, gang activity, or community service.
- This may explain:
  - good test score performance in Brazil, Germany, Romania, Turkey, S. Korea, China and Japan relative to US.
  - Consistent with evidence reviewed in Woessmann (2007).
- However, whether increased emphasis on test scores is good policy is depends upon the extent to which test scores are predictive of labor market performance.

Supply Side - Public school characteristics

- Suppose median voter selects p_s and z_s, which in deterimins expenditures on school productivity:

$$I_s = p_s - z_s$$

- School quality productivity is uncertain: $\overline{q} = \lambda_s q_H + (1 - \lambda_s) q_L$.
- Mean school human capital productivity is:
$\beta(I, \lambda_s) = \lambda_s C^{-1}\left(\frac{I}{q_H}\right) + (1 - \lambda_s) C^{-1}\left(\frac{I}{q_L}\right)$

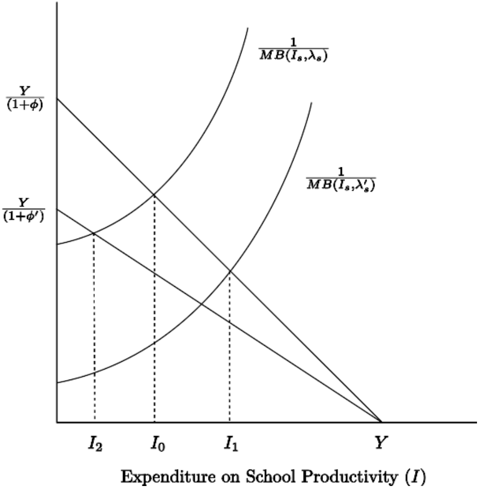
Optimal School Productivity

- Marginal impact of investment I on school productivity: $MB(I, \lambda_s) = \delta \frac{\partial \beta(I, \lambda_s)}{\partial I}$
- Utility maximizing solution satisfies:

$$\frac{1}{MB(I_s, \lambda_s)} = \frac{Y - I_s}{(1 + \phi)}$$

$$z_s = \frac{\phi[Y - I_s]}{(1 + \phi)},$$

Optimal Investment into Productivity



Supply Side Implications - Public System

- Higher quality leads to more productive schools, less amenities.
- A greater taste for amenities leads to lower productivity.
- Higher median incomes leads to an increase in both amenities and school productivity.

Outline

For Profit Schools - Productivity Observed

- Parents observe amenities and value added from each school.
- We continue to assume students vary only by income, which is uncorrelated with ability
- Higher income students will pay higher tuition than low income students, and hence attend the high quality schools:
  - High productivity schools will serve individuals with high income $Y \geq \tilde{Y}$, where $n_H = F(\tilde{Y})$
  - Since $n_H < n$, high productivity schools will earn $\Pi_H(n_H) \geq 0$; while $\Pi_L = 0$

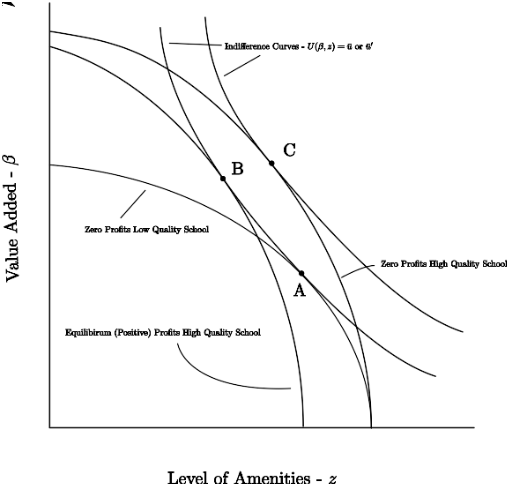
Equilibrium Profits

- The excess supply of low quality implies that they earn zero profits.
- At a competitive equilibrium students indifferent between high and low quality school, and hence high quality schools earn profit $\Pi(n_H)$ such that at income $Y(\tilde{n}_H)$:

$$max_{p,z}\ U(p,z,\Pi(n_H),e^{NS}|\tilde{Y}(n_H),1) = max_{p,z}\ U(p,z,0,e^{NS}|\tilde{Y}(n_H),0).$$

- Since demand for education falls with income, one has $\frac{\partial\Pi(n_H)}{\partial n_H} < 0$ and $\Pi(n) = 0$.

High Quality School Offers Fewer Amenities



Summary

- Private system provides schools tailored to the preferences of students.
- High income students attend higher quality schools, and consume more amenities and acquire more human capital.
- Students are indifferent between high and low quality schools - low quality schools offer more amenities.
- High quality schools earn a rent than in principle should encourage entry.
- Education is highly stratified - low income individuals acquire less human capital and consume fewer amenities.
- Consider not the redistributive effect of vouchers.

Outline

Vouchers

- Given an education tax v every student gets a voucher that can be used only for school services:

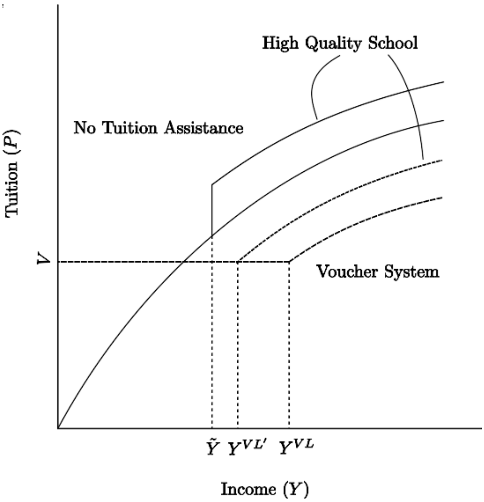
$$V = \frac{1}{n}\int_0^{Y^{max}} v \times y \times f(y)dy = v\overline{Y}$$

- Individual's after-voucher income is $Y^v(Y,V) = Y + V\left(1 - \frac{Y}{\overline{Y}}\right)$
- Recall $P(Y,\phi,0)$ is the WTP for low quality school in a fully private system and $P(Y,\phi,1) > P(Y,\phi,0)$.

Equivalent Income with Vouchers

- $P(Y^v(Y,V),\phi,0)$ is the WTP for a low productivity school under vouchers
- Define
$$P(Y^v(Y^{vL},V),\phi,0) = V$$
- At low incomes parents consume more education under vouchers, addressing a drawback of a fully private system.

Tuition under Private versus Voucher System



Equilibrium with n_H High Quality Schools

- In a fully private market, $\Pi_H(n_H)$ declines monotonically with n_H; $\Pi(n) = 0$
- With vouchers:
  - Profits for high income students is lower.
  - However, since tuition is constrained to be greater than the voucher hence equilibrium profits $\Pi(n_H, V) \geq \Pi^V > 0$, where Π^V solves

$$max_{p \geq V, z} U(p, z, \Pi^V, e^{NS} | Y^v(0, V), 1) = max_{p' \geq V, z'} U(p', z', 0, e^{NS} | Y^v(0,$$

Summary

- In the absence of reputation effects, a private education system combined with vouchers set to the same level as a non-selective public system has the following features:
  - The average productivity/human capital accumulations is higher than a public system.
  - There are greater incentives for entry by high productivity schools at all income levels.
  - There is better matching of school characteristics with individual preferences.
  - Effort is a function of the precision of the graduation test.

Outline

Anti-Lemons

- In this section we suppose that all individuals have the same income and same taste for amenities.
- Hence, they vary only in unobserved ability.
- We being with a public system as described above, where all individuals pay a tax T.
- In such a system it is never profitable for a non-selective private school to enter, but it will be the case if schools are allows to administer entrance exams, then profitable entry will occur.

Competition: *Selective* for-profit schools

- Suppose that private schools can administer a test with precision ρ^{τ}:

$$\tau_i = \alpha_i + \varepsilon_i^{\tau}$$

$$\varepsilon_i^{\tau} \sim N(0, \rho^{\tau}), \ \sigma_{\tau}^2 = \frac{1}{\rho^{\tau}}$$

- It will be an equilibrium for schools to admit students with admissions scores exactly equal to τ_s.
- Expected ability of student who attends school s:

$$\begin{aligned} E\{\alpha_i | s\} &= \pi^{(\alpha)\tau} E\{\alpha_i\} + \pi^{(\tau)\alpha} \tau_s \\ &= \pi^{(\tau)\alpha} \tau_s \end{aligned}$$

Reputation of Selective Schools

- When schools are selective, their reputation is given by

$$\begin{aligned} R_s &= E\{\alpha_i | i \in s\} + \hat{e}_s + \beta_s \\ &= \pi^{(\tau)\alpha} \tau_s + \hat{e}_s + \beta_s \end{aligned}$$

- The distribution of skill among graduates from school s is $\theta \sim (R_s, \rho^\alpha + \rho^\tau)$
- Market uses graduation test and school reputation to estimate skill:

$$w_{is} = \pi^{(t)\tau\alpha} t + \pi^{(\tau\alpha)t} R_s$$

- Note that $\pi^{(\tau\alpha)t} > \pi^{(\alpha)t}$ and hence in a selective system the market wage is more sensitive to information regarding the school.
- recall: $\pi^{(\alpha)\tau} = \frac{\rho^\alpha}{\rho^\alpha + \rho^\tau} \in [0,1]$ and $\pi^{(\tau)\alpha} = \frac{\rho^\tau}{\rho^\alpha + \rho^\tau} \in [0,1]$

Effort at Selective School

- Academic effort satisfies:

$$-\Psi'(e^S) = \delta\pi^{(t)\tau\alpha} < \delta\pi^{(t)\alpha} = -\Psi'(e^{NS})$$

where $\pi^{(t)\alpha\tau} = \frac{\rho^t}{\rho^\alpha+\rho^\tau+\rho^t} < \frac{\rho^t}{\rho^\alpha+\rho^t} = \pi^{(t)\alpha}$ s.t. it is lower than in a non-selective system

Utility from Attending Selective Private School

- Utility at time of acceptance at school with selectivity τ_s and public school taxes at T:

$$U_s = log(Y - T - p_s) + \delta R_s + \phi\, log(z_s) + \Psi(e^S)$$
$$= log(Y - T - p_s) + \delta(\pi^{(\tau)\alpha}\tau_s + e_s + \beta_s) + \phi\, log(z_s) + \Psi(e^S)$$

- Notice that since τ_s is a choice variable, then regardless of taxes T, entry by a very selective schools is *always* part of an equilibrium.
- If it is profitable for school with selectivity τ_s to enter, then always profitable for more selective school to enter - the anti-lemmons effect.
- Hence market is characterized by a $\bar{\tau}$ such that all levels of selectivity $\tau_s \geq \bar{\tau}$ enter.

Reputation of Non-Selective Schools

- The entry of selective school cream skims the more able individuals from the non-selective public system with scores $\tau_s \geq \bar{\tau}$.
- The expected wage of individuals in the public systen is given by

$$w_{i\bar{s}} = E\{\alpha_i | \tau_{\bar{s}} < \bar{\tau}, t_{is}\} + \hat{e}^{\bar{s}} + \beta_{\bar{s}}$$

where $\bar{s}$ indexes non-selective schools.

Effort at Non-Selective School

- We also have
$$\pi^{(t)\alpha} \geq \frac{\partial \overline{w}(\overline{\tau})}{\partial e} \geq \pi^{(t)\alpha\tau}$$
- Expansions in the selective sector lower the expected wage and effort incentives in the non-selective sector.

Effect of Vouchers

- Given that all individuals pay for the public system, an equilibrium is characterized by a $\bar{\tau}$ with the property that the student with score $\bar{\tau}$ is indifferent between paying the extra tuition to attend a selective private school or attend a publich school.
- The introduction of vouchers merely lowers the cost of attending a private school and when the voucher is a binding constraint the cost is the same.
- When $\bar{\tau} < 0$ the future expected wage, $w(\bar{\tau})$, in the non-selective sector, and the future expected wage when admitted to school with selectivity $\bar{\tau}$, given by $w_s(\bar{\tau})$ satisfies:

$$w_s(\bar{\tau}) \geq w(\bar{\tau}) \geq w_s(\bar{\tau}) + \frac{1}{\pi^{(\tau)\alpha\overline{\tau}}}.$$

In other words, we get an extreme anti-lemons effect and complete stratification of the education market, with the non-selective schools driven out by selective schools.

Effect of AFQT on Wages

- Recently, Aricdiancono-Bayer-Hizmo(2008) have found that AFQT scores are not related to the starting wages of high schools graduates but become more informative over time. However, ABH find that starting wages of university graduates are highly correlated with AFQT scores.
- This result is consistent the reputation model - notice that in the US, high school graduates are much more likely to be from non-selective public schools, while universities in the US are highly segregated by individual ability.
- This implies:
  1. Employers have little information regarding the ability of high school graduates, and hence starting wages are not informative, but as Gibbons and Farber (1992) show, over time wages reflect unobserved skill.
  2. Since universities are highly segregated, then the identity of the university is a sufficient statistic for an individual's skill.

Outline

Summary of Results

- We have shown that in the absence of reputation effects, and perfect observability of school productivity that a voucher system provides greater incentives for quality and better matching of school characteristics to individuals than a public system.
- In contrast, when we add school reputation effects, the outcome is strictly worst than a public system in terms of increased income inequality, and lower academic performance.
- We have not formally modelled this here, but it follows easily from out model that idenfying school productivity is more difficult in a market with selectivity.
- Next we consider two issues: 1. Are the hypothesis of the model sensible 2. What are the policy implications.

Parents Value Choice!

- A key prediction of the model is that parents rank schools according to the average ability of the peers, and not by value added, and that they prefer this over no choice:
  - In 1981 Chile implemented Friedman's (1962) voucher proposal, and the enrollments in (mainly for-profit) private schools went from from 10% to 55% of the school population.
  - In the U.S., parents use Tiebout choice extensively, and evidence indicates they are willing to pay for higher achieving schools (Black (1999) and Figlio and Lucas (2004)).
  - In North Carolina Hastings et al. (2008) report that parents react to information on school performance by requesting higher achieving students.

Causal Link with Performance is Unclear

- Our model predicts that school productivity is only one factor in school choice, and hence the relationship between choice and value added is likely to be weak:
  - Despite universal vouchers, Chile's testing performance has barely moved (McEwan et al. (2003) ; Gallego (2008))
  - The evidence on whether private schools have higher value added is mixed (Angrist et al. (2007); Krueger and Zhu (2004), Rouse (1998)).

Choice with Stratification: Chile

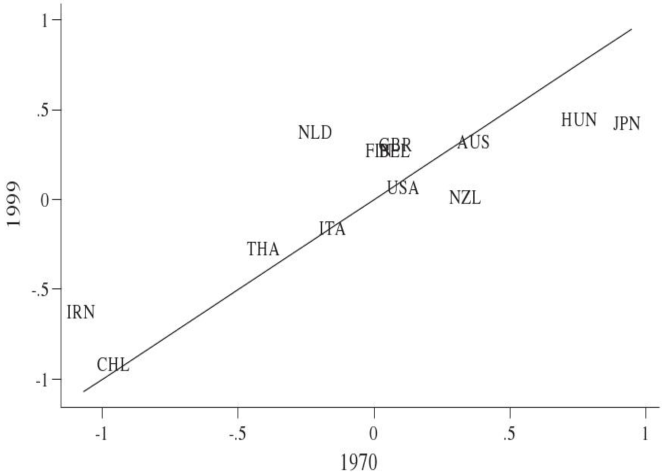
- 1981 reforms left for-profit schools very wide latitude in admissions policies (testing, parental interviews, etc.).
- This resulted in substantial stratification (Hsieh and Urquiola, 2006; Mizala et al., 2007)
- Little in terms of improvedtesting outcomes (McEwan et al., 2008; Gallego, 2008)

School Choice without stratification: Sweden

- As of early 1990s, Sweden funds for-profit schools in a manner quite analogous to Chile
- However, schools must be operated on a "first come, first served" basis, and there is less evidence of stratification (Sandstrom and Bergstrom (2005))
- Mixed impact on test scores (Bohlmark and Lindahl (2008))

Relative Country Rankings

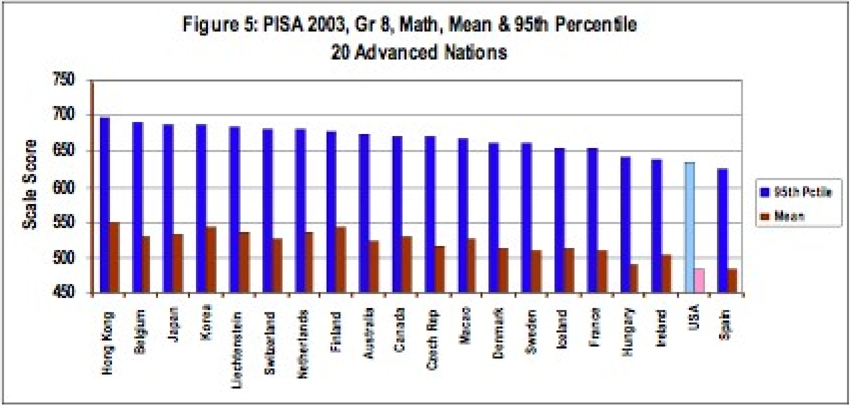
A. Median Test Scores (standard deviation from 13-country average).



Peer Effects

- There is a large literature that explores the hypothesis that peers are important part of performance.
- In our model there are no peer effects per se, yet parents behave *as if* peers are important.
- This result is consistent with the widespread *appearance* peers effects, yet careful research finds that the effect, if it exists, is rather small: Dulflo et al. (2008), Oreopoulos (2003), Katz et al. (2006), and Altonji et al. (2006).

Performance at 95 percentile



Policy Implications

1. Students respond to measures of performance - hence if one wishes better test score results then these should be made more important.
2. However, this is efficient only to the extent that test scores are correlated to skills that society values.
3. Increasing the return to activities that are not related to test score production reduces test score performance.
4. Vouchers with non-selective schools may enhance performance..
5. However, parents with high ability students will always prefer selective system making the introduction of a non-selective system difficult.
6. Moreover, there is no theoretical reason to believe that the introduction of vouchers into a system with selective schools will increase the over all economic performance of the education system.