Some Simple Analytics of School Quality

Eric Hanushek
Stanford University
Human capital investments

- Analysis concentrated on *quantity* of schooling
- Most policy focused on *quality* of schooling
- Foundation of current testing/accountability
Plan of discussion

- Describe linkage of current research and policy
- Consider benefits and costs of investment in quality
  - Benefits easier to estimate
  - Identify possible reforms
  - Bound the costs of quality
Summary of results

- Benefits of quality improvement large
  - Individual earnings and productivity
  - Aggregate effects through growth
Summary of results

- Benefits of quality improvement large
  - Individual earnings and productivity
  - Aggregate effects through growth
- Relevant Dimensions of reform
  - Magnitude of quality improvement
  - Speed of reform
Summary of results

- Benefits of quality improvement large
  - Individual earnings and productivity
  - Aggregate effects through growth

- Dimensions of reform
  - Magnitude of quality improvement
  - Speed of reform

- Quality improvements require substantial changes in teacher quality
Summary of results

- Benefits of quality improvement large
  - Individual earnings and productivity
  - Aggregate effects through growth

- Dimensions of reform
  - Magnitude of quality improvement
  - Speed of reform

- Quality improvements require substantial changes in teacher quality

- Exact change in incentives uncertain
Focus of analytics

- U.S. and international evidence on earnings and productivity
- U.S. evidence on teacher quality
- U.S. and international reform information
Earnings and productivity

- Mincer structure (Murnane et al., Lazear, Mulligan)

\[
\ln Y = \alpha_y + \beta S + \gamma Q
\]

\[S = \alpha_q + \phi Q\]

\[\gamma = 0.12\]

\[\beta \phi \frac{1}{(\gamma + \beta \phi)} \approx \frac{1}{2}\]
Median U.S. Individual Earnings with 1.0 s.d. Reform
(direct effects: $\gamma = 0.12$)
Aggregate growth

- Endogenous growth in quality (Hanushek and Kimko)
  \[ g = \varphi Y_0 + \kappa S + \lambda Q \]
  \[ \lambda = 0.01 \]

- Sensitivity/causation
  - Determinants of Q
  - East Asian
  - Immigrants
Improved GDP with Moderately Strong Knowledge Improvement

percent additions to GDP

year

10-year reform 20-year reform 30-year reform
Reform alternatives

- Ineffectiveness of resource solutions
  - U.S. evidence
  - International evidence
    - Developed countries
    - Developing countries
Resource evidence

- Aggregate U.S.
Resource evidence

- Aggregate U.S.
- Econometric studies
  - U.S. since Coleman Report
  - Developing countries
  - TIMSS
Resource evidence

- Aggregate U.S.
- Econometric studies
  - U.S. since Coleman Report
  - Developing countries
  - TIMSS
- Class size
  - Uncertainty
  - Magnitude
U.S. NAEP performance
(17 year olds)
<table>
<thead>
<tr>
<th></th>
<th>1960</th>
<th>1980</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pupil-teacher ratio</td>
<td>25.8</td>
<td>18.7</td>
<td>17.3</td>
</tr>
<tr>
<td>% master’s degree</td>
<td>24</td>
<td>50</td>
<td>56</td>
</tr>
<tr>
<td>Median experience</td>
<td>11</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>Spending/pupil</td>
<td>$2,235</td>
<td>$5,124</td>
<td>$7,591</td>
</tr>
</tbody>
</table>
TIMSS performance and spending (countries ranked by TIMSS aggregates)

- Korea
- Japan
- Belgium
- Netherlands
- Austria
- Australia
- Sweden
- Czech Republic
- Ireland
- Switzerland
- Hungary
- United States
- United Kingdom
- Germany
- Norway
- France
- Thailand
- Denmark
- Spain
- Greece
- Italy
- Portugal
- Israel

spending/student (US $)

$0 $1,000 $2,000 $3,000 $4,000 $5,000 $6,000 $7,000 $8,000

TIMSS performance and spending (countries ranked by TIMSS aggregates)
Reform alternatives

- Ineffectiveness of resource solutions
  - U.S. evidence
  - International evidence
    - Developed countries
    - Developing countries

- Teacher quality improvements
Importance of teachers

- Total effects v. measured characteristics
  (Rivkin, Hanushek, and Kain)
  - Potential importance of selection issues
  - Within school/across grade

- Magnitude (lower bound):
  1 s.d. (teacher) $\rightarrow$ 0.12 s.d. (student)
Necessary hiring points

- Teacher quality estimate: 0.22 s.d.
- U.S. replacement rates:
  - Annual exits from teaching – 6.6 percent
  - Total teacher turnover – 13.8 percent
- Calculate average quality in terms of annual quality distribution
Annual Required Hiring Percentile
Moderately Strong (0.5 s.d.) Reform

Speed of reform

percentile of annual quality distribution

low teacher replacement

high teacher replacement

61.3%
55.5%
55.7%
52.7%
53.8%
51.8%

75%
70%
65%
60%
55%
50%
Annual Required Hiring Percentile
Very Strong (1.0 s.d.) Reform

Speed of reform

- 10-year
- 20-year
- 30-year

Per centile of annual quality distribution

- low teacher replacement
- high teacher replacement
Bounds on costs

- Growth dividend estimates
  - Flow of benefits
  - K-12 expenditure paths
U.S. Growth Dividend versus K-12 Expenditure
Moderately Strong (0.5 s.d.) Reform Begun in 2005

Billions of 2002 Dollars

- 10-year reform
- 20-year reform
- 30-year reform
- Total K-12 expenditures
Bounds on costs

- Growth dividend estimates
  - Flow of benefits
  - K-12 expenditure paths
- Teacher bonuses per class
  - Feasibility just from individual productivity
  - 50% bonus to half of teachers → pupil/teacher > 6 for 0.5 s.d. reform
Conclusions

- Quality dimension extremely important
- Simple analysis ignores:
  - Crime
  - Cost of remediation
  - Intergenerational transmission
  - Health
- Improvements feasible with change in teacher quality
- Uncertainty about exact incentives