Education Markets: Part 1

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This lecture is Part 1 of a two part series on “Education Markets”, jointly with Asim Khwaja. It is based on joint work with Tahir Andrabi, Natalie Bau, Asim Khwaja and Naureen Karachiwalla.

Preliminaries

1. Slides accompany Lecture 7 of the education module titled “Education Markets” and are best viewed together with the lecture
2. This is Part 1 of a 2-part lecture with Asim Khwaja (Harvard University)
3. Technical slides are marked with a (**): There are many more slides than I will cover, this is so that you can use them for reference or return to them at your leisure

Updates: This is V1, dated 2/17/2022

1. These slides will be **updated** at the end of May: Please download the latest versions at that time
2. At that time, you will also have access to papers discussed in these slides from the LEAPS website, to which the slides will contain a link (LEAPS is the Learning and Educational Achievement in Pakistan Study)
    1. From there, you can also download data and additional instructional resources
3. I will hyperlink to papers discussed here; these hyperlinks will be updated by the end of May

What we will cover in this lecture

- Many children in low-income countries now live in settings with substantial school choice
- We call these “Education Markets”
- This means that
  - Parents and children choose what schools to go to
  - Schools choose to respond to parental demand in what they offer and at what price (if they can charge fees)
- **This lecture** will
  - Discuss what this environment looks like in terms of schooling options
  - Show how the lens of “Education Markets” changes how we think of key policy and research questions
- **Lecture 8** will examine now to improve outcomes in education markets
- We will start with a brief aside on the broader picture of education in low-income countries

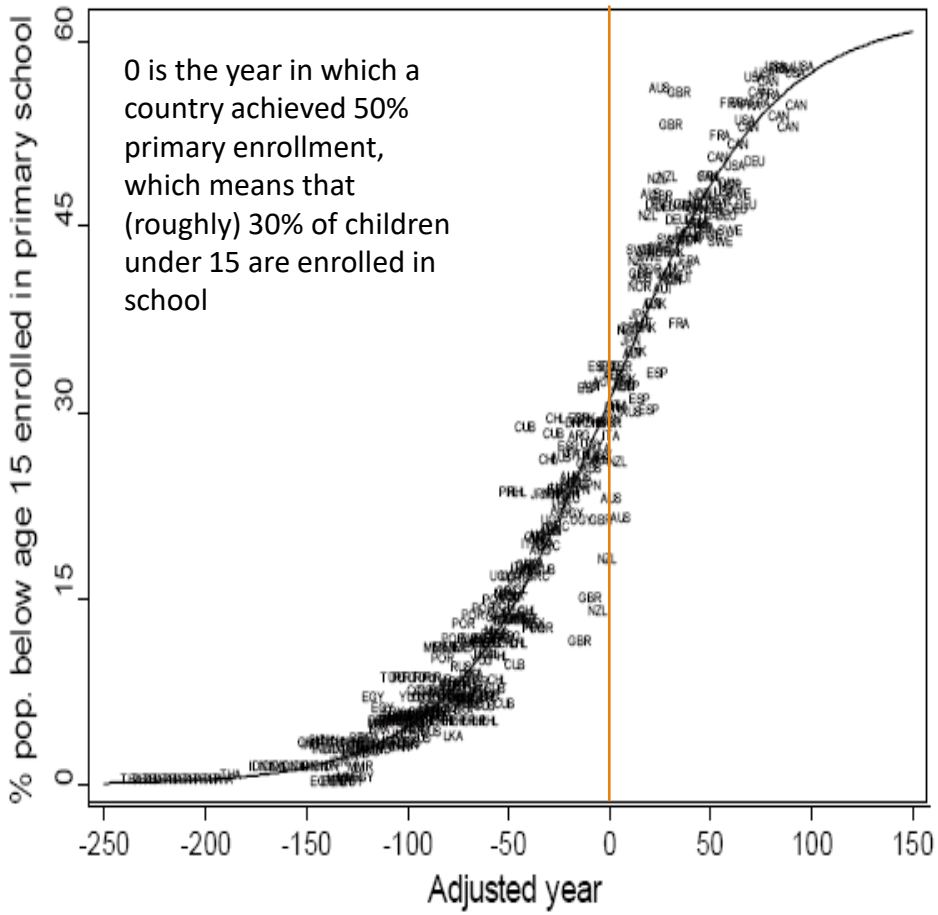
Education: The view from 30,000 feet

"25 million _____ adults cannot read the poison warnings on a can of pesticide, a letter from their child's teacher or the front page of a daily paper. An additional 35 million read only at a level less than equal to the full survival needs of our society. Together these 60 million people represent more than one-third of the entire adult population."

--Jonathan Kozol, Illiterate America (1985)

- Sizeable fractions of the population cannot read and/or do basic math required to function in society
- Although countries are reforming constantly (and spending more money on education), quality of schooling has been very hard to improve
- Low-income countries have done exceptionally well compared to todays' high-income countries and have recovered from the destruction of their schooling systems under colonial regimes in record time

Enrollment increases in today's high income countries took a long time



Michael Clemens has investigated the historical experience of enrollment increases around the world

The picture on the left shows that historically, enrollment increased in a fairly uniform manner

From

- 50% => 70% it took around 22 years
- 70%=> 80% it took around 36 years
- 80% =>90% it took around 58 years

What is the experience of low-income countries?

NOTE: I thank James Habyarimana for this reference

Example 1: Burkina Faso

Burkina Faso: A country that was "severely off-track" to meet the MDG targets

- 36% net ER in 2000
- 59% in 2015 (expected)

If it were growing at the 19th century transition rate

- 45.4% in 2015

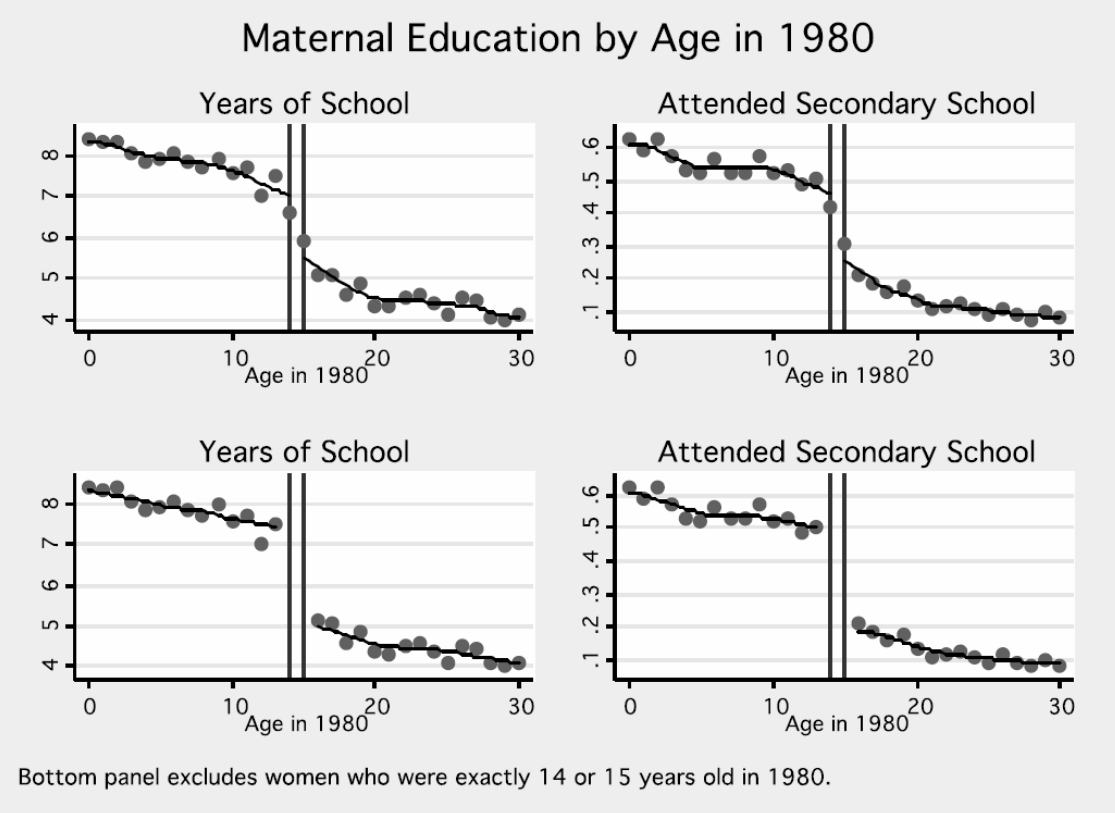
At the typical post-1950 rate

- 49.4% in 2015

What was the actual experience?

- 69% in 2015 (actual)
- 78% in 2018 (actual)

Example 2: Zimbabwe



This improvement is even *more* remarkable when we realize that many countries received their independence from colonial rule only in the last 70 years

- And once they did, they invested heavily in education

Prashant Bharadwaj & Karen Grepin have looked at the experience of Zimbabwe

They show that schooling expanded phenomenally with independence in 1980

Example 3: India

Historians have assembled data for the Madras Presidency, and their best estimates suggest that

- The presidency was *more* illiterate in 1930 than it used to be in 1820
- In 1825, the state of education in Madras Presidency was significantly better than England in 1800

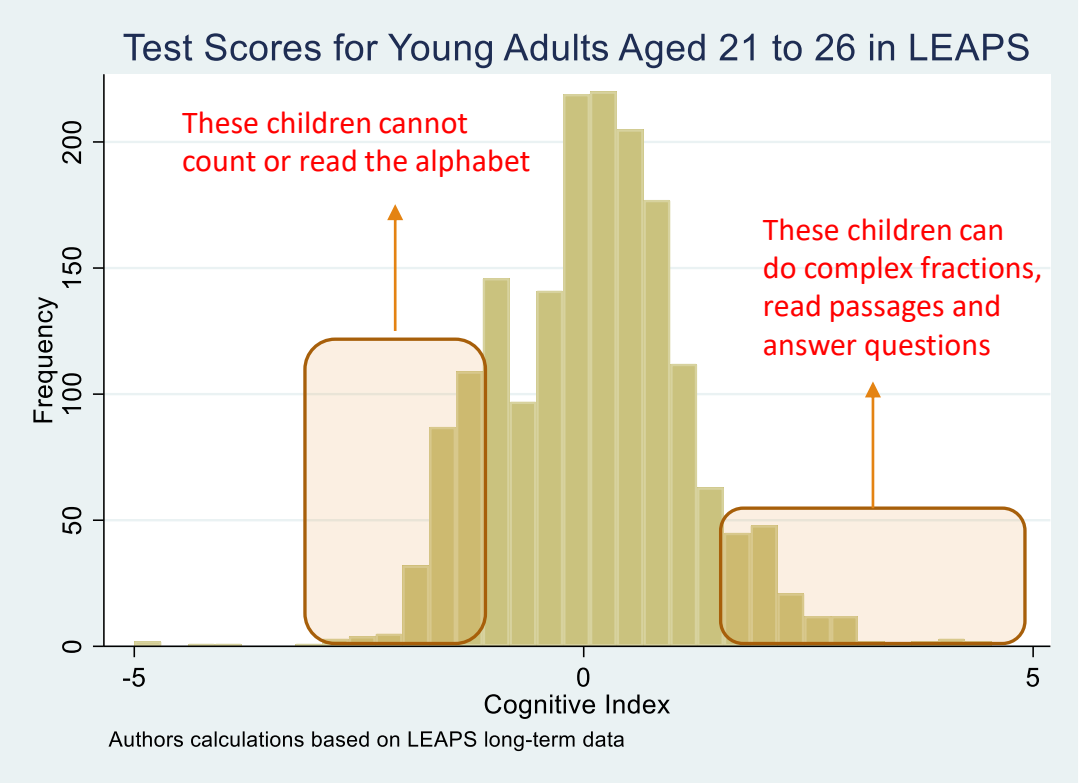
The historian Dharampal writes in "The Beautiful Tree"

"Prior to 1770, (by which time they had become actual rulers of large areas), the British (..) interests, as in the subsequent period too, were largely mercantile, technological, or were concerned with comprehending, and evaluating Indian statecraft; and, thereby, extending their influence and dominion in India. Indian religions, philosophies, scholarship and the extent of education—notwithstanding what a few of them may have written on the Parsis, or the Banias of Surat—had scarcely interested them until then.

(…) The main reason for this, however, lay in the fact that the British society of this period—from the midsixteenth to about the later part of the eighteenth century—had few such interests. In matters like religion, philosophy, learning and education, the British were introverted by nature. It is not that Britain had no tradition of education, or scholarship, or philosophy during the 16th, 17th, or early 18th centuries. However, this considerable learning and scholarship were limited to a very select elite."

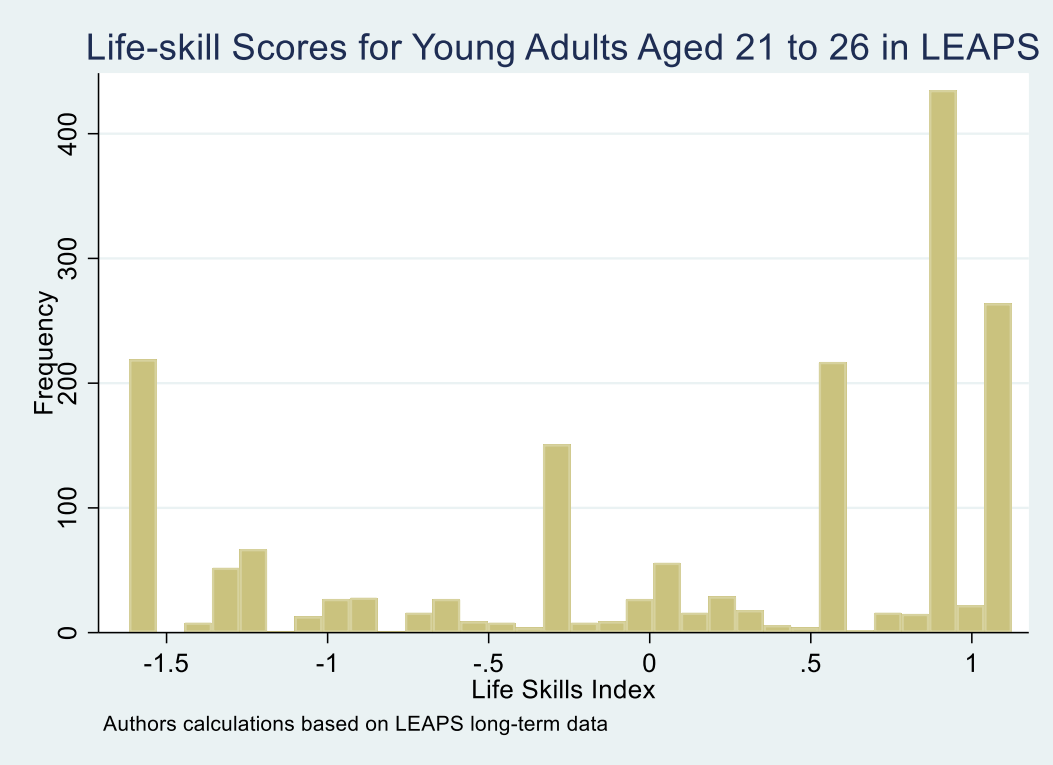
After independence India had to remake an education system that had been significantly undermined in the previous 150 years

What is the situation today?



- Enrollments have increased, but learning is lagging behind
- **BUT** the fact that children have problems with reading and math does not mean that *all* children are doing equally poorly
- Graph on the left shows a histogram of test scores among young adults aged 21 to 26 in LEAPS
- While there are some young adults who are indeed doing poorly, others are doing significantly better
- We find exactly the same patterns for functional skills like buying vegetables, paying electric bills or reading text messages
- What is driving this variation?

Variation among functional skills among young adults



Life Skills Questions

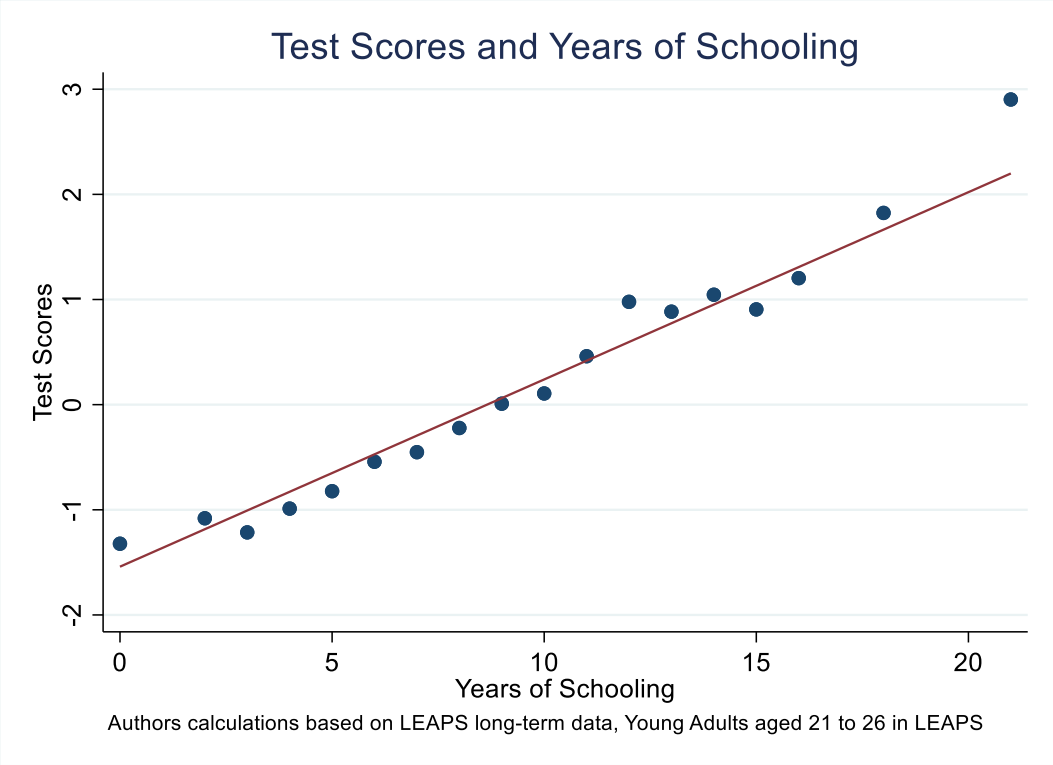
1. Electricity Bill: Read an electricity bill with increasingly complex calculations
"Meter reading is 2500 kV units. The first 500 KV will be charged at Rs. 10 and any KV units more than 500 will be charged at Rs. 20. Late fee of Rs.500. Compute amount due before/after due date"

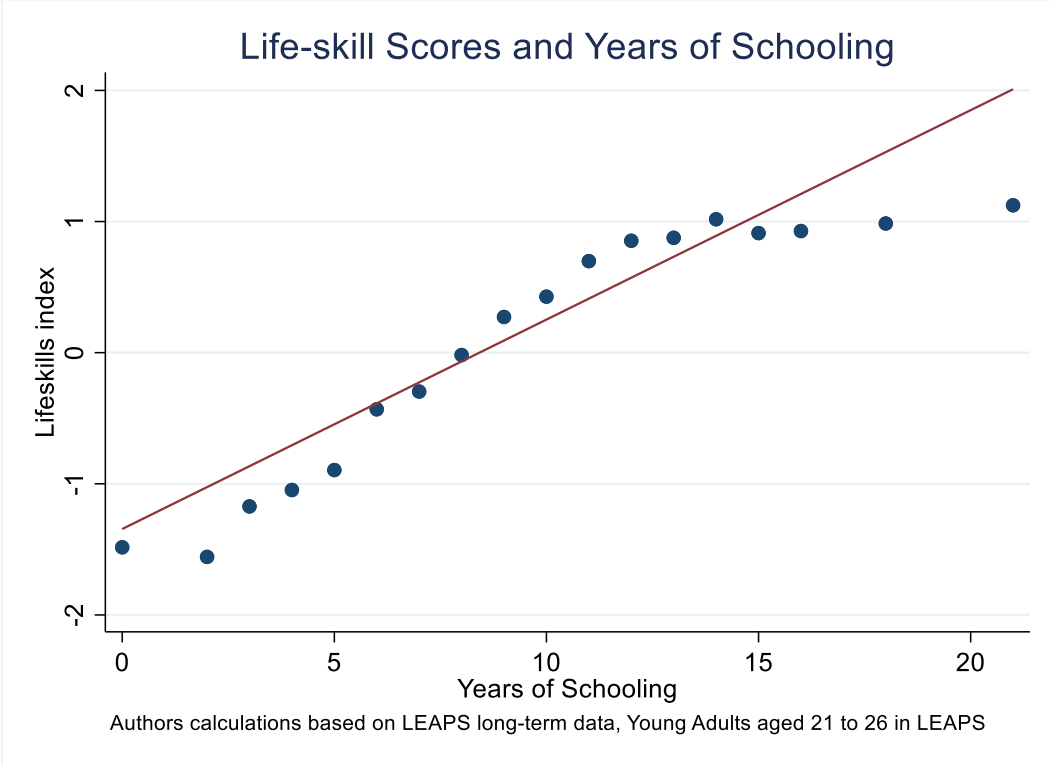
2. Text Messages: Increasingly complex text messages in both Roman Urdu & Urdu.

"Most complex: Friend, I am stopped outside the village and my motorcycle has broken down. Can you pick me up?" [Urdu: *Yaar mein gaon se bahir ruka huwa hoon aur meri motorcycle kharab hogayi hai. Kya mujhay lenay aasaktay ho*?]

3. **Market Shopping:** Shop for different amounts and then receive change for some money (different items have different prices for different quantities)

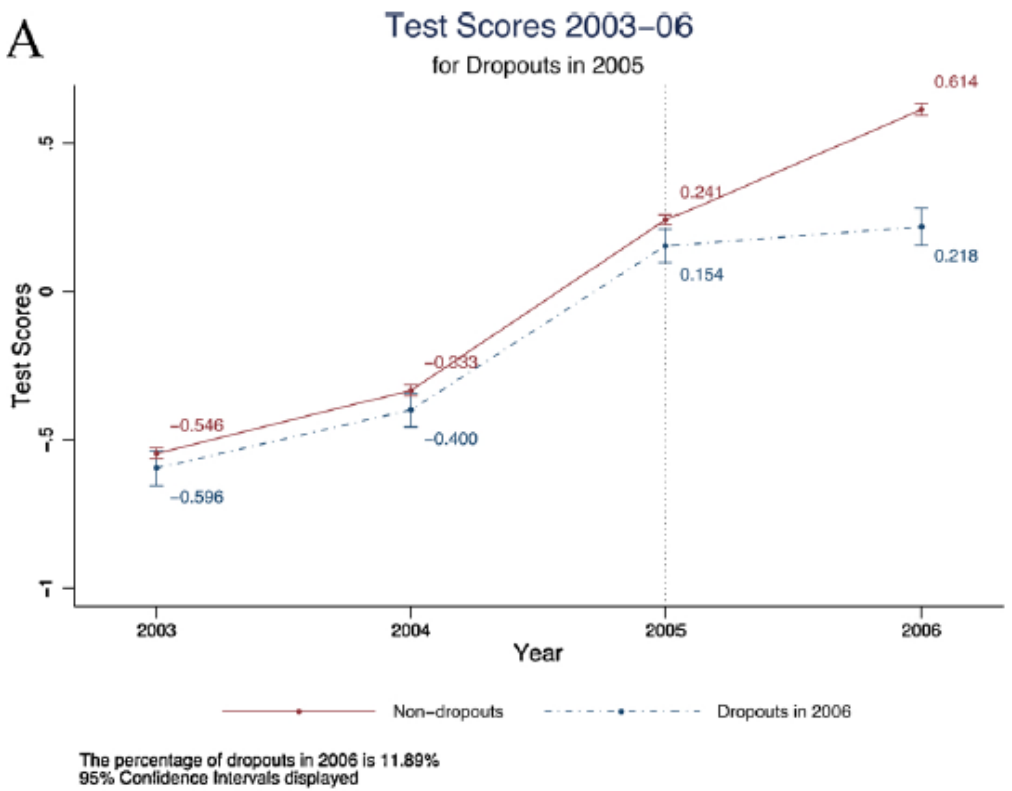
This variation is correlated with schooling





In the LEAPS data, it is very clear that children with more years of schooling have higher test scores and better life-skills as young adults

This does not reflect just selection into schooling



One reason for this correlation could be that children who continue in school are fast learners—and would have learnt all this naturally, as they age

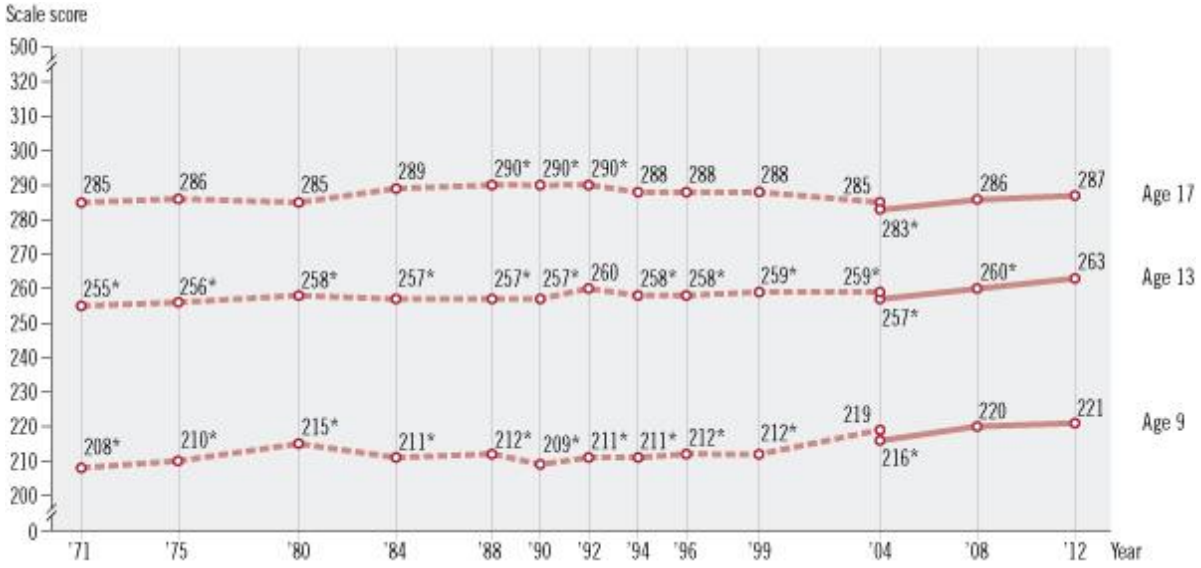
Bau, Das & Yi Chang show that children who dropout in LEAPS

- Were on same test score trajectory as those who stayed in school
- BUT see immediate and sharp reduction in learning compared to those who remained

- Very likely that schooling `causes' learning
- Tremendous concern over school closures under Covid-19 and increasing evidence of learning loss confirms that children are learning *something* in school

What are the next steps for low-income countries in this journey towards recovery?

- Can we create the institutions and ecosystems that spur innovation in order to speed up learning and improve productivity
- Remind ourselves that the stakes are very high and there are no obvious lessons to be drawn from high-income countries
  - Over the last 50 years, test scores have remained flat in countries like the United States and
  - Cost of schooling increased → productivity of schools has declined.



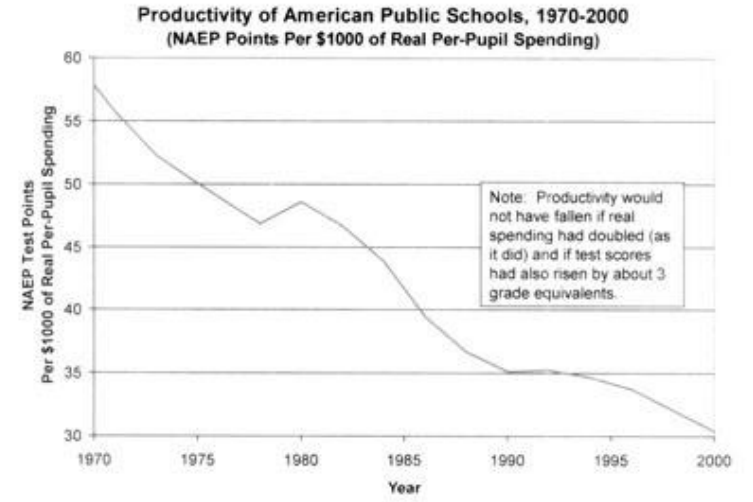


Figure 4. Productivity of American public schools, 1970–2000 (NAEP points per $1000 of real per-pupil spending). Source: Author's calculations using U.S. Department of Education (2003e, 2004) and U.S. Department of Labor (2004) data.

Question Break

Post-Break agenda

1. Context: Schooling Markets
2. School Value-Added: Estimation and Findings
3. A model of strategic quality investments
4. Implications of the model
   - Implications for estimates of `private school effectiveness'
   - Implications for programs like vouchers
   - Implications for investments in public schools
5. Concluding discussion

Context: Pakistan

We will focus on Pakistan, and within Pakistan, the province of **Punjab**

Punjab is the largest province in Pakistan, with a population of >100 million

By some measures, its schooling system is the 12th largest in the world, with 14 million children enrolled just in public schools

Punjab has also been

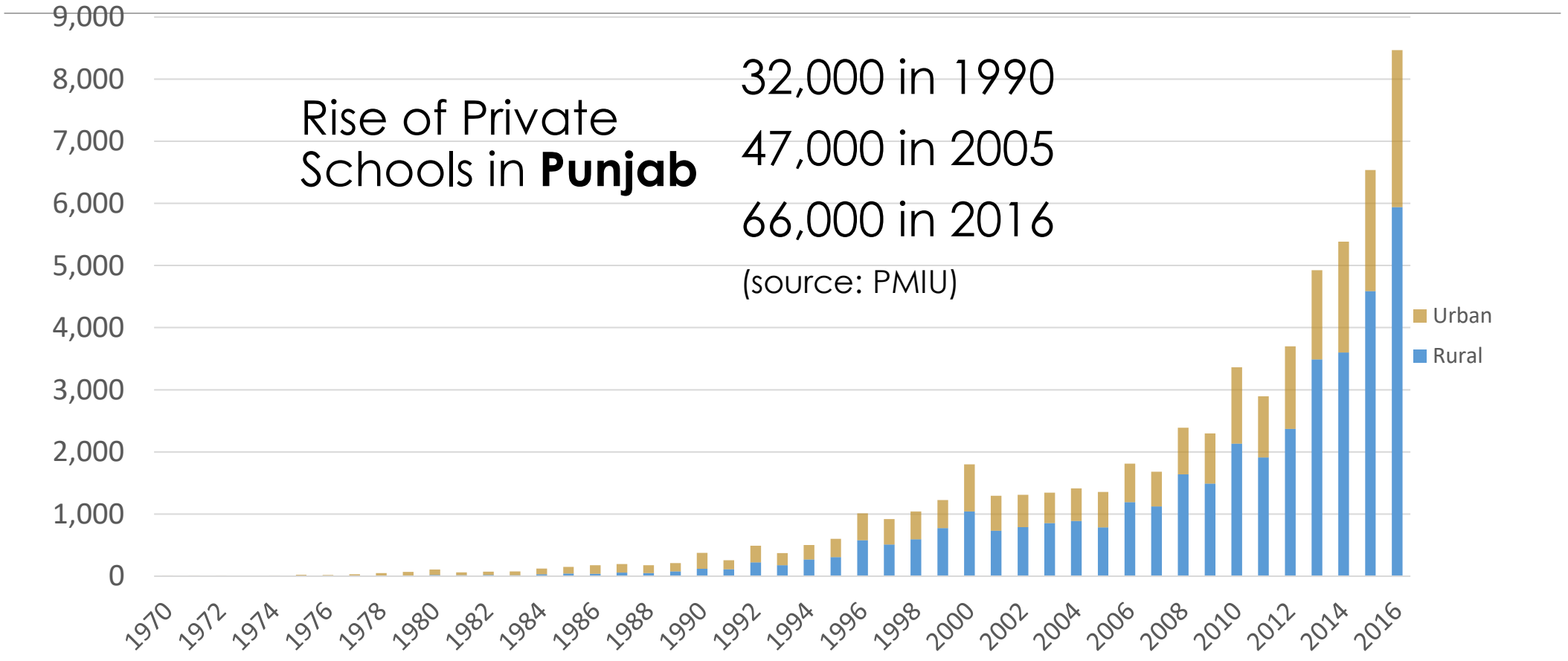
- A hub of school reform
- Home to the largest panel data on learning and schools in a low-income country, from 2003-2018 (The Learning and Educational Achievement in Pakistan Schools or LEAPS project)
- Large volume of research, including on the economics of education

Context: Multiple Educational Institutions

2017 Distribution of Schools & Students in Pakistan

	Total	Public	Private
# of Students	47.5 million	27.5 million (58%)	20 million (42%)
# of Institutions	303,446	191,170 (63%)	112,275 (37%)

Private Schools Established in Punjab by Year



Rise of Private Schools in **Punjab**

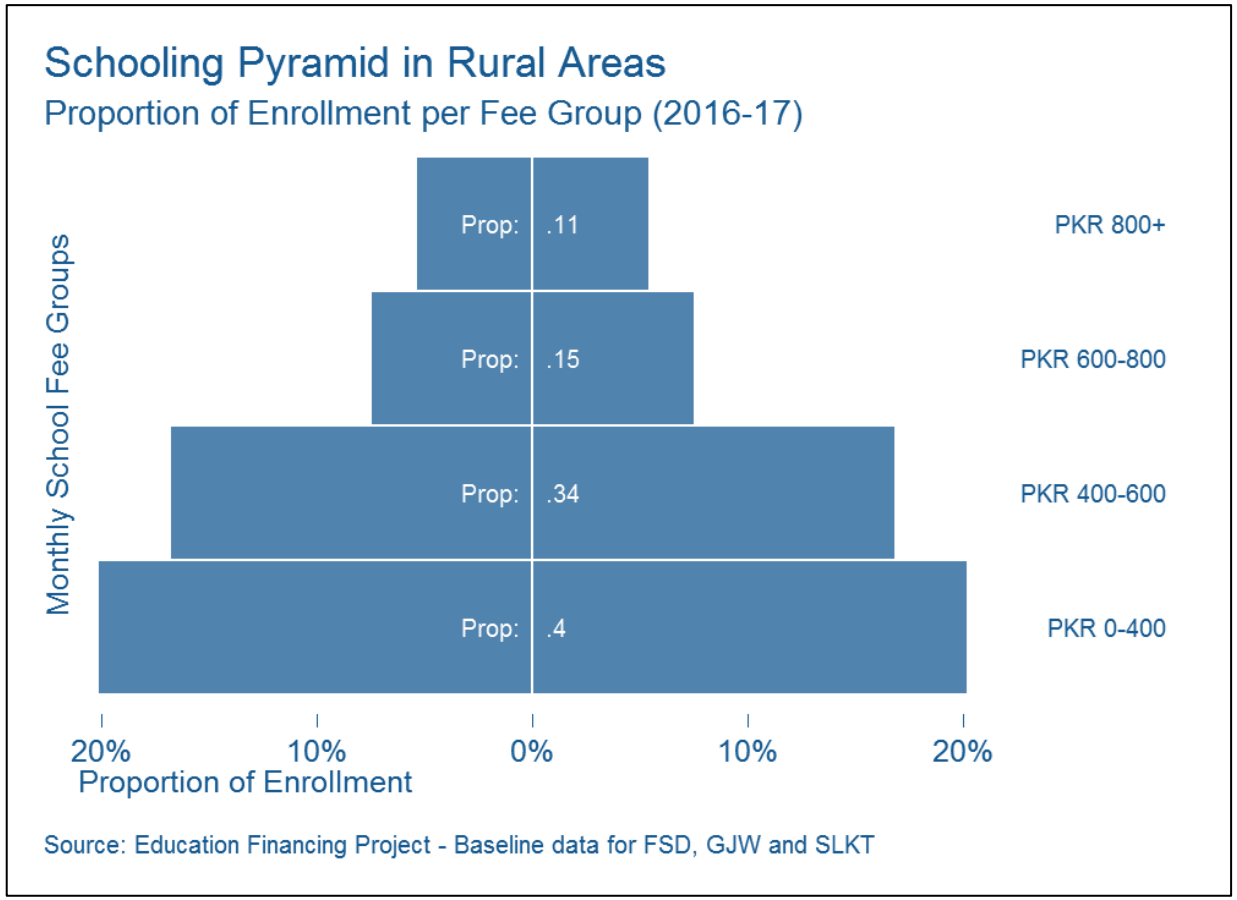
32,000 in 1990

47,000 in 2005

66,000 in 2016

(source: PMIU)

School Fees



Public Schools are all free, with a minimal annual `admission fee'

Private Schools charge prices that they determine, with little to no regulation or subsidy during the time of the LEAPS study

(This is still largely true, but a 3rd group of private schools that are supported through public subsidies has also arisen—and are a much higher share of the market in countries like Chile, and now in India)

A Typical Village in Punjab

Dense choice environment

Key

- Private Schools
- Public Schools

Context: Schooling markets

The rise of private schools combined with a focus on equity that led to substantial investments in public school construction has fundamentally changed the schooling environment

- More than 70% of the children in *rural* Punjab live in areas where they can access multiple schools within a walking distance
- This is also true for other countries in South Asia and urban Africa, but not necessarily rural parts of other countries
- It is possible that this trend will spread to other countries—but harder to tell post-Covid
- You can read more about the context and various papers describing this education system here, here and here

Schooling Market: Description

Education market are characterized by multiple schools within the same geographical area who differ in their characteristics.

Consumers choose based on these characteristics, leading to allocation of market share among schools.

One set of big questions we are interested in is:

- Do these schools differ in test-score based quality and if so,
- How significant are these differences?
- Do parents react to these differences?

If the answer to each of these questions is yes, it is likely that schools investments in quality reflect strategic positioning in the market

We investigate these questions in the LEAPS data, following Andrabi, Bau, Das & Khwaja (2022)

What data do we use?

SURVEY DATA: Collected from 112 villages as part of LEAPS project, yearly from 2003/04-2006/07
- Sample restricted to villages with at least 1 private school
- Additional year of data collection in 2011

SCHOOL SURVEYS: Surveyed all schools in the village each year
- More than 800 schools in these 112 villages!
- School infrastructure, GPS coordinates, teacher information
- Children tracked as they move between schools

TEST SCORES: Researcher-administered tests for two cohorts of children (3rd graders in 2003/04 and 2005/06)
- Yearly scores for Math, English and Urdu (vertically linked tests)
- Civic scores in 2004

Test scores consistent with low levels of learning, but growth over time (BAU, DAS ANDRES YI CHANG 2020)

How do we define school quality?

Focus on School Value-Added (SVA) as a measure of test-score based quality

Defined SVA≡ “Increase in test scores that a *randomly selected child* will experience in the school”

Standard problem: Suppose the children who learn faster go to School A and others go to School B. Then, increases in test scores are higher in School A, but this reflects the student body and *not* the SVA.

Proposed Solution: Use a rich set of controls over past test scores to (perhaps) eliminate sorting

Check: Devise an *out-of-sample* test to assess the validity of the proposed solution

How do we estimate school value-added (SVA)

SVA ≡ Increase in test-scores that a randomly selected child will experience in a given school

Key estimating equation

- $y_{igst} = \beta_0 + \lambda_g y_{igs,t-1} + \alpha_s + \alpha_g + \alpha_t + \varepsilon_{igst}$

Where

- y_{igst}: test score of student i in grade g of school s in year t
- $y_{igs,t-1}$: lagged test score
- α_g: grade fixed-effects
- α_s: school fixed-effect or our estimate of SVA
- α_s is unbiased as long as sorting into school is not related to unobserved student characteristics (conditional on flexible controls for past test scores)
- Computing Var(SVA): use empirical Bayes to shrink estimates to account for potential measurement error to compute Var(SVA) OR when using SVA as a dependent variable

How do we know that our estimates are valid?

FORECAST UNBIASEDNESS #1: Out-of-sample validation on switchers

- Idea: Suppose we know SVA of sending and receiving school for children who switch. Then, for children who switch schools, check if SVA predicts test score gains in year of switch and thereafter with coefficient 1, but never before switch

FORECAST UNBIASEDNESS #2: Use school closure to instrument for SVA

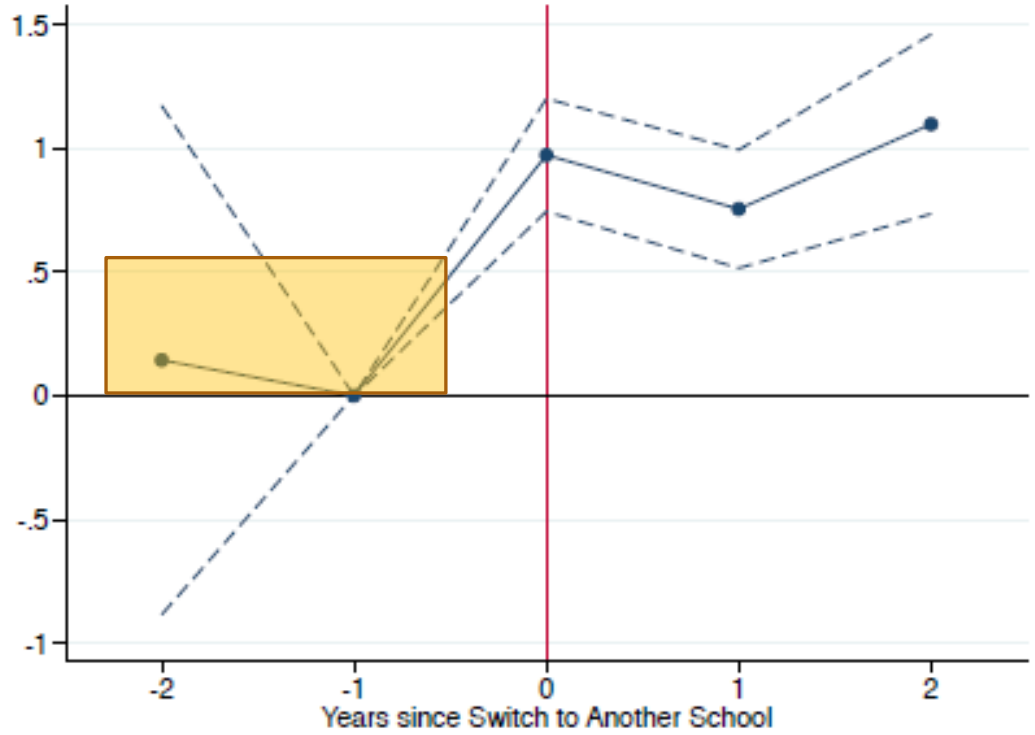
- Idea: Suppose we have exogenous variation in attendance from another source (private school closures). We can instrument for SVA in new school using school closures and see if SVA in new school predicts test score gains perfectly

SCHOOL-LEVEL UNBIASEDNESS: Overidentification test with school closure instrument (Angrist et al. 2017)

- Idea: Previous tests tell us that SVA is unbiased *on average* (if valid). But some SVAs could be biased in one direction and other SVAs biased in the other, cancelling out on average. Present results from an overid test using school closure instruments.

Result from all 3 tests show that SVA valid and unbiased

Validation #1: Forecast Unbiasedness



Suppose our estimates of SVA are forecast unbiased

We should be able to predict how much a child will gain/lose if they switch schools by comparing the SVA of the school they join

Examine test score gains of children who switch, regressed against predicted gain from SVA in event-study framework

Coefficient is 0 prior to switch

Cannot reject that coefficient = 1 at switch and after

Validation #2: Overidentification test(**)

Following ANGRIST ET AL. (2017), exploit the fact that identification assumptions of SVA + IV create overidentifying restrictions, which can be used in a 2SLS-style overidentification test

- Create 26 instruments by interacting $closure_{it}$ with village fixed-effects
- Intuitively, verify that SVA estimates correctly predict the effect on a student of attending a different school in village *j* due to a closure

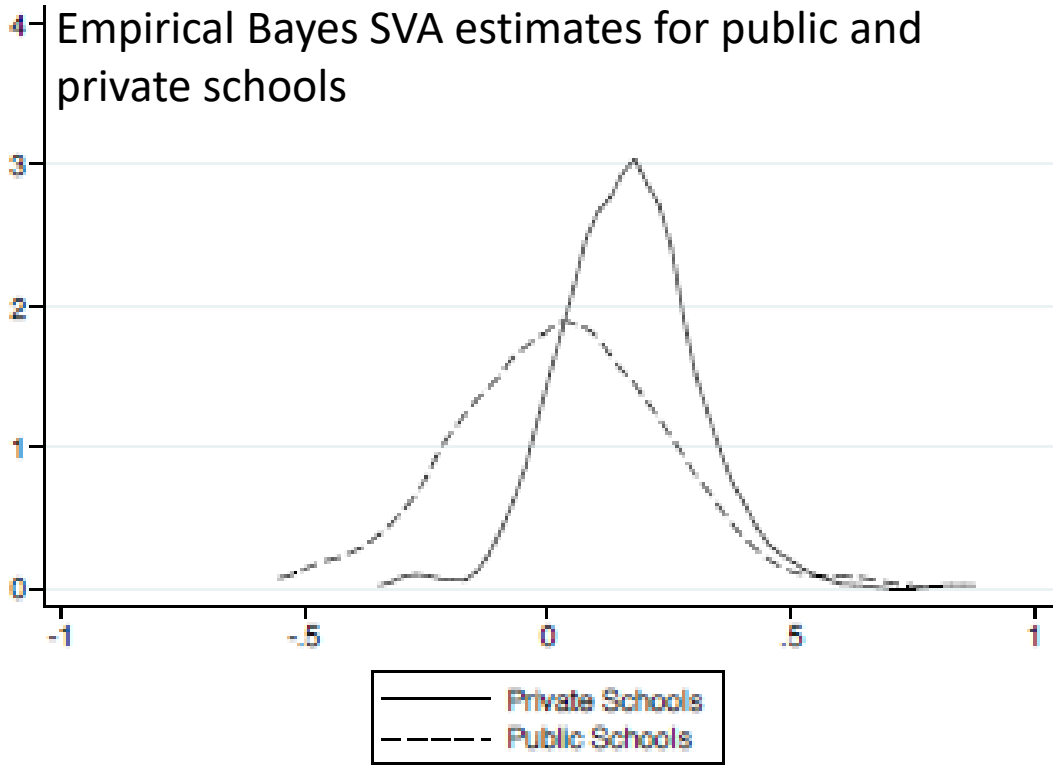
	(1)	(2)	(3)
	Dep. Var.: Mean Test Scores		
	Uncontrolled	Value-Added	Value-Added (UJIVE)
Forecast Coefficient	0.475***	0.977***	1.296***
	(0.126)	(0.120)	(0.260)
p-value (Forecast Coefficient = 1)	0.000	0.852	0.256
Overid Chi^2(24)	17.364	0.035	–
p-value (Overid)	0.000	0.896	–
First Stage F-Stat	6.804	15.015	15.015
Number of Villages With Closures		25	
Student-Year Observations		10,487	

Cannot reject SVA are forecast unbiased

Does not reject the overid restrictions implied by the model

Conclude that SVA estimates are valid in our context

Results: How much does SVA vary?

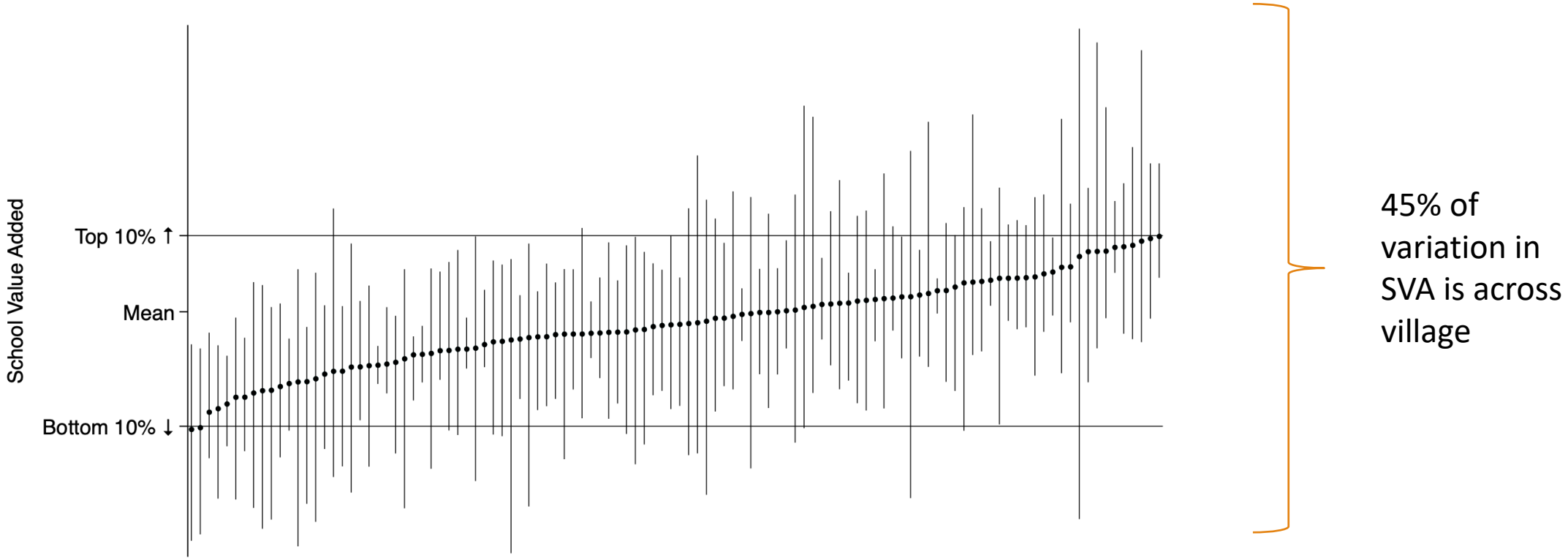


Attending a 1sd better

Private school increases mean test scores by 0.21 (student test scores) sd

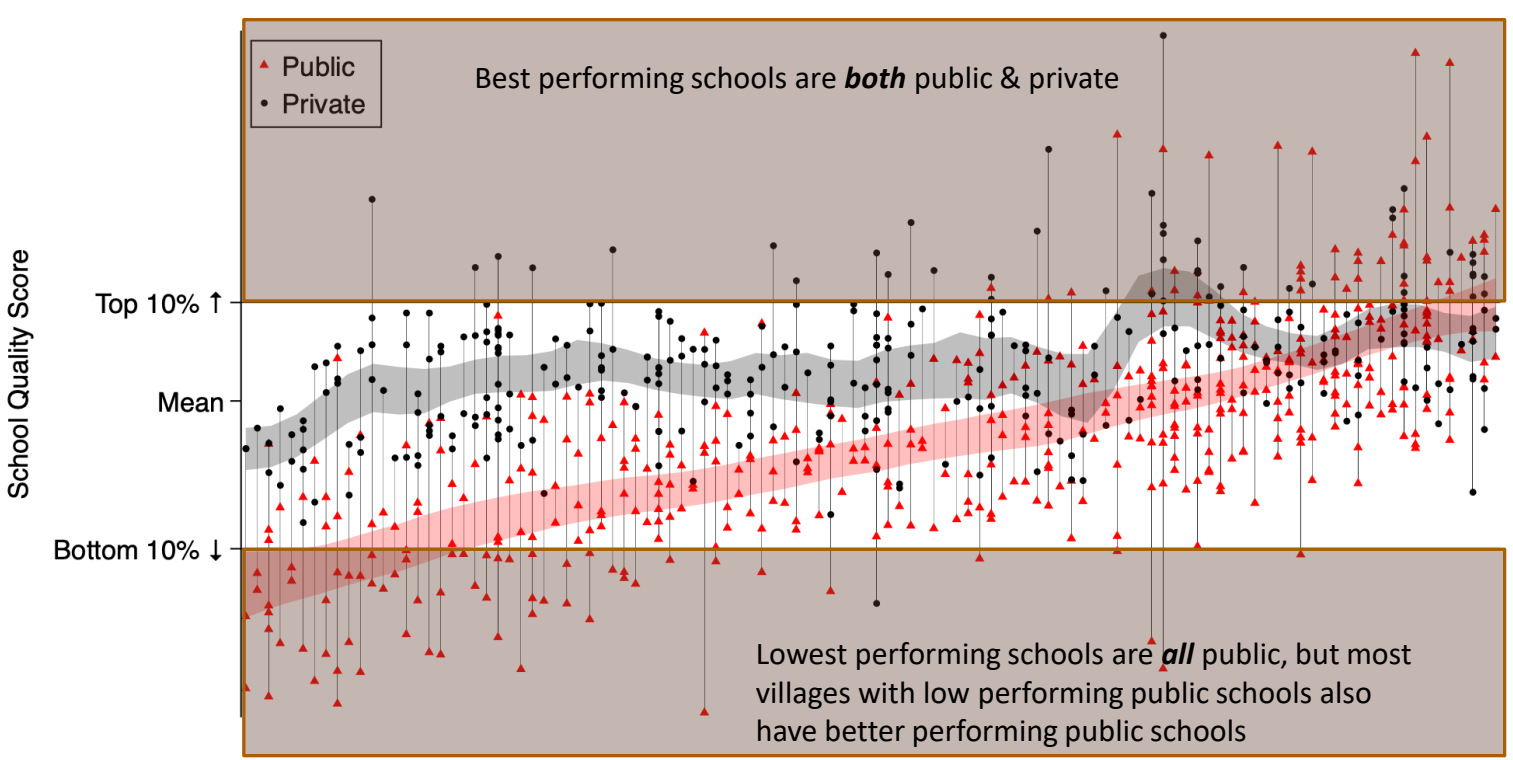
Public school increases mean test scores by 0.32sd—driven by poorly performing lower tail

Results: SVA varies within the village



Every village is shown, sorted by average school quality. Vertical bars show the entire range of SVA.

Results: SVA varies within village & sector



45-46% of SVA variation for public and private sector respectively is within village

Pink: public schools; Black: private schools. All villages and all schools shown, sorted by average quality of public schools in the village

There is no `single' estimate of private school effectiveness

Villages have multiple public and private schools that parents choose from

Quality varies *within* village and sector

This creates treatment heterogeneity:

'Private school effect' depends on quality of sending & receiving school, ranging from min. of 2 to max. of 8 in figure

There is no `single' estimate of private school effectiveness

	Public to Best Private			Public to Worst Private		
	(1) p(10)	(2) Mean	(3) p(90)	(4) p(10)	(5) Mean	(6) p(90)
Math	-0.108	0.211	0.522	-0.226	0.072	0.377
English	-0.118	0.307	0.715	-0.315	0.087	0.497
Urdu	-0.012	0.227	0.472	-0.114	0.086	0.304
Mean	-0.063	0.248	0.548	-0.218	0.082	0.359

Consider policies that reallocated children from public to private schools *within the same village*

Depending on how the policy reallocates children, we can get very different *causal* treatment effects of private school effectiveness due to treatment heterogeneity

Mean: Average across all individual-level treatment effects

P(10) and p(90): treatment effects at 10th and 90th percentiles (distribution because quality of current public school also varies)

Correspondence between average and distributional estimates

Any *average* estimate combines the distributions of SVA in the public and private sector with a specific reallocation of children across schools

- This reallocation can be explicit, from a policy such as vouchers or school closures
- It can also be implicit, such as compliers in an IV estimator

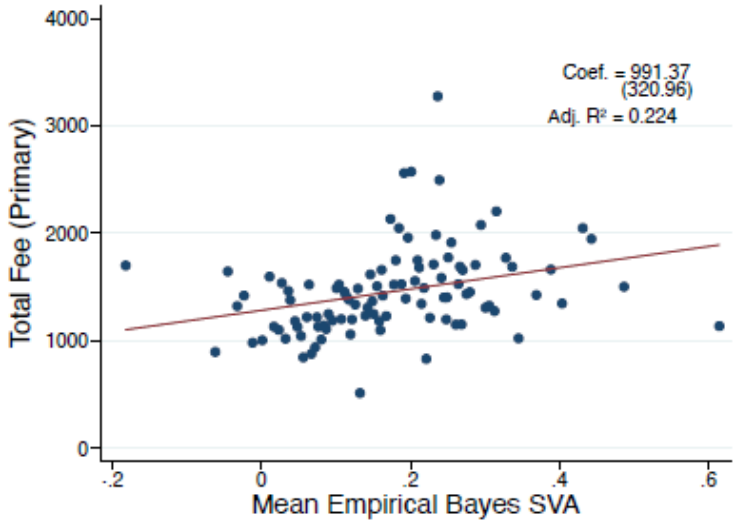
Andrabi et al. (2022) evaluate 3 such estimators, using children switching schools, private school closures and a distance-based IV and show that in the LEAPS data all implied reallocations lead to positive average estimates of private school effectiveness, ranging from 0.15sd to 0.30sd

- Practically, this implies (for instance) that when children move, we never see them move from a well performing and free public school to a poorly performing and fee-charging private school

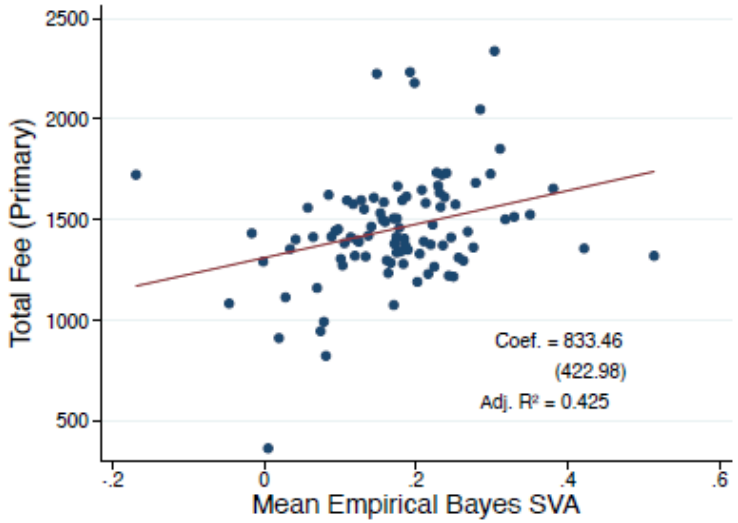
Do parents respond to SVA?

If parents respond to SVA, we should see some relationship between SVA and prices in private schools

In fact, SVA and prices are highly correlated



(a) District Fixed Effects

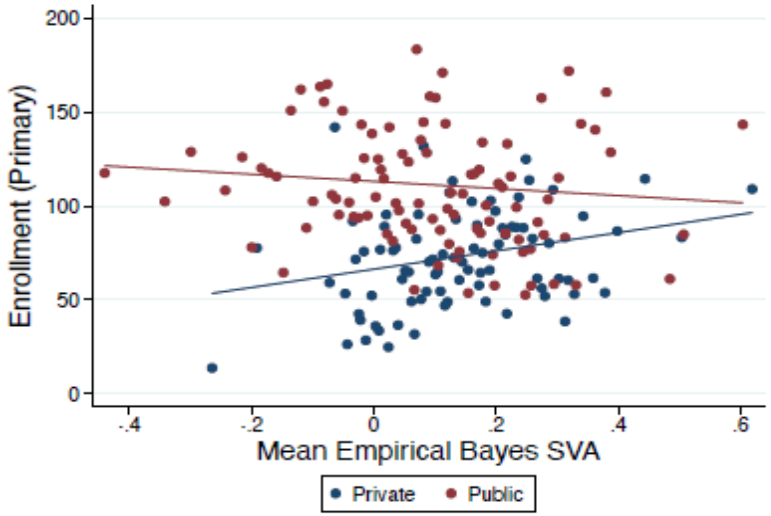


(b) Village Fixed Effects

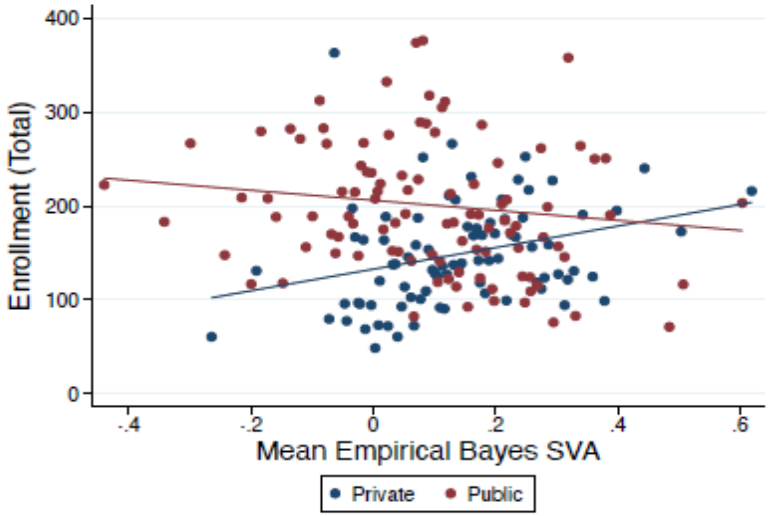
SVA and enrollment

SVA and enrollment are also correlated—but only for the private sector

Correlation between Enrollment and SVA (Empirical Bayes)



(a) Primary Enrollment



(b) Total Enrollment

Does SVA predict market evolution between 2003 and 2011 in LEAPS?

	Δ Market Share 2006-11	Test Scores 2011	Closure 2011		
	(1)	(2)	(3)	(4)	(5)
Panel A: All Schools					
Emp. Bayes SVA	0.041***	0.709***	-0.177**		-0.166
	(0.014)	(0.180)	(0.074)		(0.119)
Market Share 2003				-0.660***	-0.676***
				(0.113)	(0.118)
SVA × Market Share 2003					-0.155
					(0.569)
Sample Mean	-0.008	-0.092	0.155	0.147	0.147
Adjusted R^2	0.009	0.354	0.101	0.135	0.141
Observations	780	661	794	754	754
Clusters	112	112	112	112	112

Higher SVA schools increase market share

SVA predictive of test scores 6-8 years later

Higher SVA schools less likely to exit

"Penalty of smallness"

Evolution of private schools

	Δ Market Share 2006-11	Test Scores 2011	Closure 2011		
	(1)	(2)	(3)	(4)	(5)
Panel B: Private Schools					
Emp. Bayes SVA	0.061*	0.802*	-0.627***		-0.930***
	(0.031)	(0.416)	(0.205)		(0.333)
Market Share 2003				-1.089***	-1.609***
				(0.271)	(0.524)
SVA × Market Share 2003					3.043
					(2.152)
Sample Mean	-0.002	0.352	0.282	0.281	0.281
Adjusted R^2	0.009	0.259	0.034	0.046	0.075
Observations	309	223	319	285	285
Clusters	108	98	108	108	108

Evolution of public schools

	Δ Market Share 2006-11	Test Scores 2011	Closure 2011		
	(1)	(2)	(3)	(4)	(5)
Panel C: Public Schools					
Emp. Bayes SVA	0.035**	0.576***	-0.087		-0.031
	(0.017)	(0.202)	(0.061)		(0.113)
Market Share 2003				-0.483***	-0.492***
				(0.120)	(0.117)
SVA × Market Share 2003					-0.372
					(0.557)
Sample Mean	-0.012	-0.317	0.069	0.066	0.066
Adjusted R^2	0.001	0.236	0.046	0.093	0.095
Observations	471	438	475	469	469
Clusters	112	112	112	112	112

Summary

SVA can be feasibly computed in our context & is forecast unbiased

There are large variations across schools in SVA: Half this variation is *within* village/market and *within* sector

This implies *feasible choice*: Parents have to make active decisions of where to enroll their children, how far to send them and how much to pay

In making these choices, parents seem to care (enormously!) about SVA in the private sector

Curiously, the evidence that they factor SVA in the public sector into their decisions is weak

In line with evidence from the United States and Romania

At the minimum, this implies that we can think of private schools as making strategic quality choices to position themselves in the market

We now think about how that can be modelled and the central trade-off that schools face

Question Break

When we return

- How should we think of schools choosing their strategic investments in quality
- What are the implications of this way of thinking for investments in *public* schools

Theory

Theory provides a structured way to think of the schooling market—and schooling decisions among parents and schools

Models can provide a key intuition to take to the data or illustrate processes/channels that we need to pay attention to in understanding data/policy even if we are not testing the model

I will sketch models of how schools might make decisions

In these models, parents choose among schools with different characteristics, and schools have to choose how to respond to these demands

A central intuition is that if schools choose the same characteristics, they will have to price the same and each will undercut the other till they earn zero profits

But, if they differentiate themselves from each other, then they can earn positive profits since each enjoys some market power

This differentiation can be of two types—horizontal or vertical

Types of differentiation

KEY POINT: In the classic Hotelling model of ice-cream sellers and consumers located along a street, 2 ice-cream sellers will both set up in the middle and split the market, earning zero profits. This is because they can't change the price.

Allowing them to set price sets off a trade-off: should I locate closer to my competitor and get more consumers but also engage in more intense price competition or should I differentiate myself and soften price competition, but potentially lose consumers

Horizontal: Even if the two schools have the same price, they are different in a way that different consumers will choose different firms. For instance, maybe one school is "English Medium" and another is "Urdu Medium" or one offers "Arts" and another offers "Computers".

Vertical: If two firms charge the same price but are vertically differentiated, then everyone will prefer one firm to the other. Think of vertical differentiation as quality—if both schools charge the same price, but one school is `better' than the other, then everyone will prefer the better school.

Theory: Vertical differentiation (**)

FIRMS: Two firms, producing quality a_1 $and a_2$ with $a_2 > a_1$ and marginal cost c

BUYERS: Buyers have willingness to pay $\theta_i \sim uniform(0,1)$. Each buyer buys exactly one unit of the good and their valuation of quality is given by the indirect utility function: $V_i = a\theta_i - p$

- Step 1: Locate the marginal buyer: $a_1\theta^* - p_1 = a_2\theta^* - p_2 \Rightarrow \frac{p_2 - p_1}{a_2 - a_1}$
- Step 2: Identify demand functions: $D_1(p_1, p_2) = \frac{p_2 - p_1}{a_2 - a_1}$ and $D_2(p_1, p_2) = 1 - \frac{p_2 - p_1}{a_2 - a_1}$
- Step 3: Maximize profits to get best response functions: $p_1 = \frac{c + p_2}{2}$; $p_2 = \frac{c + p_1 + a_2 - a_1}{2}$
- Step 4: Solve best response functions to obtain $p_2^* = c + \frac{2}{3}(a_2 - a_1) > p_1^* = c + \frac{1}{3}(a_2 - a_1)$ so that both firms earn a positive markup
- Step 4: Compute profits
- $\pi_1(p_1, p_2) = \frac{4}{9}(a_2 - a_1) > \pi_2(p_1, p_2) = \frac{1}{9}(a_2 - a_1)$
- High quality firm charges higher prices and earns greater profits, which is increasing in product differentiation

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Vertical differentiation with endogenous quality (*)

At first stage, imagine that firms can choose quality

There will be two asymmetric equilibria with maximal differentiation!

This is an incredible result as both firms have the same marginal cost—in equilibrium they both earn positive profits and locate at far ends of the spectrum

As long as products are highly differentiated in quality, firms can charge prices above markup. If their quality levels come too close, then price competition increases, decreasing profits

Note that these models are sensitive to assumptions regarding entry (zero fixed costs), the distribution of willingness to pay and the exact cost structure!

However, the basic intuition that firms will differentiate themselves in order to gain market power remains the driving force behind each of these models

Theory: Product Differentiation (**)

Hotelling's model (linear city)

- BUYERS each buy one unit of a good. They are located at different points of the city, uniformly distributed on [0,1] and very large utility, *v*, for the good
- FIRMS are located at extremes and produce exactly the same good at unit cost *c*
- PAYOFFS: Buyers travel to purchase the good. A buyer at *x* will pay $v - p_1 - tx^2$ if purchase from firm located at 0; will pay $v - p_1 - t(1-x)^2$ if purchase is from firm located at 1
  - Note: This is horizontal differentiation because at the same p, different consumers will choose to purchase from different locations

Theory: Horizontal Product Differentiation (**)

Buyers have to travel to purchase the good. A buyer at *x* will pay $v - p_1 - tx^2$ if purchase from firm located at 0; will pay $v - p_2 - t(1-x)^2$ if purchase is from firm located at 1

- Step 1: Locate x^* who is indifferent. $v - p_1 - tx^{*2} = v - p_2 - t(1-x^*)^2$
- Step 2: Note that anyone with $x\epsilon(0, x^*)$ will purchase from firm 1; anyone with $x\epsilon(x^*, 1)$ will purchase from firm 2
- Therefore: $D_1(p_1, p_2) = \frac{1}{2} - \frac{p_1 - p_2}{2t}$ and $D_2(p_1, p_2) = \frac{1}{2} - \frac{p_2 - p_1}{2t}$
- Firms max. $\pi_i(p_i, p_j) = (p_i - c)D_i$
- Solve to get best response functions: $p_i(p_j) = \frac{p_j + t + c}{2}$
- Solve to find $p^* = c + t$ and $\pi_i = \pi_j = \frac{t}{2}$
- What does this mean? Does it make sense?
- What happens when t=0
- What happens when the firms are located at the same address?

What happens if firms choose location (**)

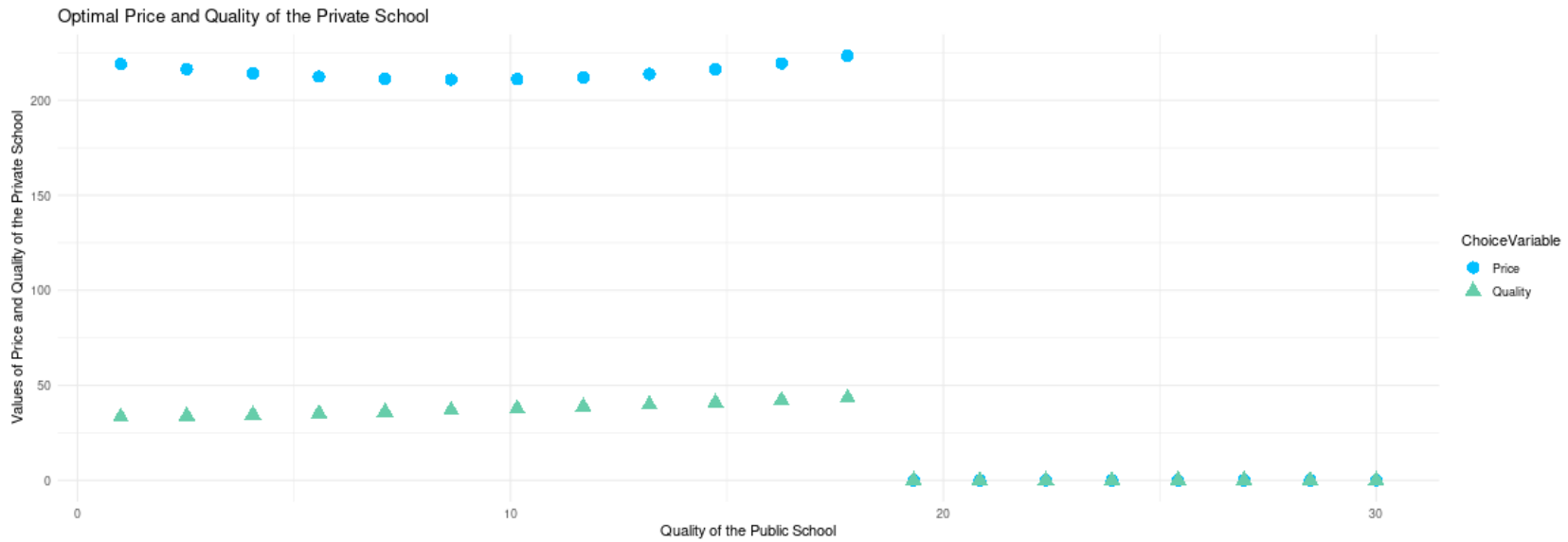
Consider extending the game so that firms choose locations, *m and n with m<n* and then choose prices

- Step 1: Show that $D_1(p_1, p_2) = m + \frac{1-m-n}{2} - \frac{p_1 - p_2}{2t(1-m-n)} = 1 - D_2(p_1, p_2)$
- Step 2: Show that $p_1^* = c + t(1-m-n)\left(1 + \frac{m-n}{3}\right)$
- Step 3: Show that $p_2^* = c + t(1-m-n)\left(1 + \frac{n-m}{3}\right)$
- Step 4: $\pi_i(m,n) = (p_i - c)D_i(p_1^*, p_2^*; m, n)$
- Step 5: $\frac{\delta \pi_i}{\delta m} = \frac{\delta \pi_i}{\delta m} + \frac{\delta \pi_i}{\delta p_i}\frac{\delta p_i^*}{\delta m} + \frac{\delta \pi_i}{\delta p_2}\frac{\delta p_2}{\delta m}$=0
- Divide into strategic and direct effect and note that both <0
- This is a model of *maximal differentiation :* firms locate at opposite ends
- All these models are quite sensitive to the specification of the demand and cost functions, but the main intuition remains: by differentiating firms can enjoy greater market power

Gaining intuition for these models

Das, Khwaja & Vassey have developed a set of simulations to guide you through some of these models

There, you can play around with different parameters and see what happens in a simple model where the public school sets its own quality, and then the private school has to respond



Empirical Implications of the Model

One implication is that “public sector” investments must account for

- How parents will react to these investments
- How schools will react to these investments

A fundamental change due to the recognition that most children are now being educated in “schooling markets” is that there is really no difference between `policies towards public schools’ and `policies towards private schools’

- At best, these are indicative of the site where the policy is being implicated, but the ramifications of each of these policies will be sector-wide
- We now discuss each of these—but not in detail!

Example: How does household demand affect policies like vouchers?

Any public sector policy has to account for what parents care about

Take the example of school vouchers in Pakistan

Premise: Private schools are “better” but many parents cannot afford them. Therefore, giving them subsidies to attend private schools (vouchers) will improve test scores

Assumptions:

- Private schools are better (not necessarily true)
- Parents cannot afford them (no evidence at time of policy)
- Private schools will continue to be better once subsidies come in (not necessarily true)

How does household demand affect policies like vouchers?

Focus on key assumption of whether parents can afford private schools

Suppose the current situation is

- 100 children in private schools
- 200 will come in with vouchers of $10
- Then, total spend is $300 (200*$10 + 100*$10) and increase in enrollment is 200, at a cost of $15 per additional child enrolled. Of this amount, $1000 or 33% is infra-marginal

An alternate scenario may be

- 100 children in private schools
- 10 will come in with vouchers of $10
- Then, total spend per additional child enrolled is $110, and infra-marginal subsidy is 90%

What are price elasticities in LEAPS and what does this imply for vouchers?

Carneiro, Das & Reis (structurally) estimate the demand elasticity for private schooling

- "(…) own-price elasticities of -1.12 for girls and -0.37 for boys, are low. These reflect the change in demand when a single school increases its price; sectoral price elasticities, which reflect the increase in demand from a reduction in the price of all private schools are -0.27 for girls and -0.10 for boys."
- They show that these low price elasticities are consistent with an experiment where they gave vouchers to households

	Girls	Boys
Median compensating variation (in U.S. dollars)	-2.7	-2.4
Total change in consumer welfare (in thousand U.S. dollars)	-102.5	-119.3
Changes in total school enrollment rate (in percentage points)	8.4	2.1
Changes in private school enrollment rate (in percentage points)	21.1	7.4
Changes in public school enrollment rate (in percentage points)	-12.7	-5.3

What do schooling markets imply for public Sector investments

One key message from research on education markets is that everything is interconnected

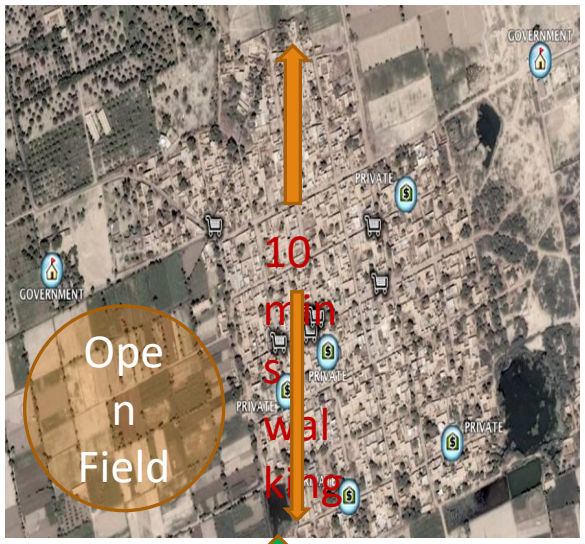
So, if we want to study the impact of public sector investments, we have to look at both the school that received the investment *as well as others* in the same `market'

A key problem with these kinds of studies is that when children move across schools, it is very difficult to separate the school from the household responses: Are we seeing higher test-scores with public sector investments in School A because of the investments or because the composition of children changed?

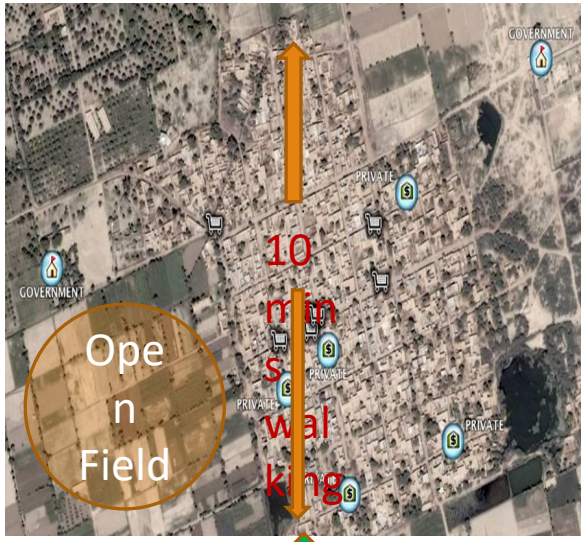
The LEAPS setting has allowed us to use a unique strategy of `market-level randomizations' that allows us to answer these questions in an empirically rigorous manner

I discuss briefly a paper by Andrabi, Bau, Das, Karachiwalla and Khwaja (2022) that showcases how to think of public sector investments in schooling markets

Market Level Randomizations



Control villages: evolve as usual

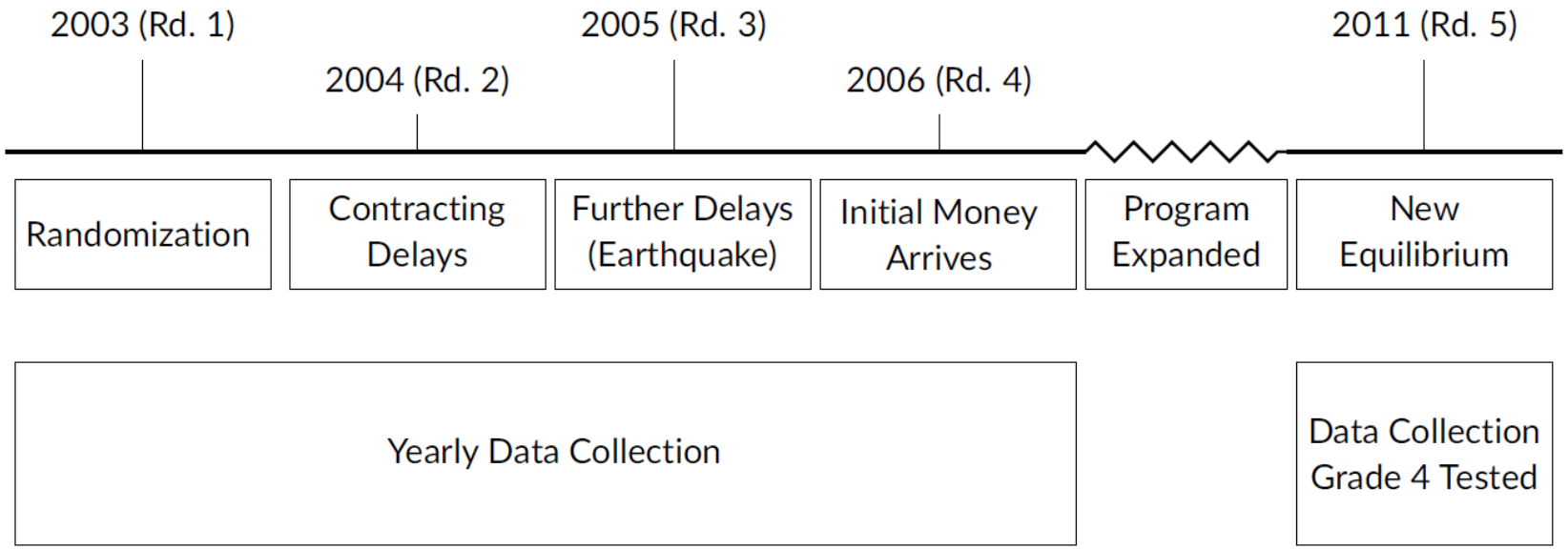


Treatment villages: shocked with a new regime, causing changes to the entire schooling system

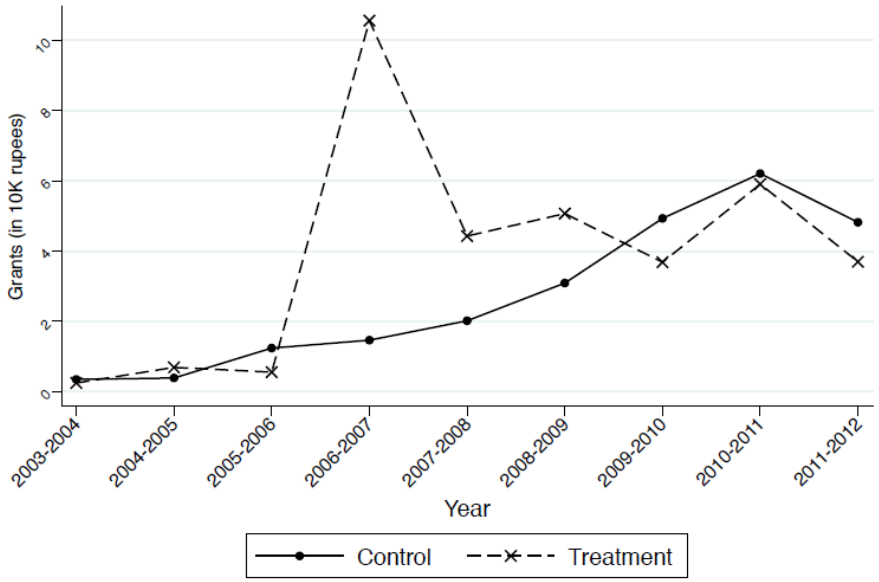
Measure test-scores, enrollment and prices, as well as school & household inputs

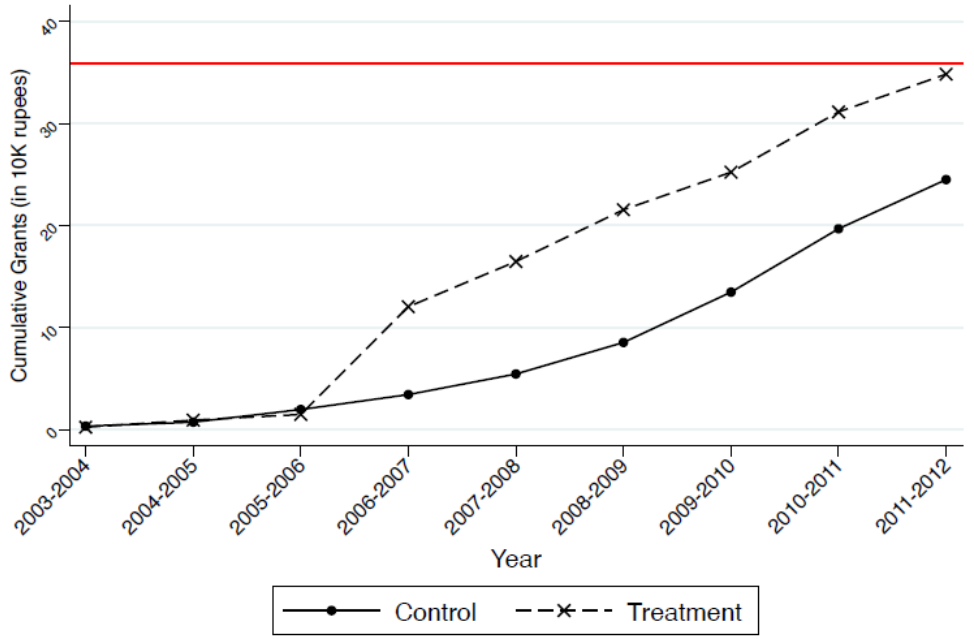
Public School Grants

In Andrabi et al. (2022) we study what happens when we give grants to public schools in *some* villages (randomly chosen) but not others



Public School Grants: Fund Flows





Substantial increase in the flow of funds to the treated villages over the evaluation period. The red line in the figure on the right sows the average annual spending in these schools.

Did Funds increase in treated villages?

	Cumulative Grants (in 10K Rs) in the Public Sector			
	(1) Total	(2) Per Pub. School	(3) Per Pub. Student Enrolled	(4) Per Pub. Student Enrolled, Primary
Treatment	49.202**	12.170**	0.107**	0.148**
	(21.716)	(5.131)	(0.045)	(0.060)
Control Mean	73.485	27.371	0.141	0.234
Adjusted R^2	0.035	0.106	0.040	0.044
N	80	80	80	80

Empirical Specification

Using Round 5 data, we estimate

$$y_{ivd} = \beta_1 I_v^{Treatment} + \mathbf{\Gamma} \boldsymbol{X_i} + \alpha_d + \epsilon_{ivd}$$

- i denotes an observation – either a village or a school (allowing for sector-specific effects).
- $I_v^{Treatment}$: indicator variable equal to 1 if the observation is a treated village or school in a treated village.
- α_d: fixed effect for district d (stratifying variable in the randomization).
- $\boldsymbol{X_i}$: vector of controls from the baseline rounds.
  - Version 1: $\boldsymbol{X_i}$ includes Round 1 and 2 values of outcome variable (if available).
  - Version 2: $\boldsymbol{X_i}$ is chosen using double-lasso, following Urminsky et al. (2016).
  - Version 0 [In paper]: no controls except the stratifying variable.

Effect on Test scores (Village-level)

	(1)	(2)
	Mean Test Scores at the Village-Level	
	Baseline Controls	Double-Lasso
Treatment	0.180**	0.191**
	(0.080)	(0.086)
Control Mean	-0.233	-0.233
Adjusted R^2	0.560	0.626
N	80	80

At the *village-level*, test scores increased by 0.18sd to 0.19sd. Since this includes children in the entire village, this eliminates any sorting. Hence the improvements can be traced to school-level responses.

Effect on Test-scores (by sector)

	(1)	(2)	(3)	(4)
	Mean Test Scores at School-Level			
	Public Schools		Private Schools	
	Baseline Controls	Double-Lasso	Baseline Controls	Double-Lasso
Treatment	0.220**	0.209**	0.198**	0.324***
	(0.090)	(0.102)	(0.089)	(0.122)
Control Mean	-0.550	-0.550	0.310	0.310
Adjusted R^2	0.300	0.290	0.298	0.307
N	231	231	193	193
Clusters	80	80	74	74

We see equal sized improvements in both the public and the private sector, suggesting large spillovers as public schools increased quality.

Cost-effectiveness

- Calculate $\frac{\Delta \textit{Test Scores}}{\Delta \textit{Dollars per Student}}$.
  - Δ*Test Scores* = Coefficient on treatment in test scores regression.
  - Δ*Dollars per Student* = Coefficient on treatment in dollars spent per pupil regression.
- Without accounting for private school spillovers: 1.18 (test score) sd per additional 100 USD spent per student.
- With private school spillovers: 2.18 (test score) sd per additional 100 USD spent per student.
- Failing to measure private school spillovers would underestimate cost effectiveness by 46%.
- More speculative: shape of relationship between money and outcomes is different across sectors.
  - Including private schools → higher optimal level of funding.

Is this a universal result?

NO! In the simulations it is very clear that if the public school quality increases are very large, the private school will shut down, or at the very least, will lose significant market share

This is what Dinnerstein & Smith as well as Nielson, Dinnerstein & Otero show in New York City and in Dominican Republic

- In the first case, an increase in grants to public schools led to children leaving private schools to attend public schools
- In the second case, a *massive* expansion in public school capacity led to the closure of private schools

(This may be socially beneficial or not depending on multiple factors)

Conclusion

The world of schools looked very different pre-Covid from a version where there is one school and the only choice that children make is to attend/not-attend

Now, many children live in areas with significant and real choice and schools are reacting to what parents and children want

This implies that we need to shift our thinking from focusing on individual schools to focusing on *markets*

Have shown that a key measure of quality—SVA—can be feasibly measured and is valid, revealing substantial variation within market and sector

Have also shown that parents react to this variation with implications for key policies like vouchers and public sector investments

Next lecture: How can we improve market functioning and solve the productivity challenge?