Investigating the Performance of Singapore Students from Different Socio-Economic Backgrounds in TIMSS/PIRLS 2011

Chew Leng POON, Hui Leng NG, Pik Yen LIM

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Oct 2013
Outline

• Motivation
• Methods
• Key Findings
• Limitations
• Conclusion
MOTIVATION

Why?
Motivation of Study

• Education as key enabler of social mobility

• Existing debates

Typically framed as zero-sum game, e.g.,


– Proportion of students at bottom-third SES in top third of national exams
Motivation of Study

• Ignored reality
  – In 21\textsuperscript{st} century, increasingly borderless world
  – Physical presence no longer pre-requisite in competition for jobs, status, “a good life”
Motivation of Study

- International studies allow 2 types of analyses

  **Type 1**
  **Within-System**
  High-SES *cf* Low-SES

  **Type 2**
  **Between-System**
  Singapore students *cf* students in other systems with similar SES

- For SGP,
  - Both allow monitoring of system-level impact of edn policy changes, including potential trade-offs
  - Type-2 analyses provide additional info that we did not have from our national exams data
Some things we decided to do

• Association between SES and student performance
• Association between student performance and future income
• Educational mobility
• Levels of social inclusion in schools
Research Questions

**RQ1**: How does the estimated relationship between SES and student performance in Singapore compare to that in other systems?

**RQ2**: How do students from different SES groups in Singapore perform relative to their peers in other systems from similar SES groups?
METHODS

How?
Methods

• Data:
  – G4 TIMSS & PIRLS (reading, math, science)
  – G8 TIMSS (math, science)

• Two new scales in TIMSS & PIRLS 2011:
  – Home Resources for Learning (HRL): G4
  – Home Educational Resources (HER): G8

→ Proxies for SES
Methods

RQ1: Type-1 Analyses (Within grade/subject)

• Separately for each system $S$, fitted

\[
(1) \quad SCORE_{is} = \beta_{0s} + \beta_{1s}SES_{is} + e_{is}
\]

*All SE adjusted for sampling design of both students and items

• Compared across systems:
  – $\beta_{1s}$ – “slope”
  – $R^2$ – “strength”
Methods

RQ2: Type-2 Analyses (Within grade/subject)

• Ignore students’ system membership, fitted

\[ (2) \text{SCORE}_i = \gamma_0 + \gamma_1 \text{SES}_i + \varepsilon_i \]

• For each student, computed residual score
• Computed the proportion from each SES quartile within each system in top residual-score quartile internationally
Methods

RQ2: Type-2 Analyses (Within grade/subject)

Within-System SES Quartile

Int’l Residual Score Quartile
Methods

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RQ2: Type-2 Analyses (Within grade/subject)

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Int’l Residual Score Quartile

![Graph showing distribution of SES and residual scores across quartiles.](image)
Methods

RQ2: Type-2 Analyses (Within grade/subject)

Within-System SES Quartile

Int’l Residual Score Quartile
RESULTS

What?
Key Findings: RQ1 Type-1 Analyses

Compared to International Average

Table 1. Fitted relationship between achievement scores and SES (HRL/HER) scale scores in Singapore, by grade and subject

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<thead>
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<th>Grade/Subject</th>
<th>Mean SES</th>
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<th>Strength ($R^2$) (%)</th>
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Notes: International values in parentheses. * denotes cases when Singapore’s value is statistically significantly different from the corresponding international value.
Key Findings: RQ1 Type-1 Analyses

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# Key Findings: RQ1 Type-1 Analyses

## Compared to International Average

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Key Findings: RQ1 Type-1 Analyses

Compared to Selected Systems

• Some systems that performed above the international level across all SES groups, but had smaller SES slopes than Singapore:
  – Russian Federation (G4 reading)
  – Chinese Taipei (G4 math)
  – Hong Kong (G4 and G8 math)
  – Korea (G8 science)
Key Findings: RQ1 Type-1 Analyses

Compared to Other Systems

• Singapore has:
  – Similar regression slopes and strength of association between SES and achievement \( cf \) the international regression line, except for G4 science & G8 Math
  – Steeper regression slopes than selected comparison systems, except for G8 Math

• But, need to view in relation to level of performance
Key Findings: RQ1 Type-1 Analyses

G4 Reading

![Graph showing predicted reading scores based on standardized HRL for different systems. The graph compares Singapore and International performance across different standardized HRL values. The graph includes lines representing System A to System F, with Singapore and International scores highlighted.](image)
Question: “Taste” for Slope?
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![Graph showing the relationship between SES and Score]

International
Question: “Taste” for Slope?
Question: “Taste” for Slope?
Question: “Taste” for Slope?
Question: “Cost” ($ + Others)?

Score

SES

International
'Closing the gap' fails schools' brightest

Patrick Griffin
10 July 2013

Education

Brightest students not fulfilling their potential

25 June 2013
Key Findings: RQ2 Type-2 Analyses

Students in Bottom SES Quartile

• High proportion in top residual-score quartile

Table 2. Proportion of students in the bottom and top SES quartiles who were in the top quartile in terms of residual score, by grade and subject

<table>
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<tr>
<th>Grade /Subject</th>
<th>% of Students in Top Residual-Score Quartile</th>
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<td>Bottom SES Quartile</td>
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<tr>
<td>G4 Reading</td>
<td>41* (30)</td>
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<td>G4 Math</td>
<td>67* (28)</td>
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<td>G4 Science</td>
<td>51* (30)</td>
</tr>
<tr>
<td>G8 Math</td>
<td>81* (28)</td>
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<td>G8 Science</td>
<td>64* (28)</td>
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G4 Reading

Proportion of Students in Bottom HRL-Quartile in the Top Residual-Score Quartile

Mean HRL Scale Score of Bottom HRL-Quartile

- Hong Kong: -1.13, 78%
- Chinese Taipei: -1.00, 52%
- Russian Fed.: -0.58, 50%
- Northern Ireland: -0.58, 47%
- Singapore: -0.63, 41%
- Finland: -0.15, 38%
- Ireland: -0.62, 35%
Key Findings: RQ2 Type-2 Analyses

Students in Other SES Quartile

• Also have high proportions from each of the other three SES quartiles in the top residual-score quartile
Key Findings: RQ2 Type-2 Analyses

Singapore G4 Reading

Home Resources for Learning Category
- Top 25th p'tile
- 50th-75th p'tile
- 25th-50th p'tile
- Bot 25th p'tile

Proportion of Students in Each Residual-Score Quartile
- 0% - 10% - 20% - 30% - 40% - 50% - 60% - 70% - 80% - 90% - 100%

Color Legend:
- Bot 25th percentile
- 25th-50th percentile
- 50th-75th percentile
- Top 25th percentile
LIMITATIONS
Limitations

• Residual-type models: Findings **not** indicative of quality of system in mitigating SES impact
• Instead, reflects collective “effect” of **everything** not included in model
  – E.g., students’ innate ability, attitudes, home language, ..., together with system factors
• Valid inferences on **relative** quality of systems require homogeneity in impact of the non-system factors across the systems
CONCLUSION
Conclusion

• Policies to better support lower-performing, lower-SES students, e.g.,
  – MOE Financial Assistance Scheme & Opportunity Fund
  – Learning Support Programmes
  – Strengthen pre-school provisions, e.g., literacy assistance to children from low-income, non-English-speaking homes
  – School-based Student Care Centers
Conclusion

• Analyses like those presented help monitor system-level impact of policy changes
  – Esp. any trade-offs in terms of re-distribution of achievement among SES groups
  – Just as society has to come to consensus about “acceptable” levels of income re-distribution, same thing for achievement re-distribution
“Keeping paths upwards wide open to all in education...has been a fundamental principle for Singapore for a very long time. It is how we have enhanced our human potential. How we have created hope for every Singaporean and is especially true in education”

Singapore PM Lee Hsieng Loong
2013 National Day Rally
18 Aug 2013