

# Determinants of educational achievement in mathematics and science

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# Outline of Presentation

- The issues
- Problems with the usual approach
- A proposed solution
- Results
- Conclusion

# THE ISSUES

# SA's dire Report Card

- Lowest Maths and Science scores of 46 countries in TIMMS
- Lowest numeracy scores in 12 African countries in MLA study
- Mediocre performance in SAQMEC study
- ***Need to understand what drives achievement to guide policy decisions***

# The economists approach

- Educational production function

$$Y = \beta_0 + \beta_1 p + \beta_2 h + \beta_3 s + \beta_4 t + u$$

- Where  $Y$  represents student achievement,  $p$ ,  $h$ ,  $s$  and  $t$  are vectors of pupil, household, school and teacher characteristics that have an impact on educational achievement and  $u$  is the residual.

# **THE PROBLEMS WITH EDUCATIONAL PRODUCTION FUNCTION**

# Problems with Educational Production Functions

- Mixed evidence on relationship between resources and achievement
- Major methodological issues
  - Omitted variable bias
  - Selection Bias
  - Measurement error

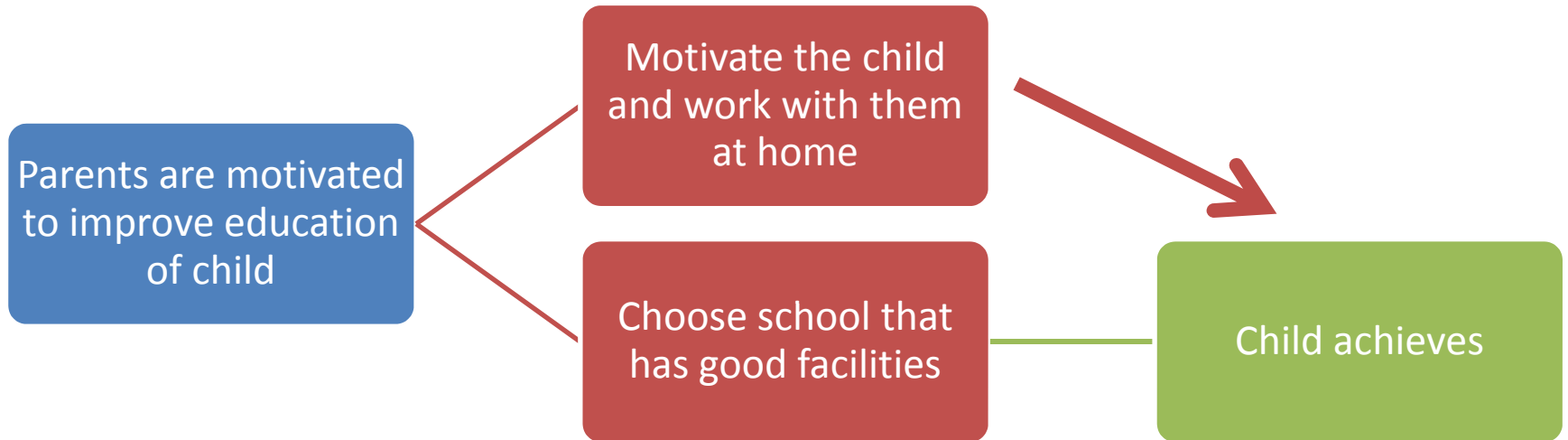
# Omitted student level variable



# Omitted student level variable

- Eg. Variation in student achievement based on their intrinsic capabilities
  - IQ tests or refinements of such tests to control for innate ability
  - Panel data to get better estimates of determinants of achievement

# Omitted school level variable



# Omitted School level variable

- Unobserved parental tastes for education could result in children from homes with a keen interest in education being sent, on average, to schools with better facilities or resources. However, these factors could also impact on student achievement directly.
  - Proxy variables.
  - Instrumental variable (IV)

**A PROPOSED (PARTIAL) SOLUTION**

# Three regressions

- OLS regression- partial correlation
- School fixed effects regression- to assist with school level omitted variables
- Student fixed effects regression- to assist with student level omitted variables
  
- Data: TIMSS 2003

# School fixed effects regression

- Uses within-school transformation, while controlling for certain variables.
- Measures the deviation from the mean *within* a school.
- Takes away effects of school selection

# Student fixed effects

- Regress the difference in scores between mathematics and science against the differences in subject specific variables such as teacher variables.
- Reduces impact of subject invariant characteristics such as intrinsic ability

# **THE RESULTS**

# Overall

- Effects of omitted variable bias and school selection very strong
- Results from OLS regression are altered significantly
  - Eg. No of Books in a household
  - Eg. Extra lessons
  - Eg. Class size

# OLS regression- select school level variables

- Similar results to other SA studies
- SES of school
- Shortage of electricity and heating significant
- Provincial variables important

# School fixed effects regression

## Within schools variation

- Age
- Family income proxies- basic amenities matter, possessions don't
- Language is key
- Maternal education important

# Student fixed effects

- Class size
- Teacher characteristics such as education and experience are important

**CONCLUSION**