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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

SINGAPORE QUALITY CLASS

PEOPLE DEVELOPER SINGAPORE

Integrity, the Foundation ▪ People, our Focus ▪ Learning, our Passion ▪ Excellence, our Pursuit

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Outline

- Motivation
- Methods
- Key Findings
- Limitations
- Conclusion

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Why?

MOTIVATION

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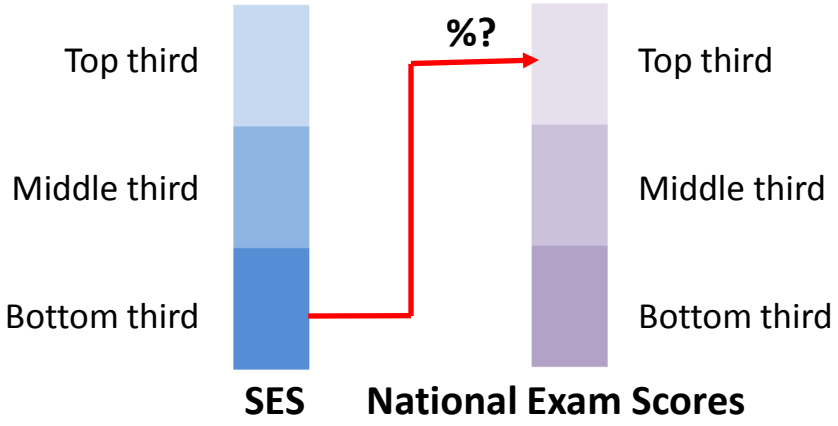
Motivation of Study

- Education as key enabler of social mobility
- Existing debates

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

  – Ng, I. Y. H. (2012). The political economy of intergenerational mobility in Singapore. *International Journal of Social Welfare.*

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



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Motivation of Study

- Ignored reality
  - In 21st century, increasingly borderless world
  - Physical presence no longer pre-requisite in competition for jobs, status, “a good life”

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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

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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

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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?

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How?

METHODS

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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

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Methods

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

- Separately for each system *S*, fitted

$$(1)\ SCORE_{iS} = \beta_{0S} + \beta_{1S} SES_{iS} + e_{iS}$$

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

- Compared across systems:
  - β_{1s} – "slope"
  - R^2 – "strength"

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Methods

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

- Ignore students' system membership, fitted

$$(2)\ SCORE_i = \gamma_0 + \gamma_1 SES_i + \varepsilon_i$$

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

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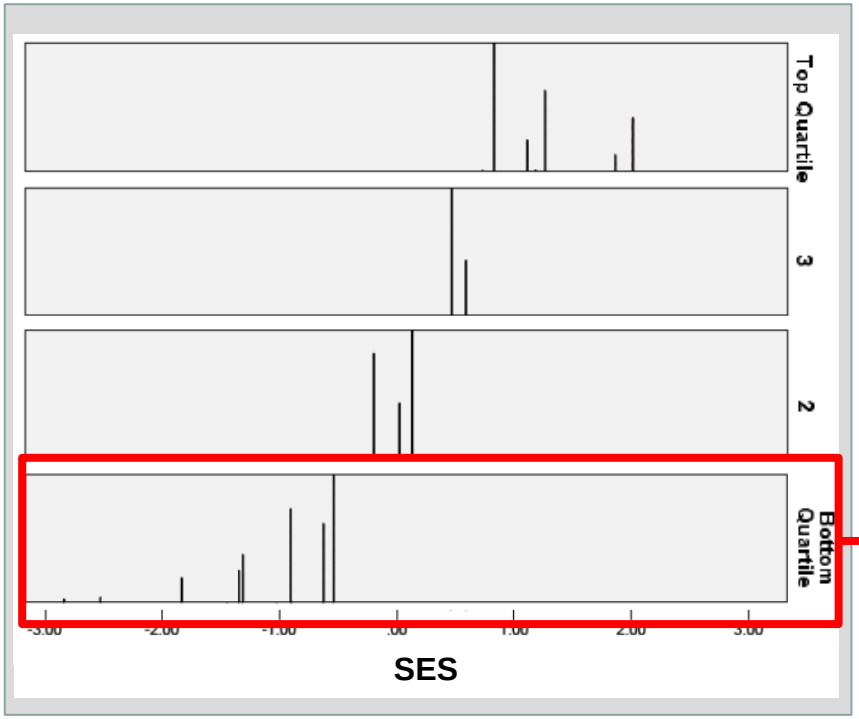
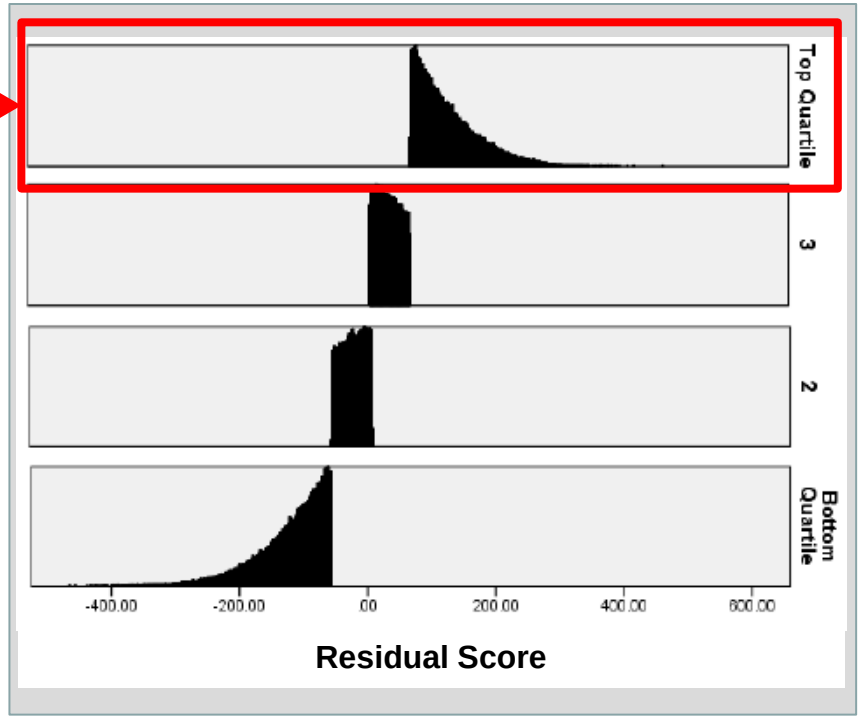
Methods

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

Within-System SES Quartile



Int'l Residual Score Quartile



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Methods

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

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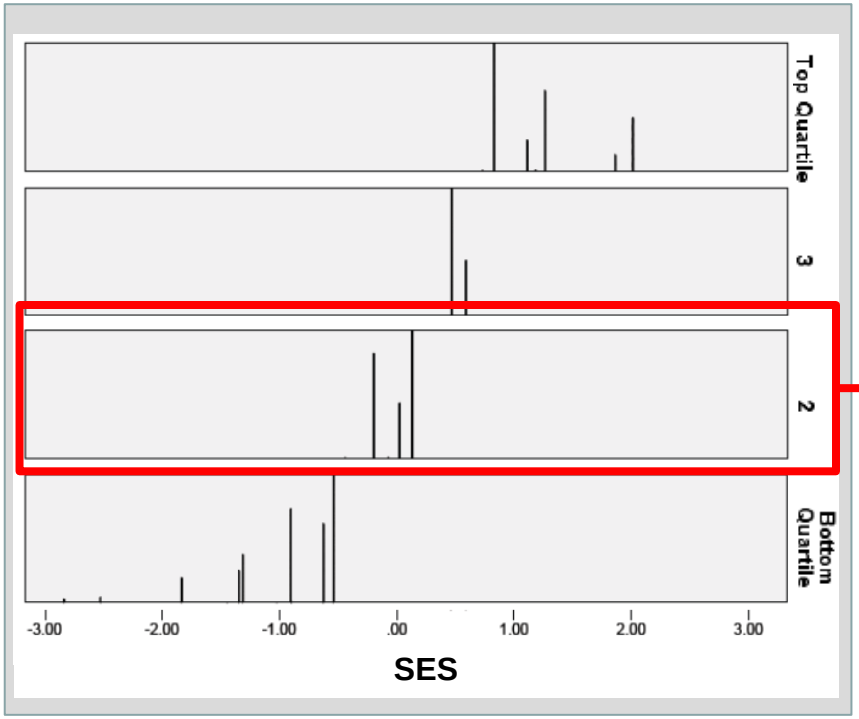

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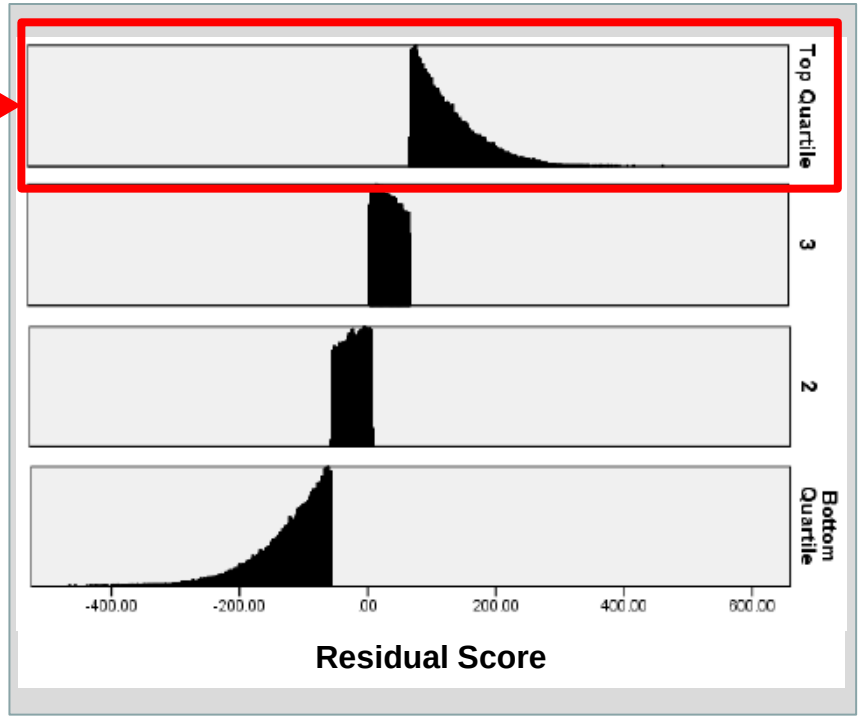

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Methods

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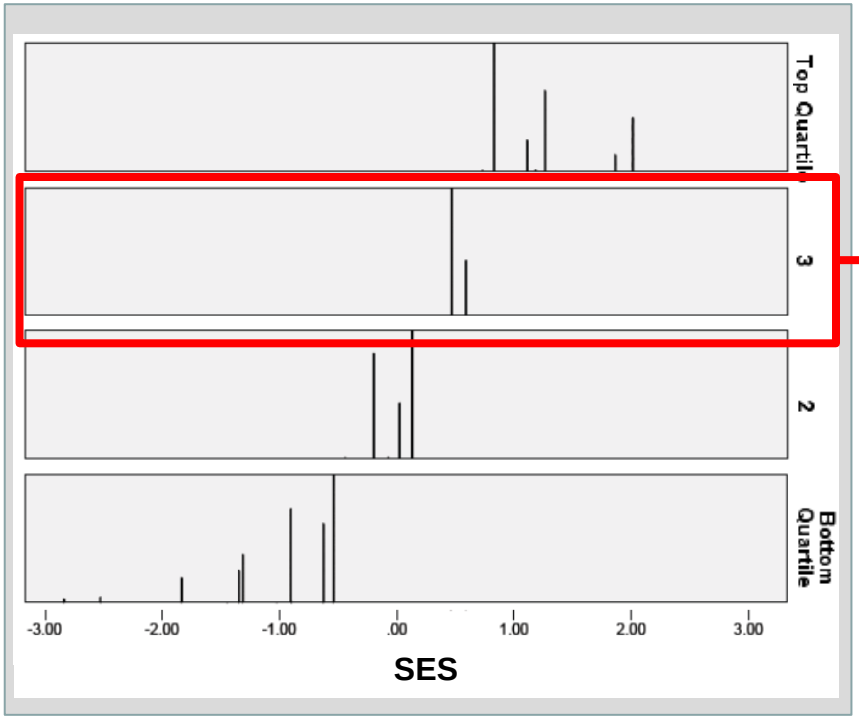

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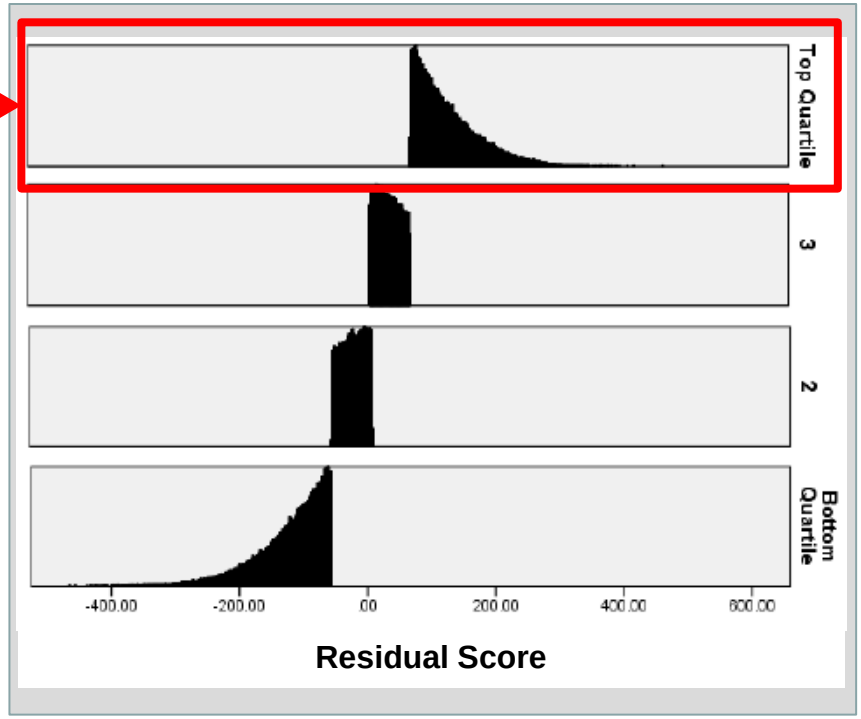

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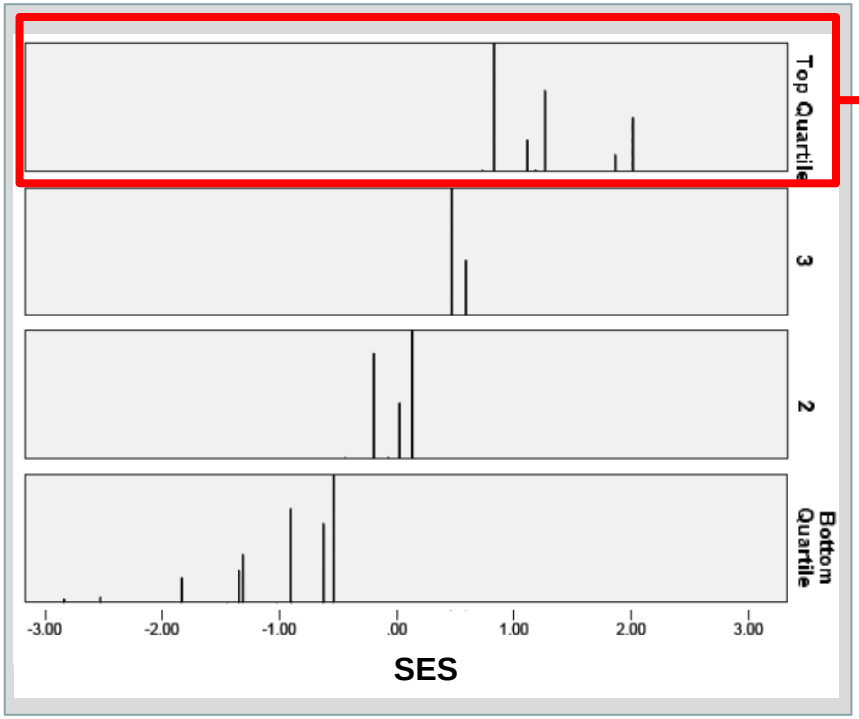

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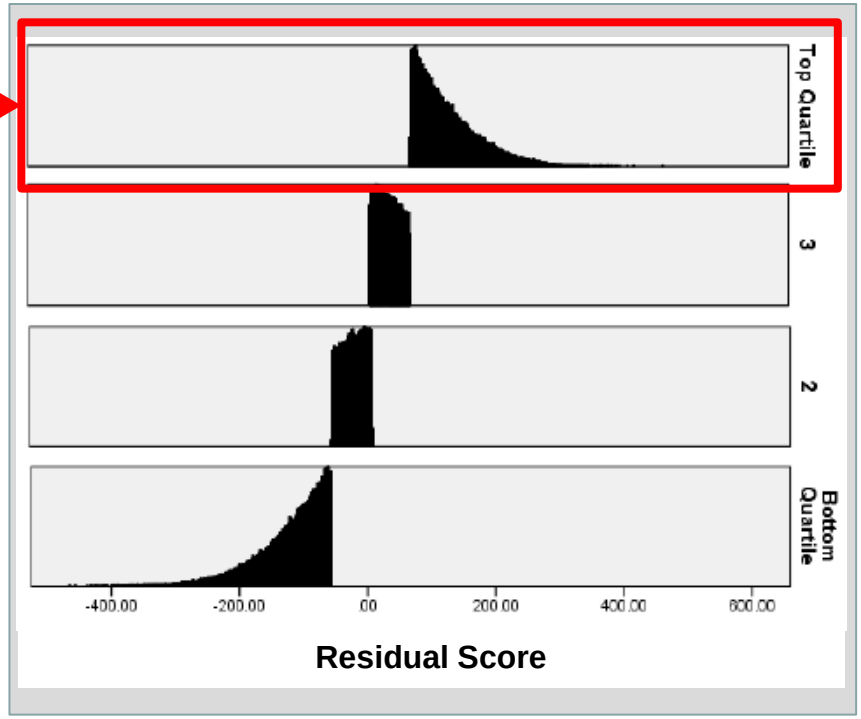

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What?

RESULTS

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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

Grade /Subject	Mean SES	Mean Score	Slope ($\tilde{\beta}_{1S}$)	Strength (R^2) (%)
G4 Reading	0.34* (0.00)	570* (515)	48 (45)	23 (24)
G4 Math	0.36* (0.00)	608* (501)	42 (43)	20 (19)
G4 Science	0.36* (0.00)	586* (501)	52* (47)	24 (21)
G8 Math	0.15* (0.00)	611* (468)	37* (50)	13* (20)
G8 Science	0.15* (0.00)	590* (478)	49 (47)	18 (20)

Notes: International values in parentheses. * denotes cases when Singapore's value is statistically significantly different from the corresponding international value.

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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)

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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

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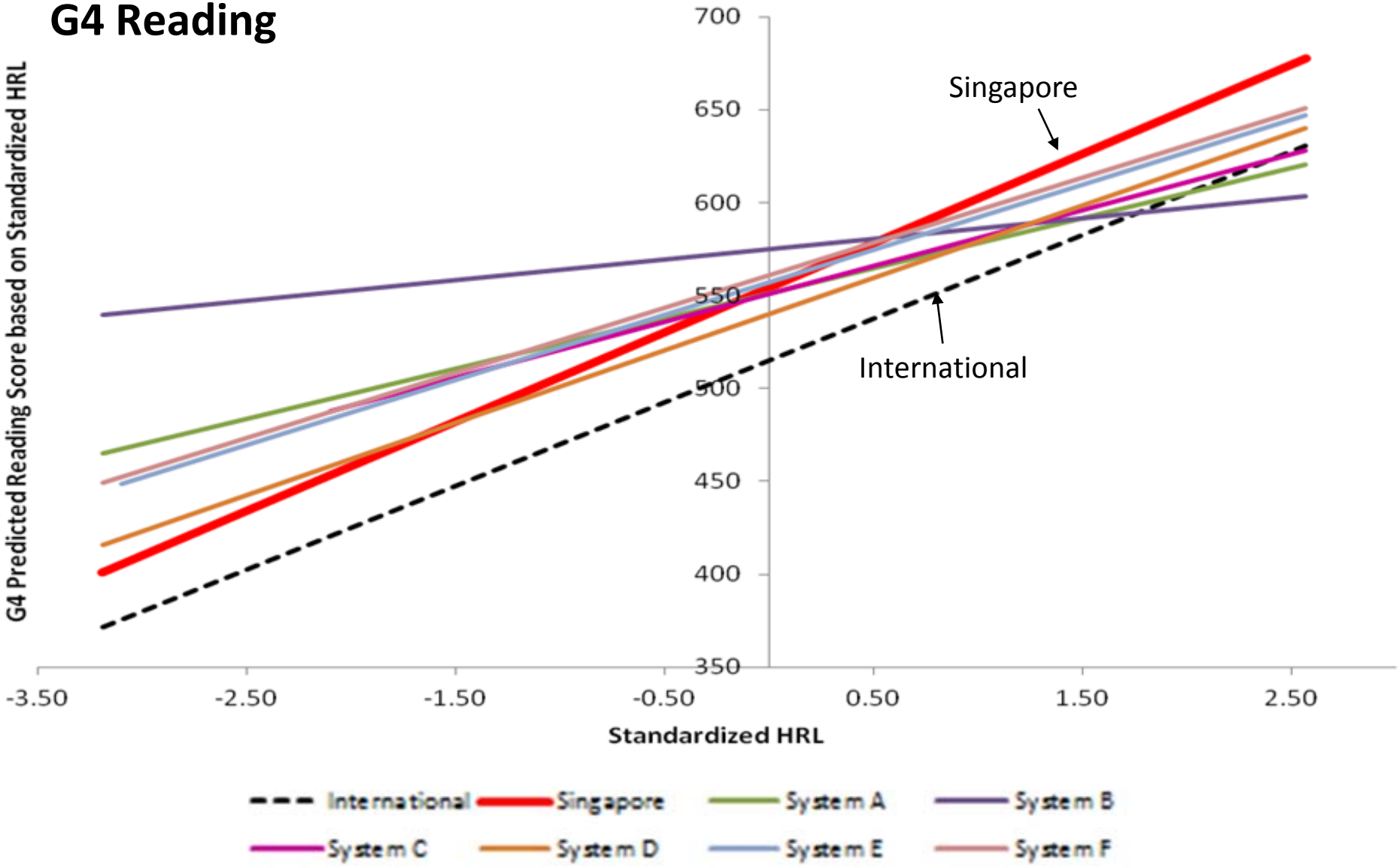
Key Findings: RQ1 Type-1 Analyses

G4 Reading



Question: “Taste” for Slope?

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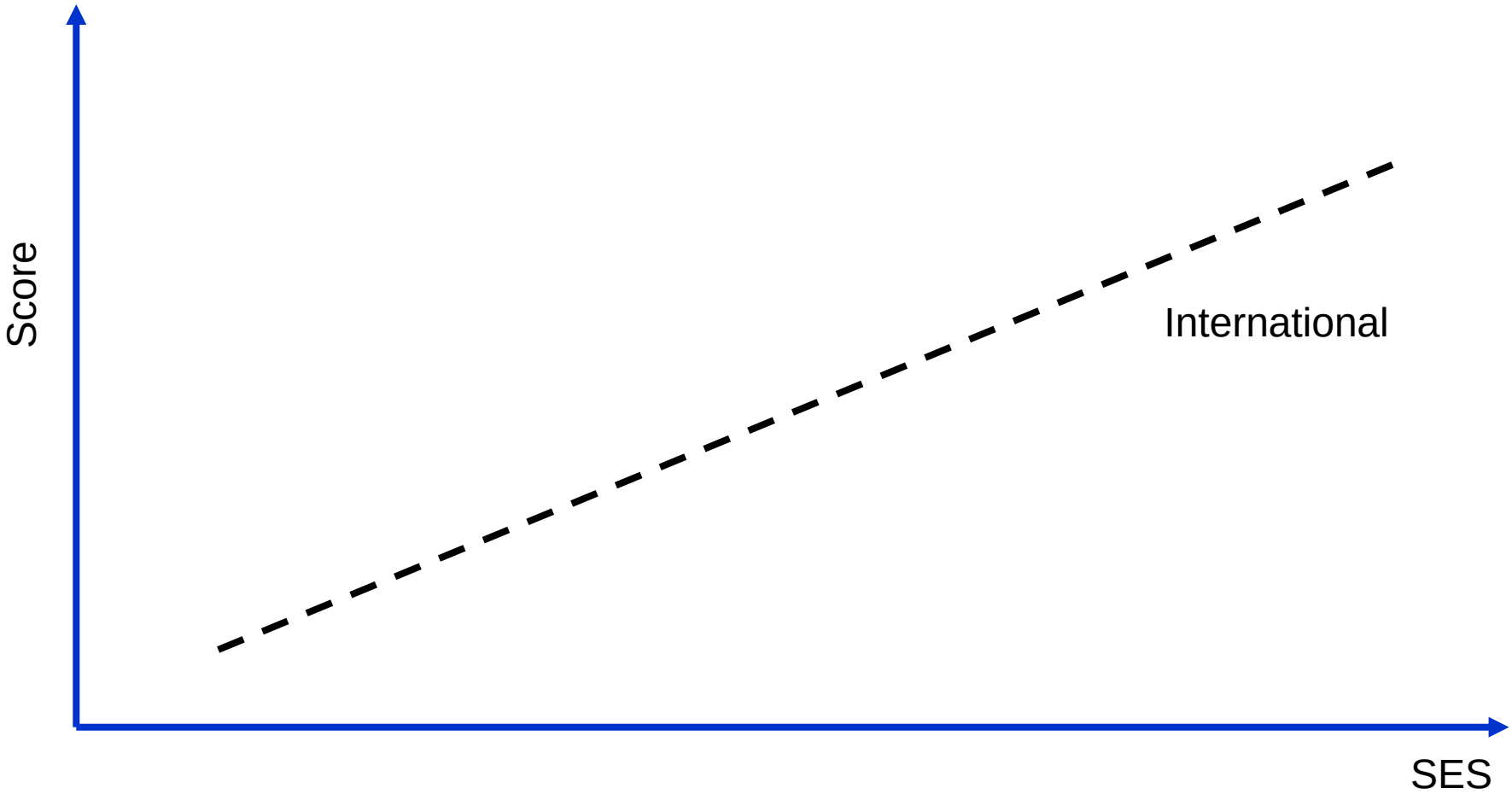

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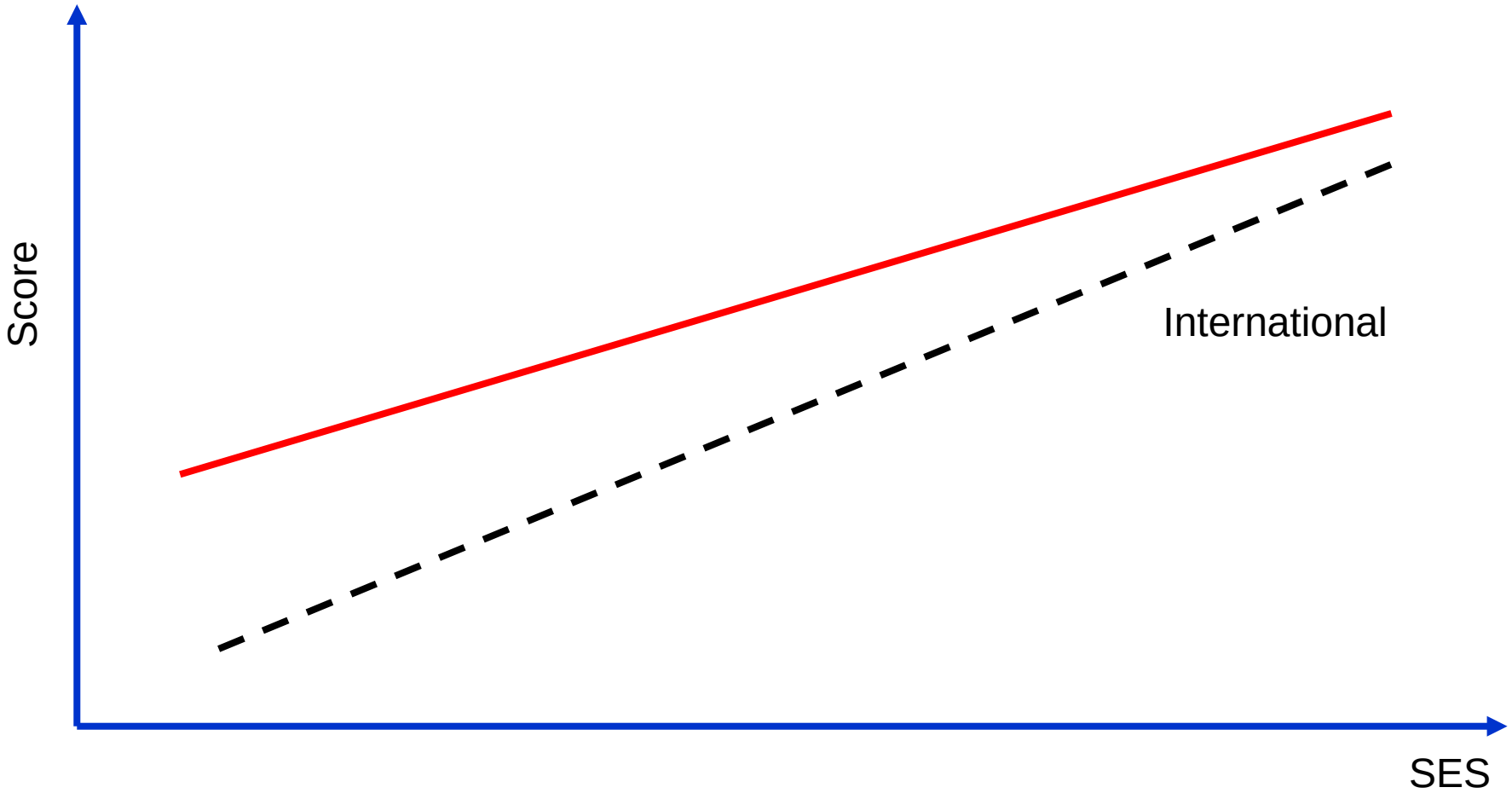

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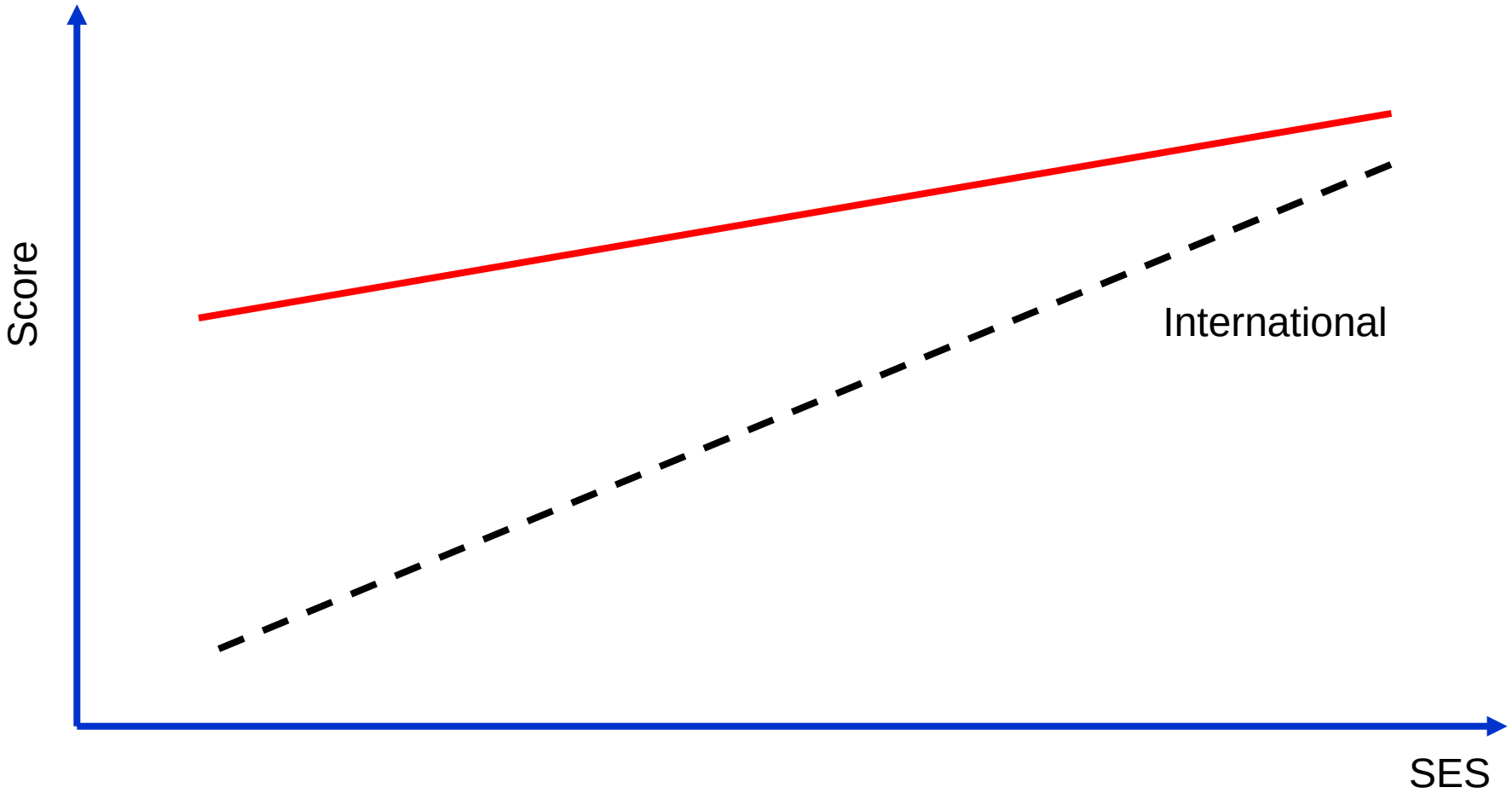

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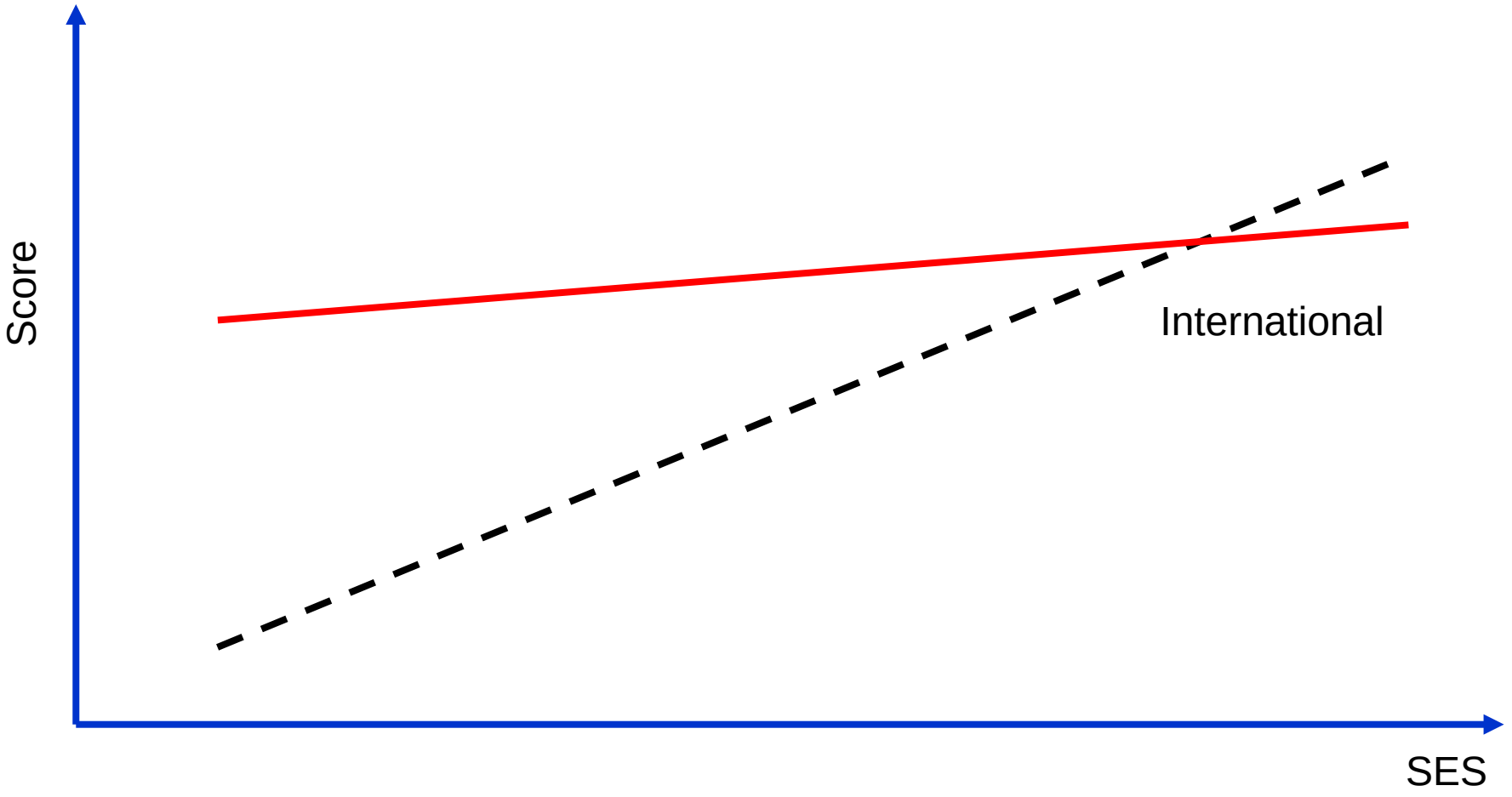

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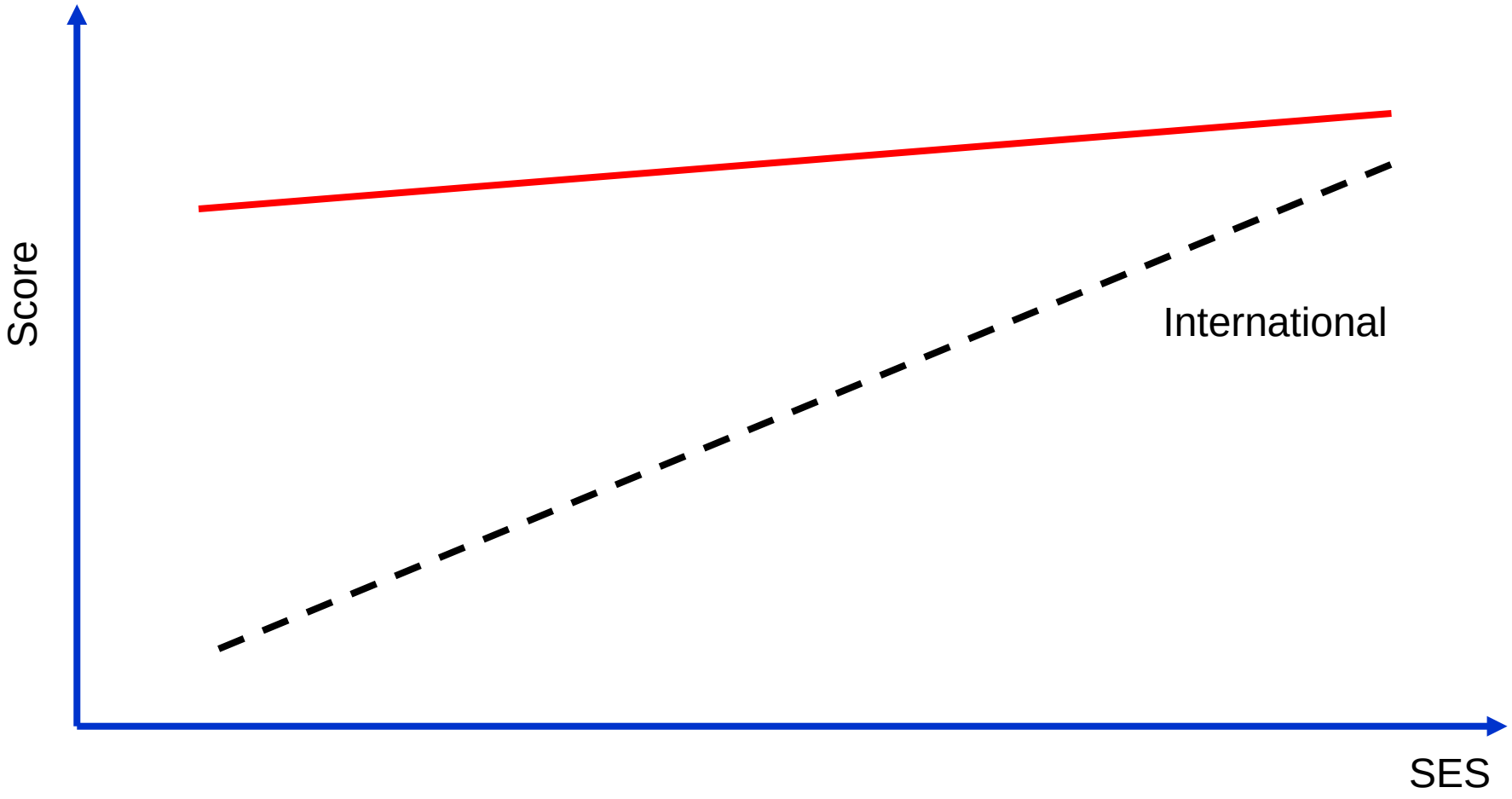

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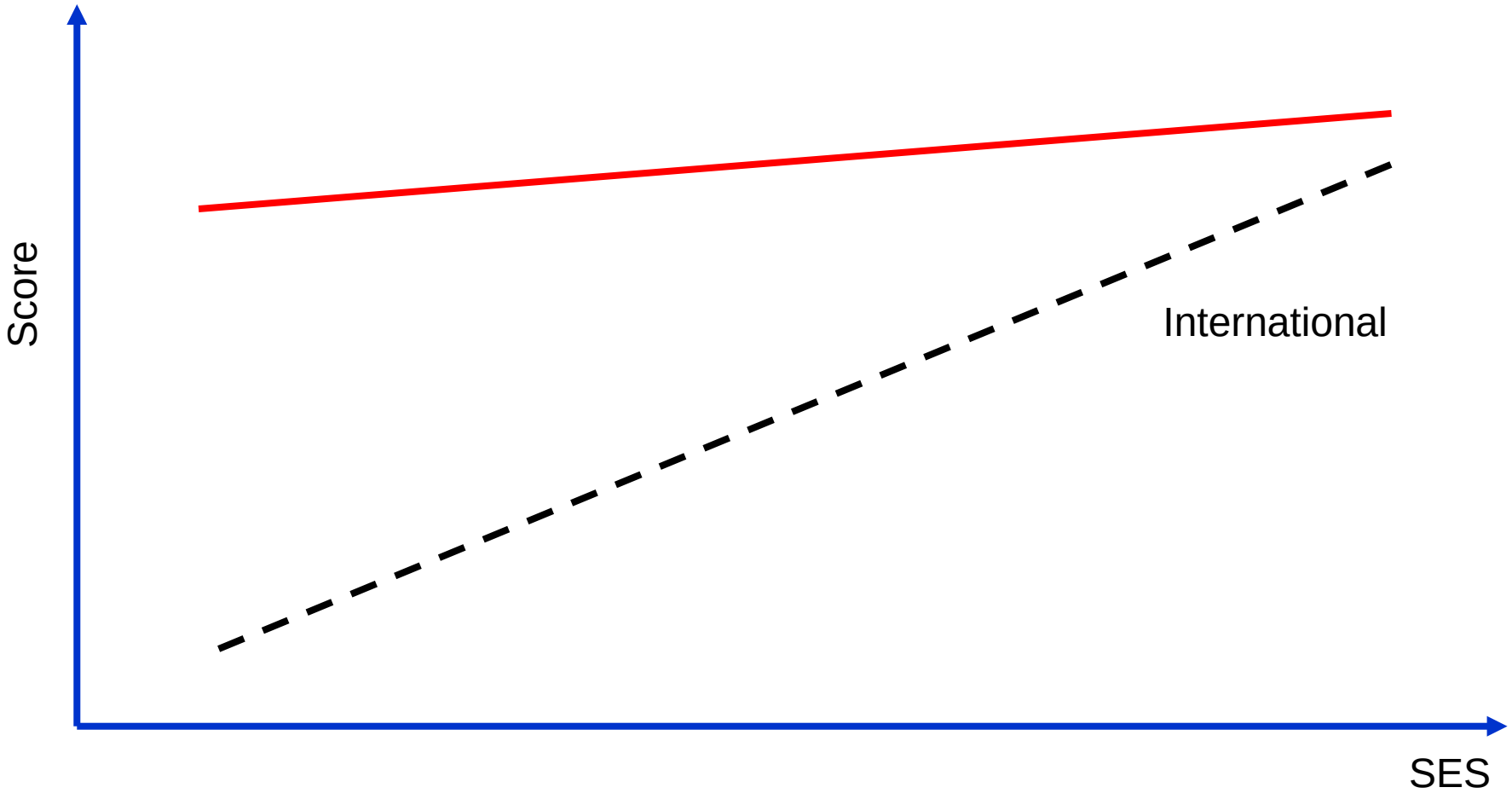
Question: “Cost” ($ + Others)?



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保底不封顶

'Closing the gap' fails schools' brightest

Patrick Griffin

10 July 2013

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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

	% of Students in Top Residual-Score Quartile	
Grade /Subject	**Bottom SES Quartile**	**Top SES Quartile**
G4 Reading	41* (30)	43* (18)
G4 Math	67* (28)	70* (21)
G4 Science	51* (30)	57* (18)
G8 Math	81* (28)	79* (21)
G8 Science	64* (28)	74* (20)

Notes: International values in parentheses. * denotes cases when Singapore's value is statistically significantly different from the corresponding international value.

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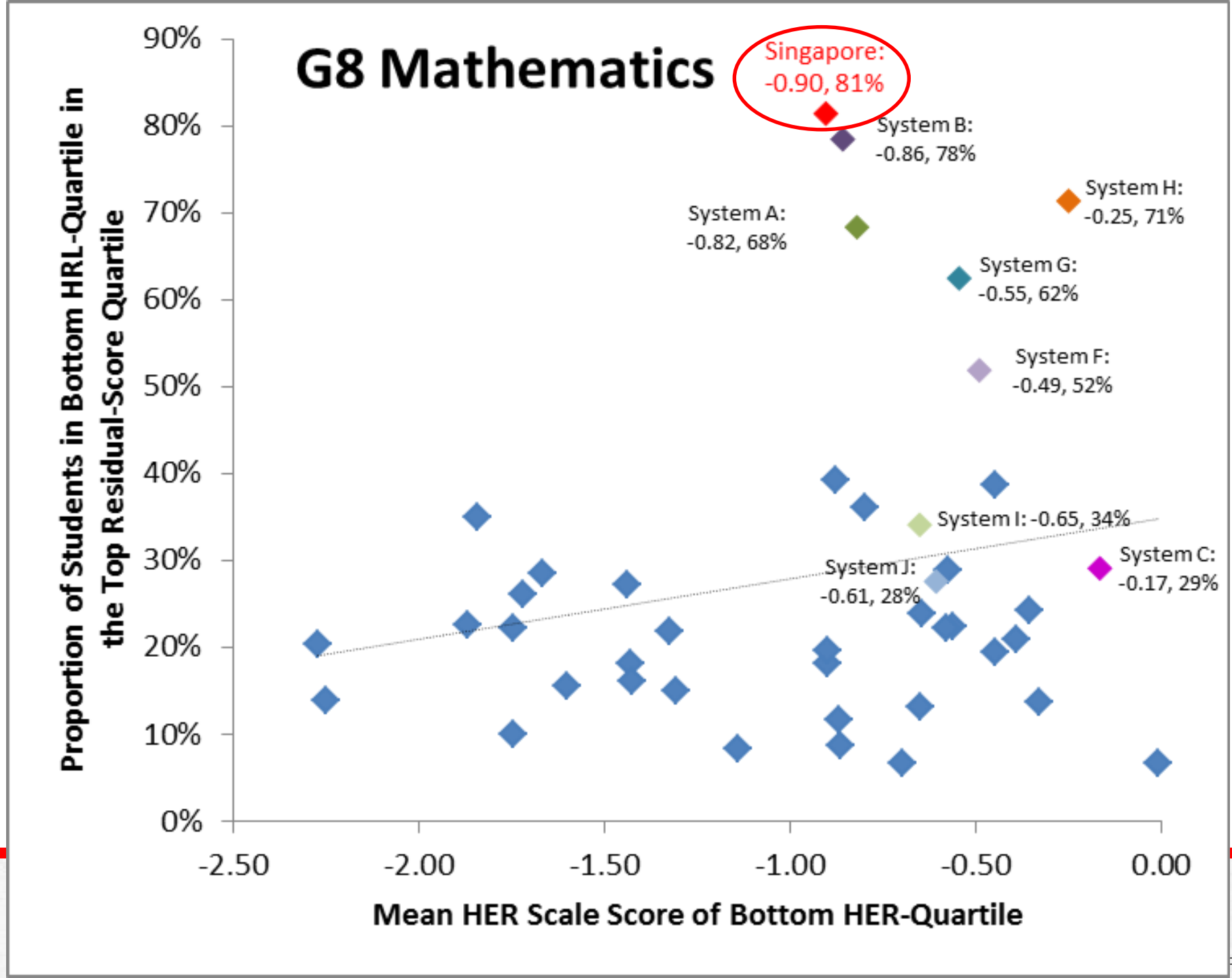
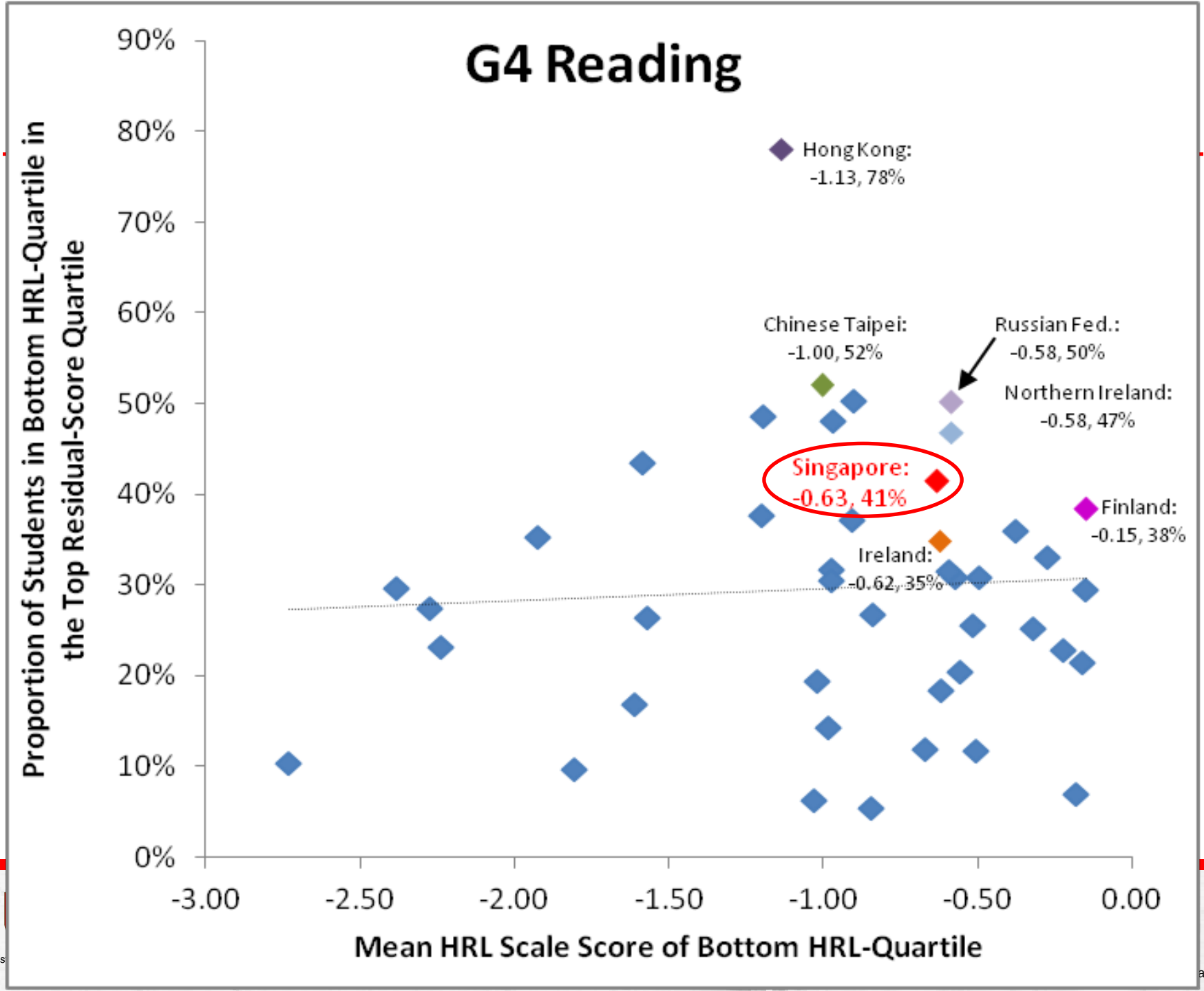

G8 Mathematics
Singapore: -0.90, 81%
System B: -0.86, 78%
System H: -0.25, 71%
System A: -0.82, 68%
System G: -0.55, 62%
System F: -0.49, 52%
System I: -0.65, 34%
System C: -0.17, 29%
System J: -0.61, 28%
Proportion of Students in Bottom HRL-Quartile in the Top Residual-Score Quartile
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
-2.50
-2.00
-1.50
-1.00
-0.50
0.00
Mean HER Scale Score of Bottom HER-Quartile


G4 Reading
Proportion of Students in Bottom HRL-Quartile in the Top Residual-Score Quartile
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
-3.00
-2.50
-2.00
-1.50
-1.00
-0.50
0.00
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

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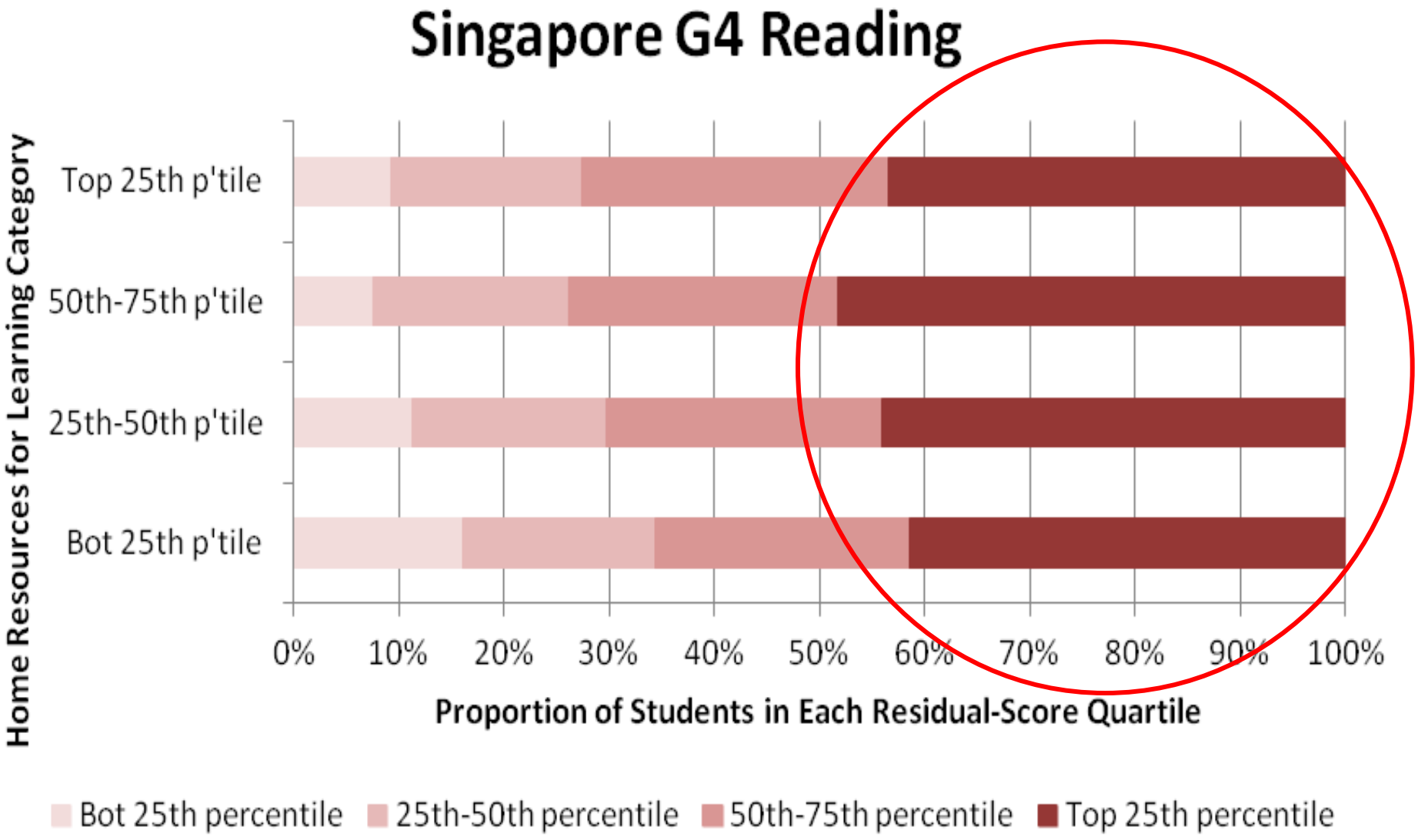
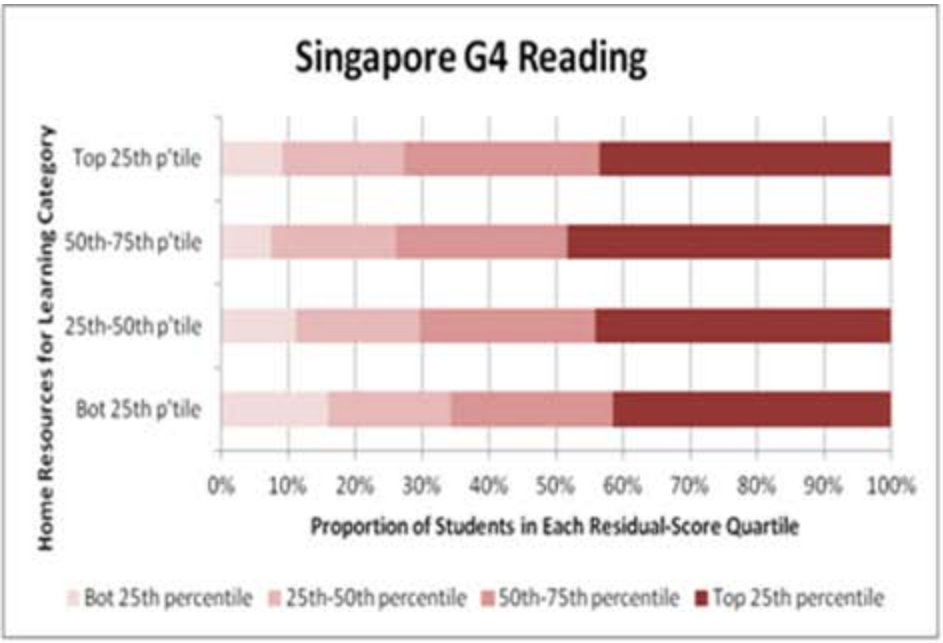
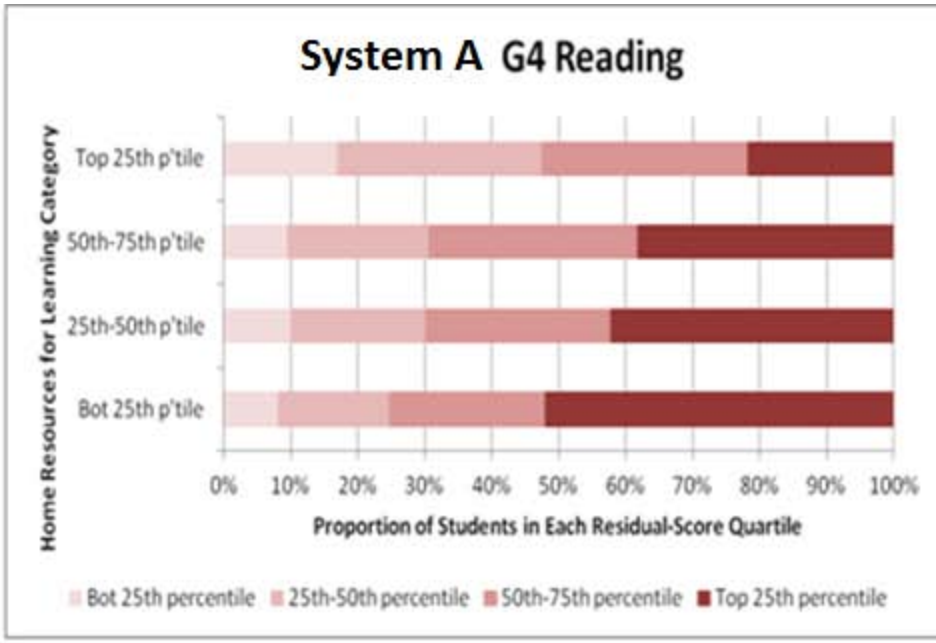
Key Findings: RQ2 Type-2 Analyses




Singapore G4 Reading
Home Resources for Learning Category
Top 25th p'tile
50th-75th p'tile
25th-50th p'tile
Bot 25th p'tile
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Proportion of Students in Each Residual-Score Quartile
Bot 25th percentile
25th-50th percentile
50th-75th percentile
Top 25th percentile


System A G4 Reading
Home Resources for Learning Category
Top 25th p'tile
50th-75th p'tile
25th-50th p'tile
Bot 25th p'tile
0%
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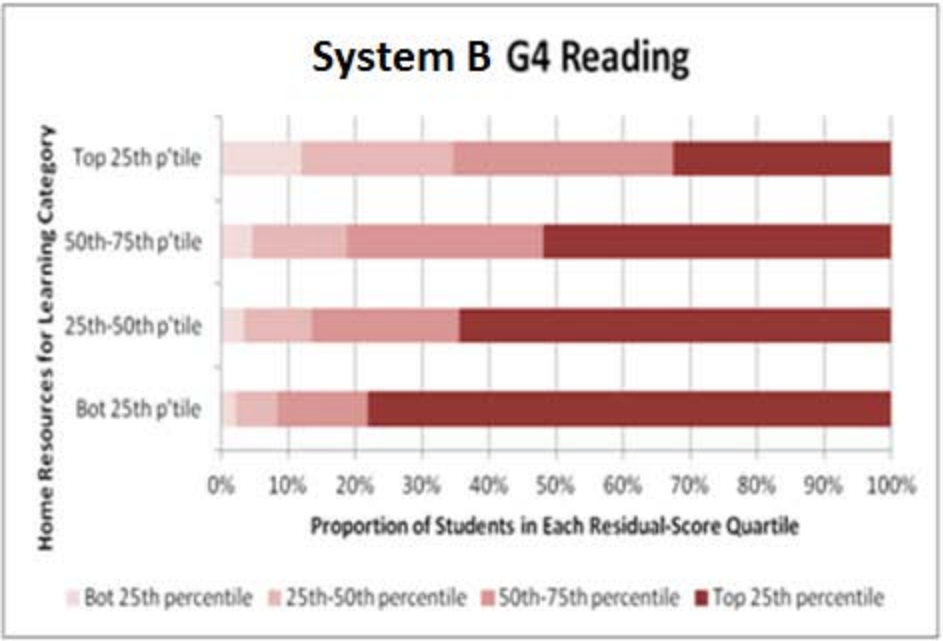
System B G4 Reading
Home Resources for Learning Category
Top 25th p'tile
50th-75th p'tile
25th-50th p'tile
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0%
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40%
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80%
90%
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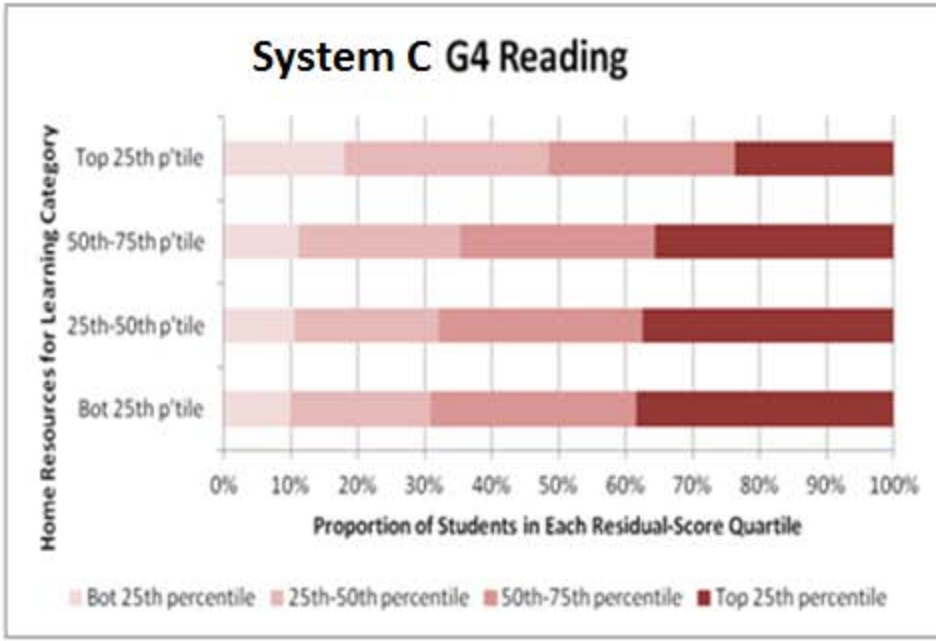
System C G4 Reading
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Top 25th p'tile
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20%
30%
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50%
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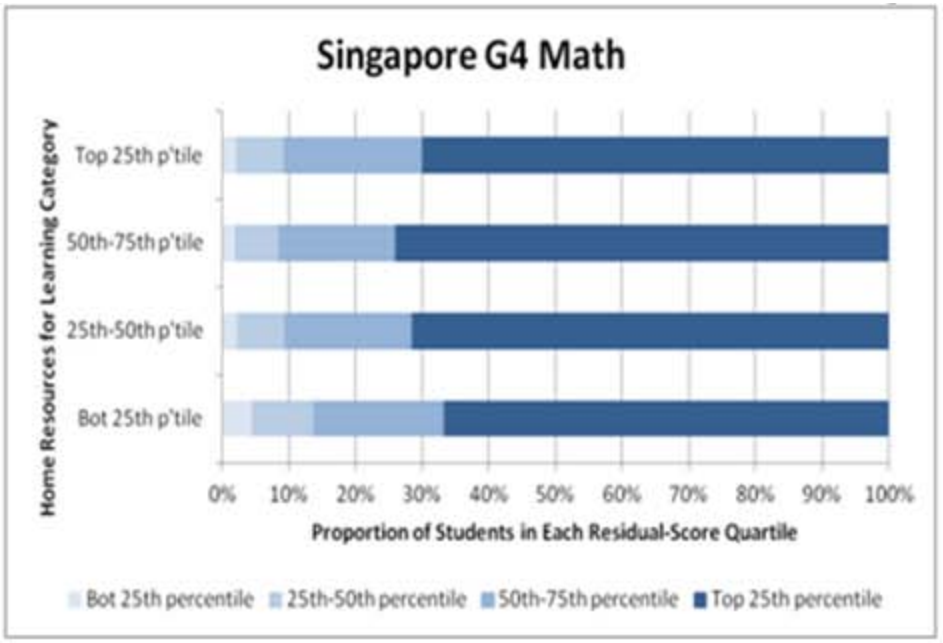
Singapore G4 Math
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Top 25th p'tile
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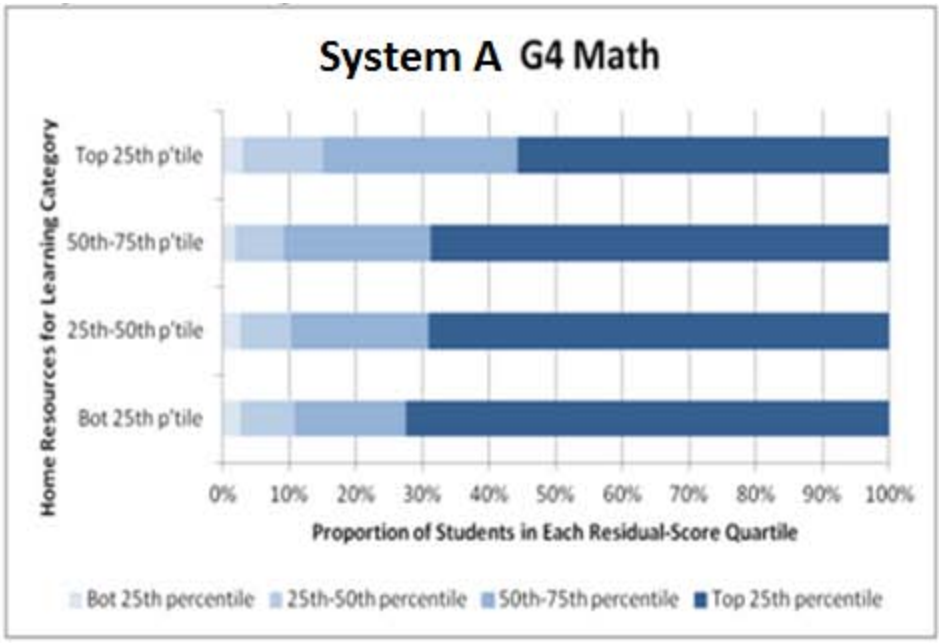
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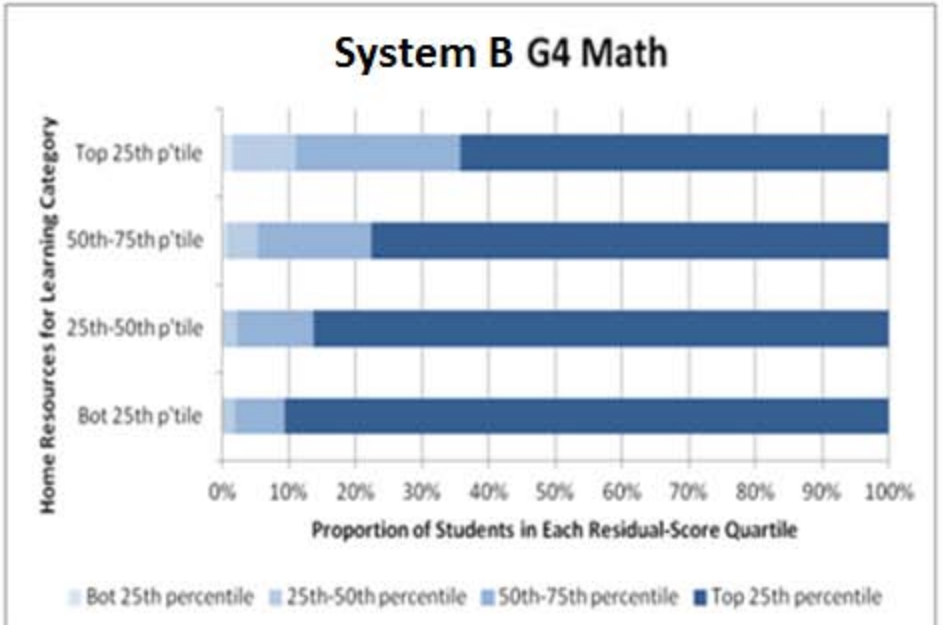
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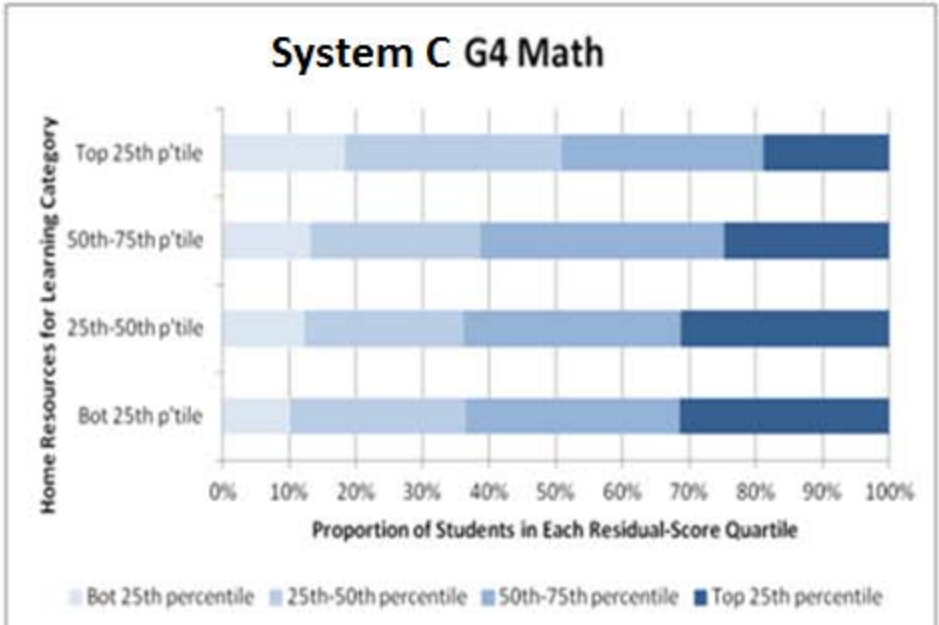
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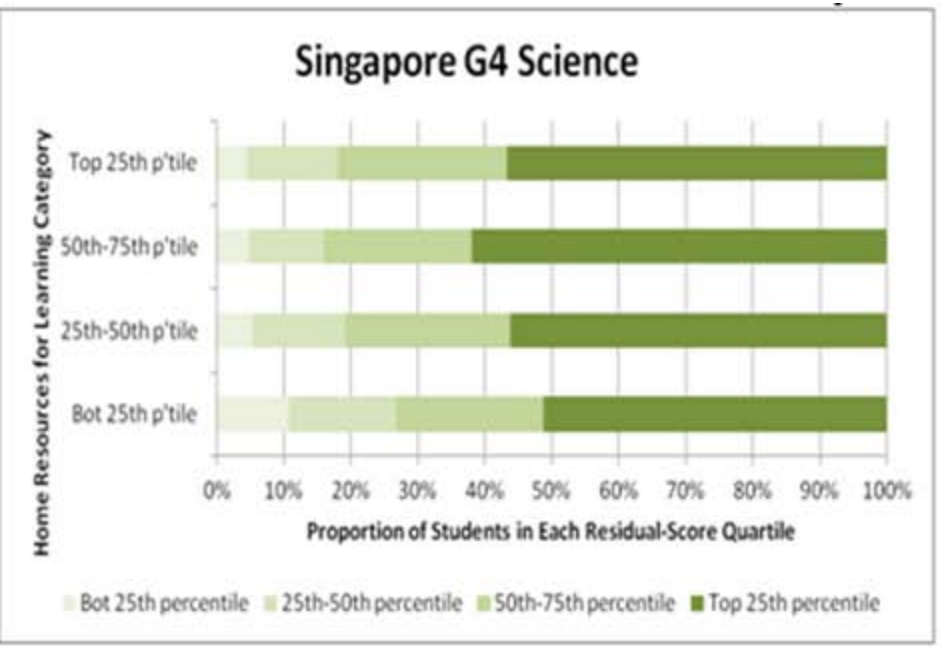
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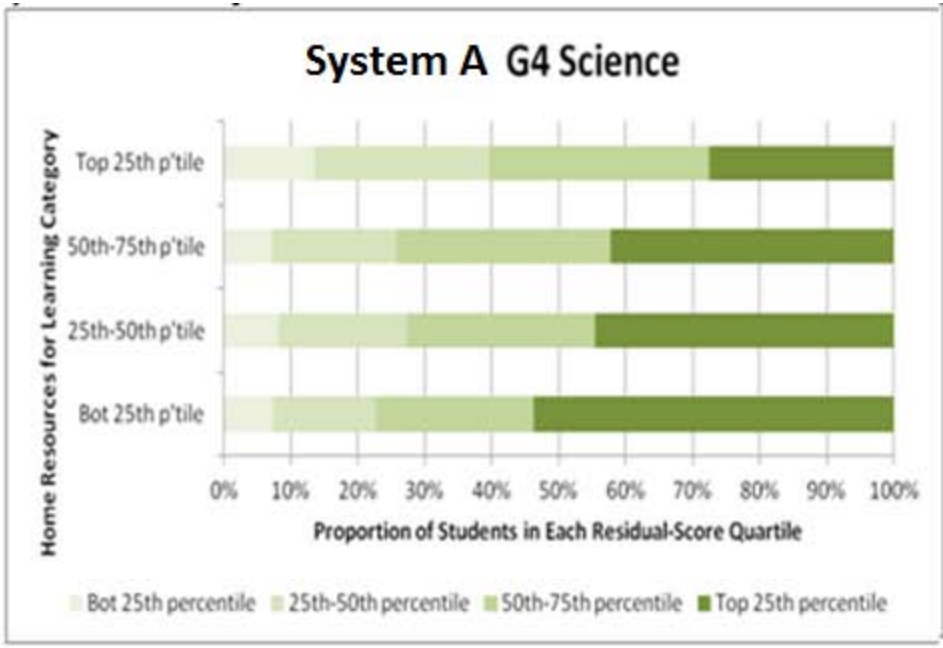
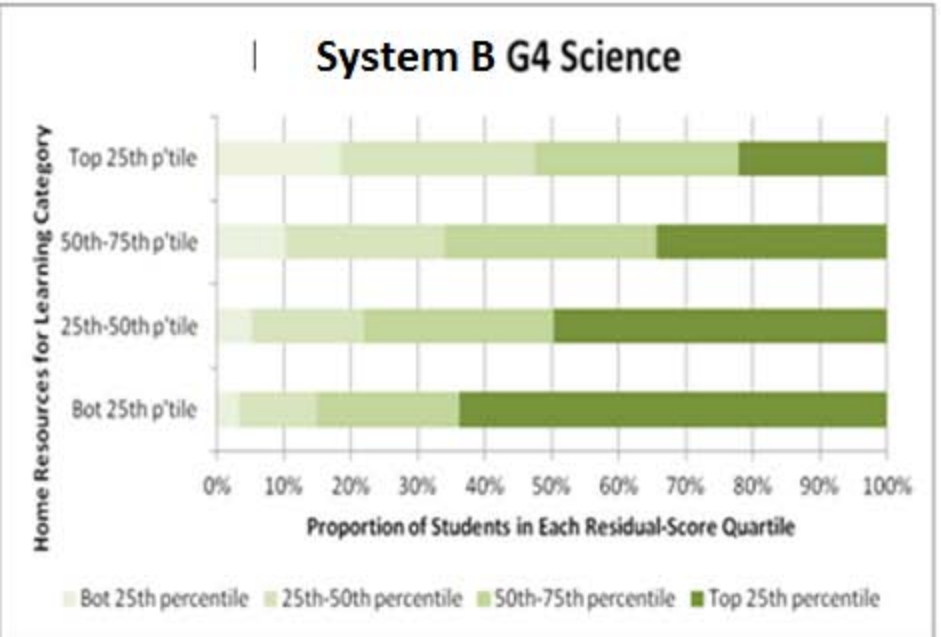
Bot 25th percentile
25th-50th percentile
50th-75th percentile
Top 25th percentile


System A G4 Science
Home Resources for Learning Category
Top 25th p'tile
50th-75th p'tile
25th-50th p'tile
Bot 25th p'tile
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Proportion of Students in Each Residual-Score Quartile
Bot 25th percentile
25th-50th percentile
50th-75th percentile
Top 25th percentile


System B G4 Science
Home Resources for Learning Category
Top 25th p'tile
50th-75th p'tile
25th-50th p'tile
Bot 25th p'tile
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Proportion of Students in Each Residual-Score Quartile
Bot 25th percentile
25th-50th percentile
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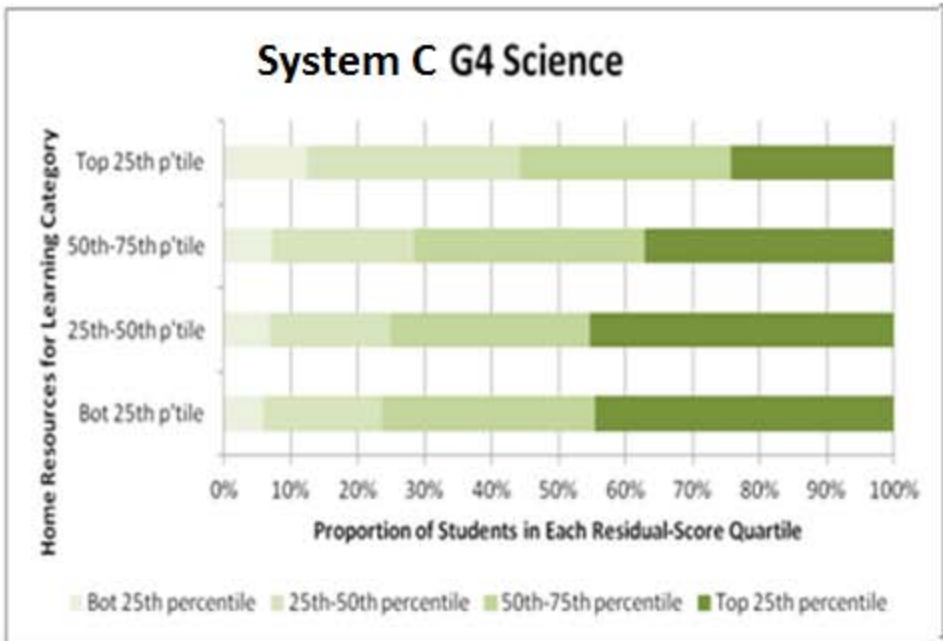
Top 25th percentile


System C G4 Science
Home Resources for Learning Category
Top 25th p'tile
50th-75th p'tile
25th-50th p'tile
Bot 25th p'tile
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Proportion of Students in Each Residual-Score Quartile
Bot 25th percentile
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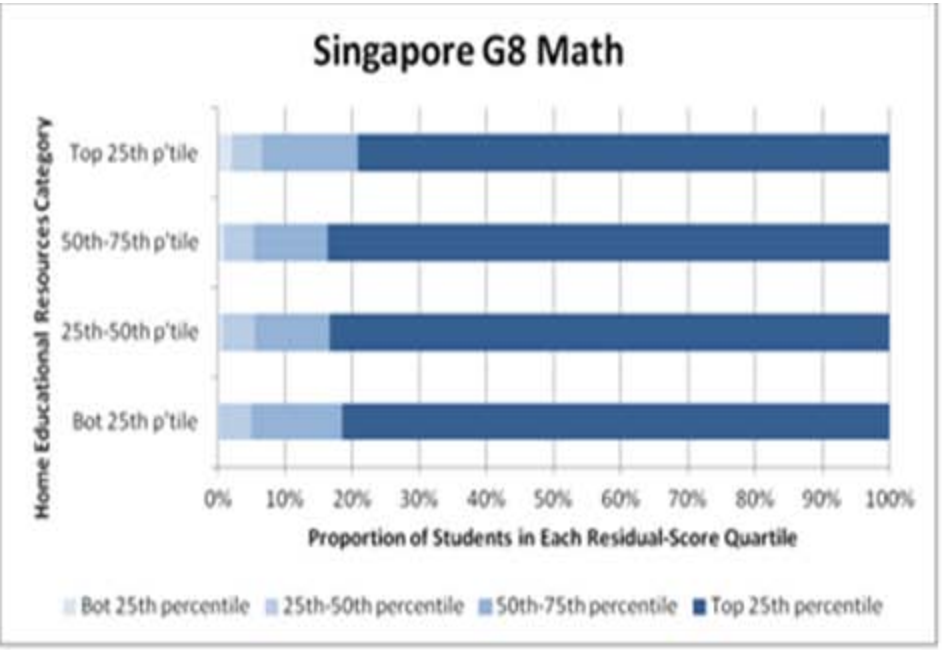
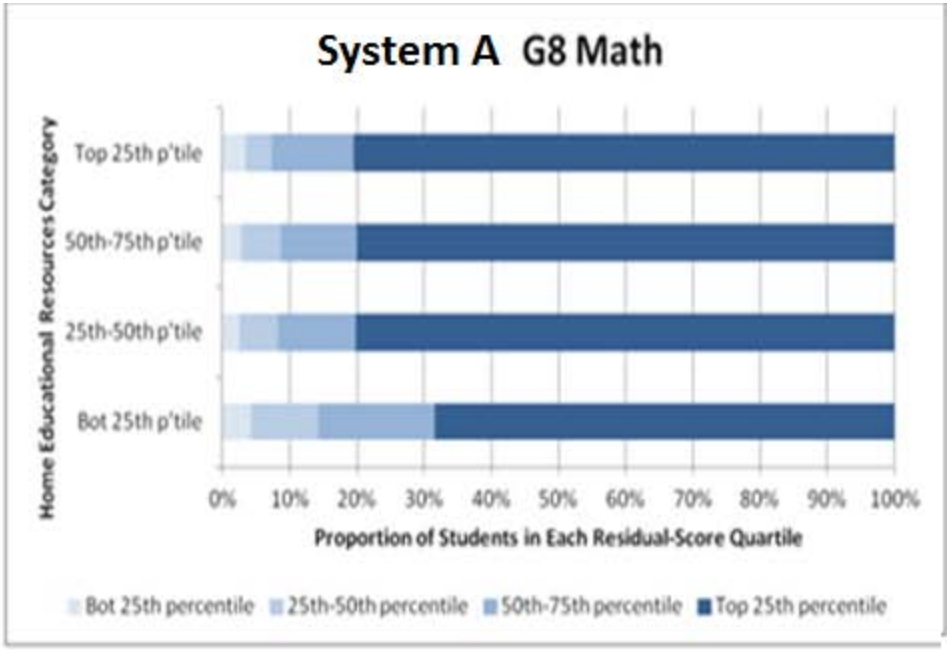
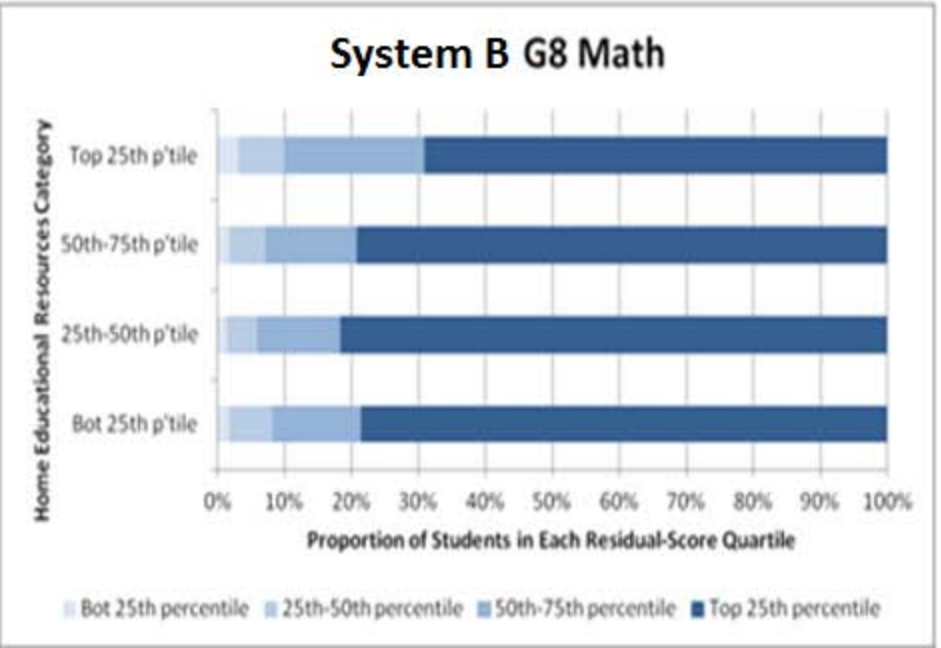
Top 25th percentile


Singapore G8 Math
Home Educational Resources Category
Top 25th p'tile
50th-75th p'tile
25th-50th p'tile
Bot 25th p'tile
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Proportion of Students in Each Residual-Score Quartile
Bot 25th percentile
25th-50th percentile
50th-75th percentile
Top 25th percentile


System A G8 Math
Home Educational Resources Category
Top 25th p'tile
50th-75th p'tile
25th-50th p'tile
Bot 25th p'tile
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Proportion of Students in Each Residual-Score Quartile
Bot 25th percentile
25th-50th percentile
50th-75th percentile
Top 25th percentile


System B G8 Math
Home Educational Resources Category
Top 25th p'tile
50th-75th p'tile
25th-50th p'tile
Bot 25th p'tile
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Proportion of Students in Each Residual-Score Quartile
Bot 25th percentile
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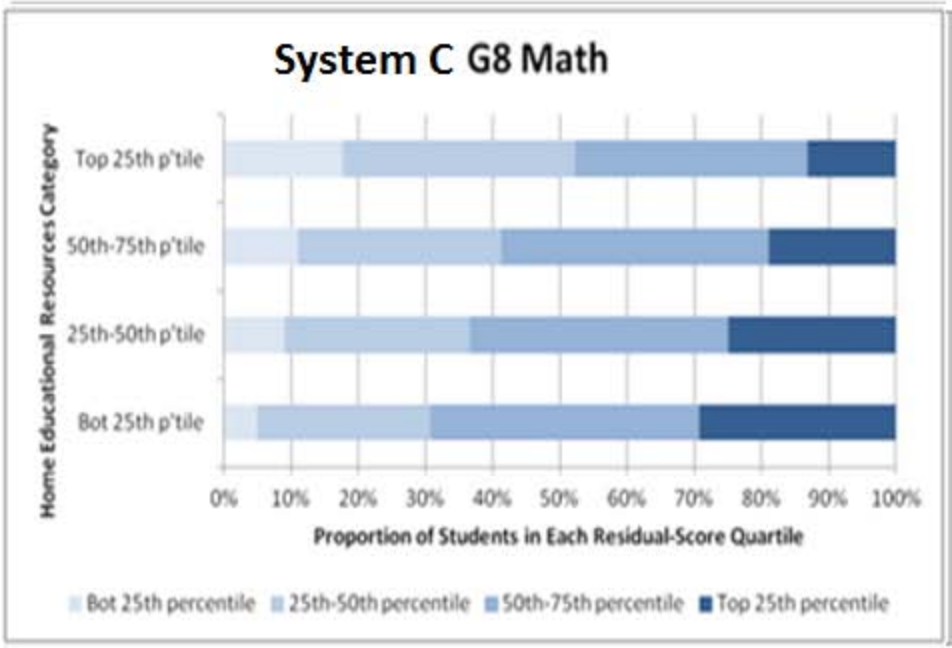
Top 25th percentile


System C G8 Math
Home Educational Resources Category
Top 25th p'tile
50th-75th p'tile
25th-50th p'tile
Bot 25th p'tile
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
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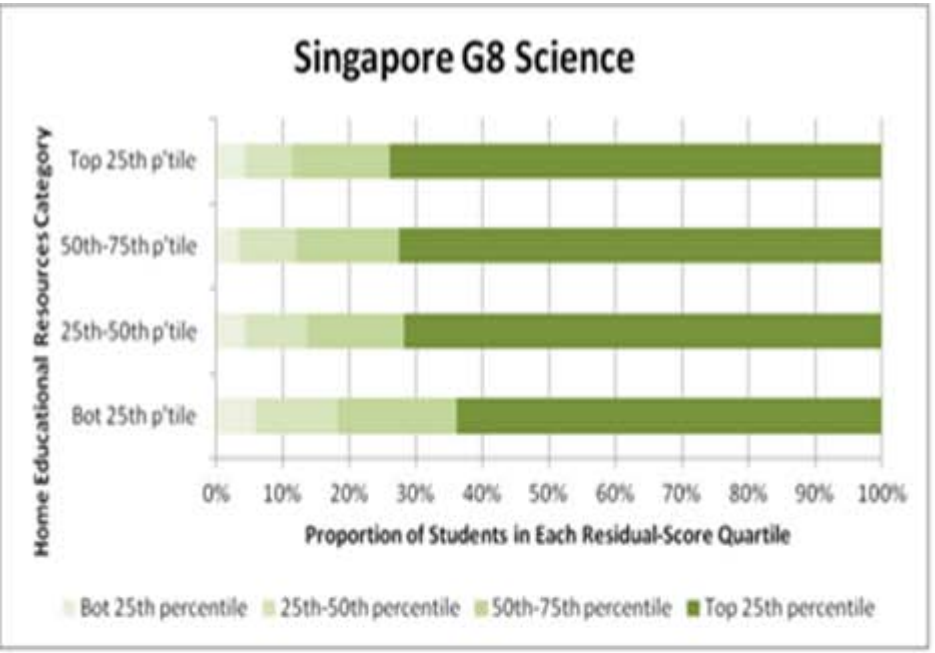
Singapore G8 Science
Home Educational Resources Category
Top 25th p'tile
50th-75th p'tile
25th-50th p'tile
Bot 25th p'tile
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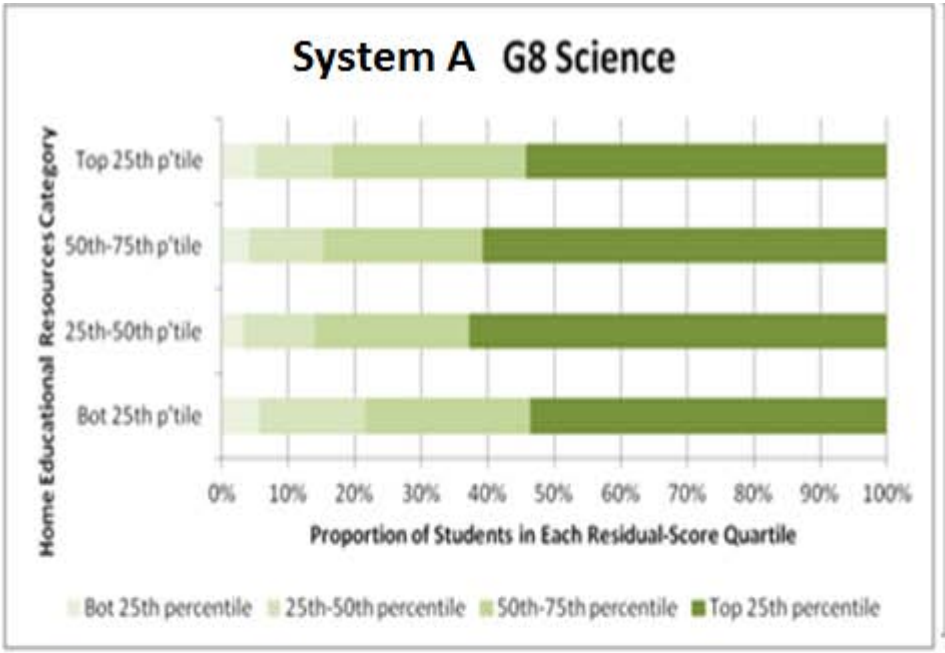
System A G8 Science
Home Educational Resources Category
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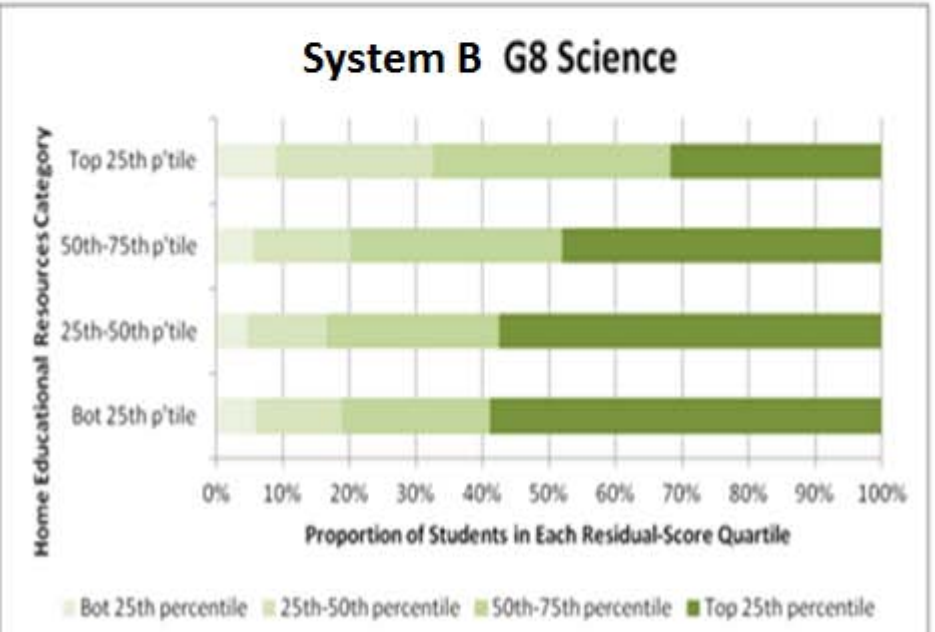
System B G8 Science
Home Educational Resources Category
Top 25th p'tile
50th-75th p'tile
25th-50th p'tile
Bot 25th p'tile
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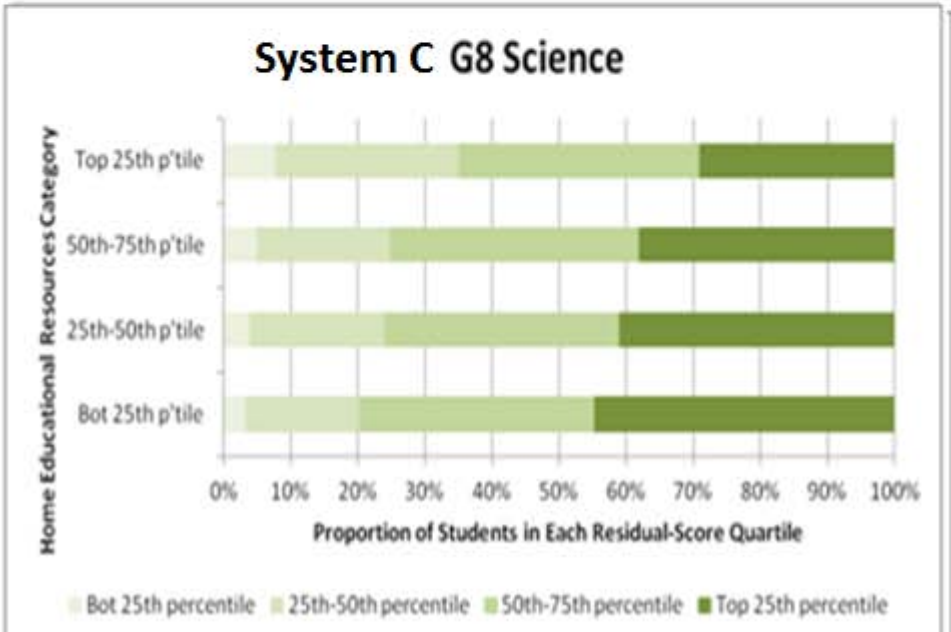
Top 25th percentile


System C G8 Science
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Top 25th p'tile
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25th-50th p'tile
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Proportion of Students in Each Residual-Score Quartile
Bot 25th percentile
25th-50th percentile
50th-75th percentile
Top 25th percentile

LIMITATIONS

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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

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CONCLUSION

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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

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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

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Conclusion

"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

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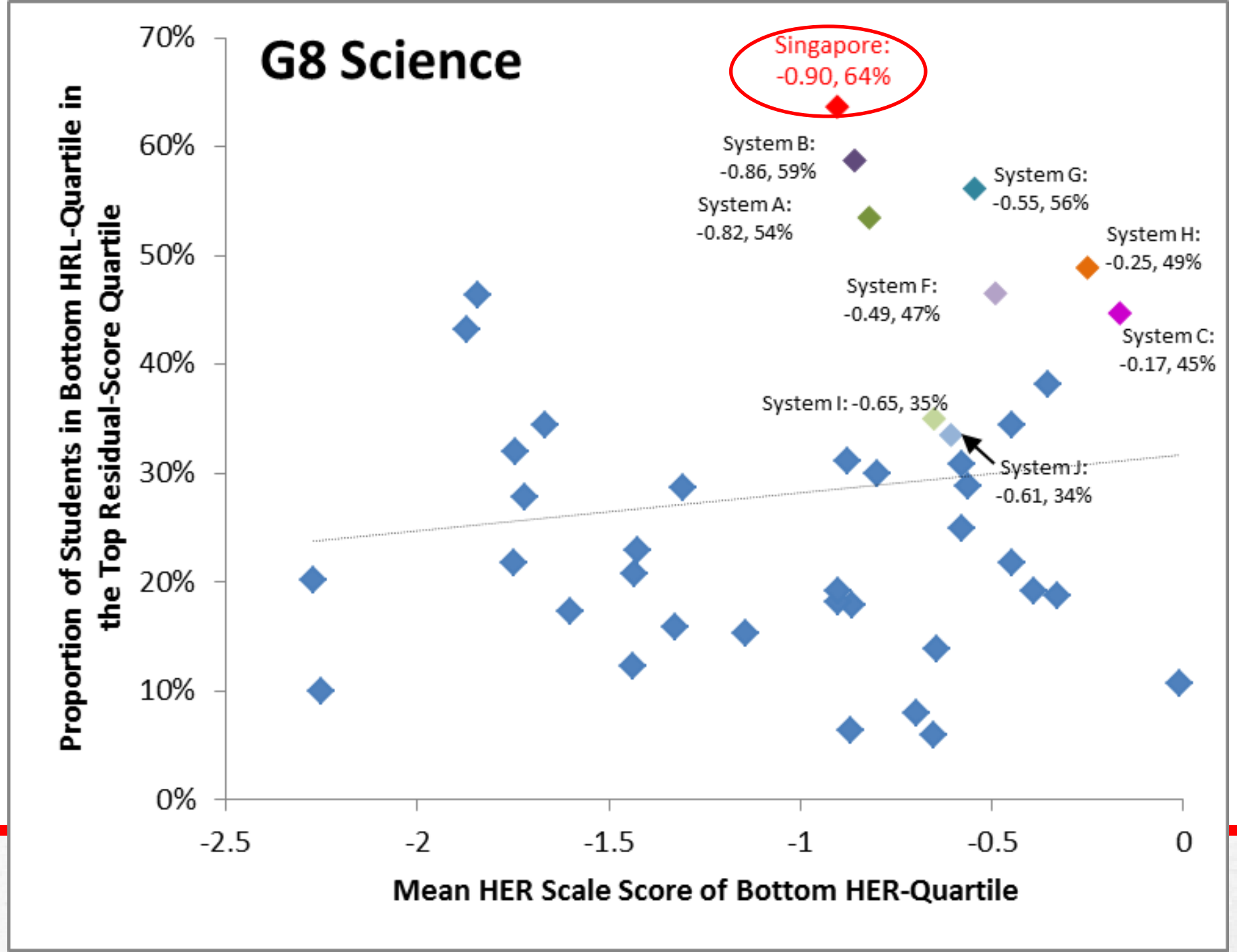
G8 Science
Singapore:
-0.90, 64%
System B:
-0.86, 59%
System A:
-0.82, 54%
System G:
-0.55, 56%
System H:
-0.25, 49%
System F:
-0.49, 47%
System C:
-0.17, 45%
System I: -0.65, 35%
System J:
-0.61, 34%
Proportion of Students in Bottom HRL-Quartile in the Top Residual-Score Quartile
70%
60%
50%
40%
30%
20%
10%
0%
-2.5
-2
-1.5
-1
-0.5
0
Mean HER Scale Score of Bottom HER-Quartile