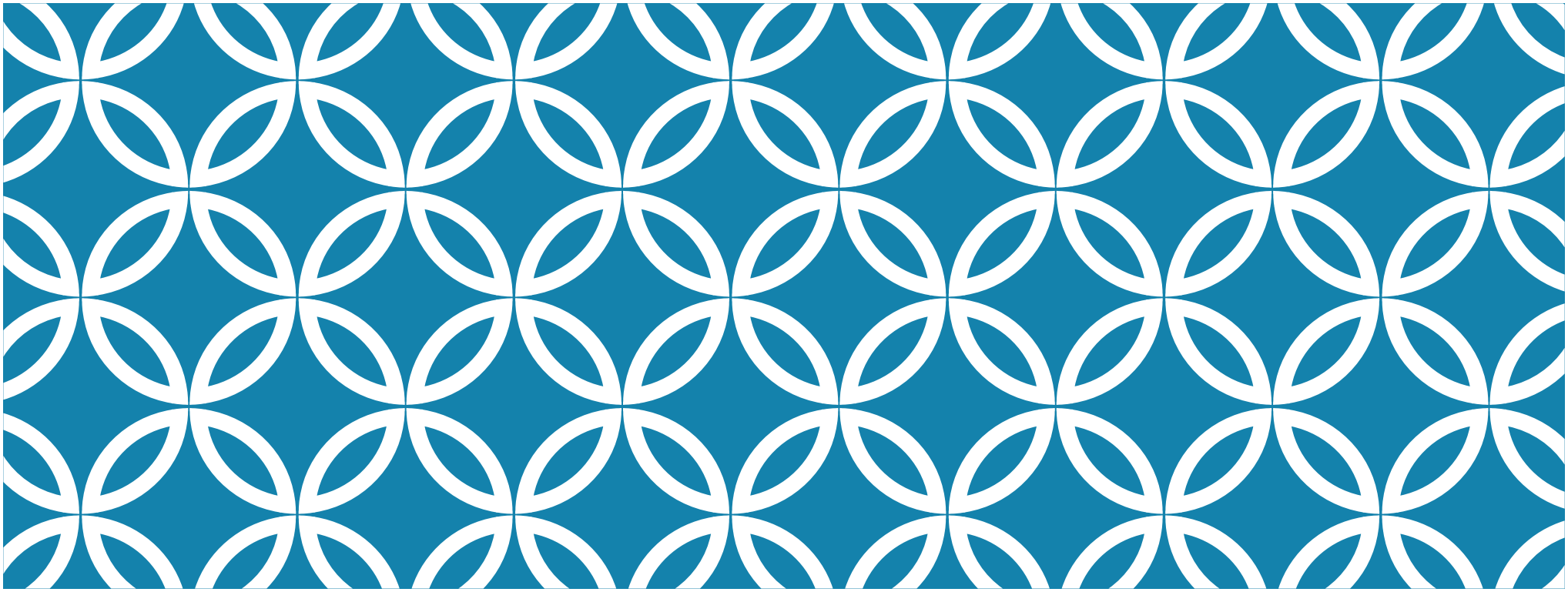


THEORETICAL CONCEPTS IN THE ECONOMICS OF EDUCATION

INTRODUCTION

Previously, scholars and policy makers tended to view education and economics as separate realms, with economics applied to the study of private goods and education as a public goods

- Given concerns with the productivity of educational institutions and the fact that the study of incentives, choice, and competition lie at the heart of economics, economists have become more relevant to education-reform debates
- They bring increased attention to resource allocation and decision making at the school level, take the view of educational organizations as potentially competitive enterprises, and those running them as entrepreneurs
- The study of incentives lies at the heart of economics, an understanding of how actors in large complex systems respond to incentives, and changes in incentives, helps shed light on how teachers might react to merit pay incentives or schools might react to increased competition from choice programs and charter schools

ECONOMICS DEFINED

- The study of the allocation of scare means to satisfy competing ends (Gary Becker as quoted by Walberg and Bast, 2003)
- In the case of education, economists are interested in how society organizes and uses scare resources to produce various types of knowledge and skills through formal schooling, and how these types of knowledge and skills are distributed to various groups in society

- Economists typically begin an explanation of observed phenomena by building a theory or a model in order to simplify reality and highlight key characteristics
  - A model contains a set of assumptions, and yields predictions, ceteris paribus.

Economic theories are typically built on three basic foundations: scarcity, rationality, and optimization

- Scarcity refers to the assumption that individuals and society will never have enough resources to completely satisfy their unlimited wants
- Rationality refers to people's ability to make decisions in a systematic and purposeful way
  - A consistency of response to general economic incentives and an adaptability of behavior when those incentives change (Ehrenberg and Smith, 2006)
- Optimization – either profit or goal maximization with reference to organizations or utility maximization with reference to individuals

Economics provides a framework for understanding the behavior of individuals and organizations as they generate and allocate human, material, and financial resources

- How much education(does and) should an individual acquire? – Human capital
- How should education be produced and allocated by a society? – Market
- Can we be more efficient and effective in organizing the production of education? – Education production

HUMAN CAPITAL

- Education is modeled as an individual investment decision that will receive a monetary return in the labor market, typically in the form of higher lifetime earnings
- Adam Smith, John Stuart Mill, and Alfred Marshall suggest that individual's skills could contribute to their economic status

- Knowledge and skills acquired through educational investments increase human productivity
  - With each investment, one may incur costs in the form of out-of-pocket expenses, foregone earnings, and psychic costs associated with the pressure of studying and examinations
  - Benefits accrue later in life through enhanced earnings in the labor market, access to better job, a higher likelihood of being employed, and better health
  - There are also psychic benefits from enhanced social status and the prestige associated with higher levels of education

- Although individual's motivation for pursuing schooling may differ and the psychic costs and benefits may be quite varied depending on personality, expectations of returns, and other traits, economists hypothesize that, other things equal, the more the education acquired, the higher the earnings achieved after the schooling is completed
- Human capital theory is to be found in the strong positive relationship between education levels and earnings that exist in almost every developed country
- Earnings rise with education level and they increase at an increasing rate in immediate post education years, continue to increase at a slower pace and then flatten as individuals approach retirement (Ehrenberg and Smith, 2006)
- This general pattern of earnings by education level holds for almost all subgroups, including men and women, and difference racial and ethnic groups, but it is the differences among these groups that often fuels education policy debates about the distribution of education subsidies and services
- Economic research had also found nonmonetary benefits, both private and public, associated with educational attainment – individuals who have invested in education and job training often have more job stability, improved health, are more likely to receive employer-provided health insurance and pension benefits, are more inclined to vote, and have generally increased social and cultural capital that often enables upward mobility

MARKET AND MARKET FAILURE

- Countries spend a sizable percentage of their GDP on education each year
- Educational spending can be undertaken by private individuals and by governments through public expenditures
- The decision as to how education at different age levels should be allocated is at its core an economic decision about how best to allocate scare resources in order to maximize output
- A market is defined in an economic context as a collection of buyers who purchase and sellers who produce and sell goods and services; the interaction of buyers and sellers results in the possibility of exchange and, hence, in the allocation of goods and services
- The transaction is facilitated through agreement on price

When markets do not efficiently organize production or allocate goods/services to consumers, then market failure is said to occur – there are several reasons why market fail

1. Market power may arise when a supplier of a good/service has the ability to control price

2. Consumers have incomplete information about price and product quality, in which case the market cannot respond efficiently and correctly

3. Externalities exist when consumption or production have an indirect effect on others that is not reflected in market prices

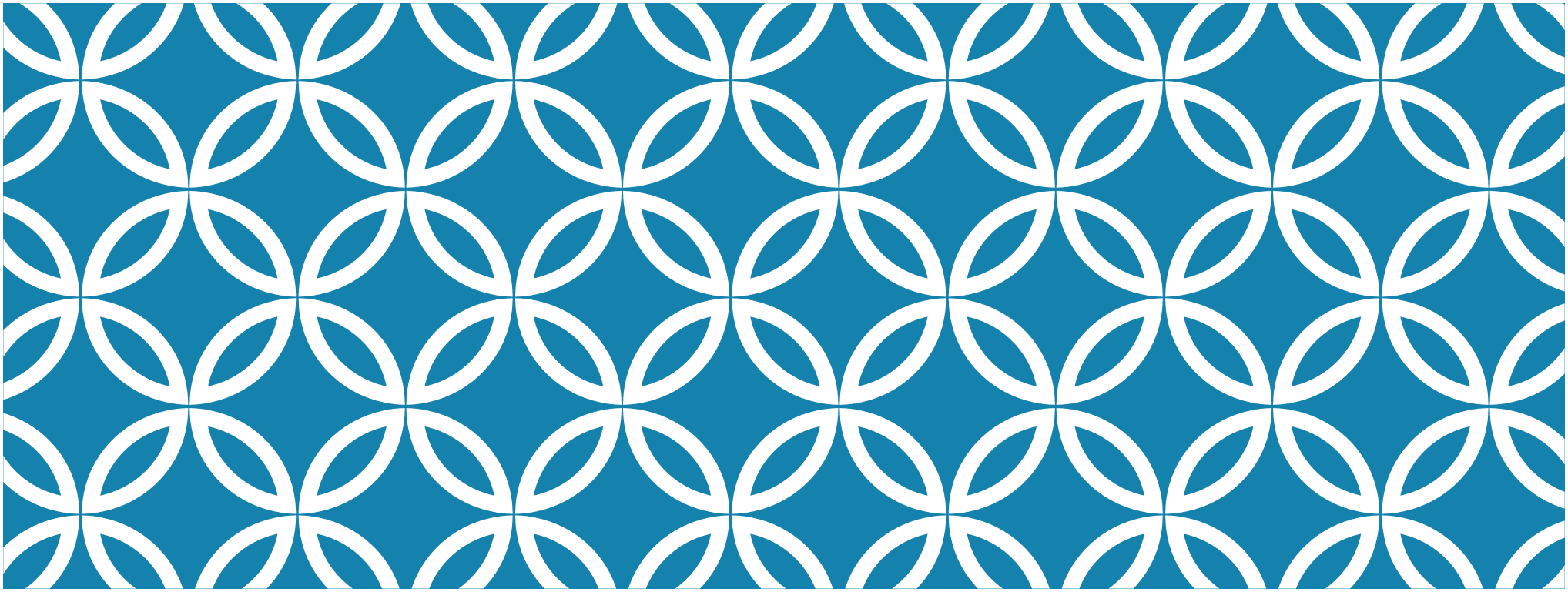
4. Markets may fail for public goods – those that can be made available to additional people with out additional cost (nonrival), and once provided are difficult to prevent others from consuming (nonexcludable)

EDUCATION PRODUCTION

Two different forms:

1. The first approach is to treat education as a production function wherein schooling inputs are processes from which outputs are produced

2. The second approach explicitly looks inside the black box and examines the organization as a web of interpersonal contracts wherein individuals seek to coordinate others (and are in turn coordinated by others) in the performance of work
   - Transaction cost economics or as applications of principal-agent theory



EMPIRICAL RESEARCH METHODS IN THE ECONOMICS OF EDUCATION

INTRODUCTION

Empirical research in the economics of education often seeks to identify causal relationships between policies or investments, and a variety of school or individual outcomes

- Do additional years of schooling cause individuals' earnings to increase?
- Does attending private instead of public schools cause students' test scores to improve?

Threats to internal validity can come from several sources:

- Differential attrition between treatment and control groups
- Sampling error
- Knowledge of the treatment (or control) status, which independent affects behavior

COMMON RESEARCH TERMS

- Internal validity
  - A result is internally valid when it identifies a believable causal link between a policy or program and an education outcome
  - The policy or program is often called a treatment

- External validity
  - A causal result is externally valid when it can be generalized to modified versions of the policy treatment, to alternate measures of student outcomes, to diverse populations of students or schools, or to different policy contexts

For example
Results from a study in Iowa may not necessarily apply in California if students' and institutions' characteristics are vastly different. RCTs with very small samples also make the results unlikely to be externally valid, as the small group of people studied are unlikely to be representative of state or national populations.

Randomized Control Trials (RCTs) : The Experimental Ideal

An experiment in which people are randomly assigned to the treatment and control groups. On average, this makes the two groups identical but for receiving the treatment.

Measuring Treatment Effects in an Experimental Context	
Group (randomly assigned)	Mean outcomes
Treatment	A
Control	B
Treatment effect	A-B

Hawthorne effect

The phenomenon that when people know they are in an experiment to demonstrate a particular effect, they are likely to behave in a way to make that effect occur.

For example, teachers who know they are in a class size experiment may behave in accordance with the study's hypothesis:

Teachers of small class will perform better than those with larger classes. This response is not due to the effects of class size per se but is due to the knowledge of being in the experiment.

The causal effect of a policy treatment is the difference between students' outcomes when treated, and the same students' outcomes when not treated (commonly referred to as the counterfactual)

Researchers estimate counterfactual outcomes by identifying a separate group of untreated students, called a control group or comparison group

Members of the control or comparison group should be similar to their treated counterparts, in every respect but for exposure to the treatment

In practice, the groups are often dissimilar, in ways that affect the outcomes of interest but have nothing to do with the treatment (E.g. students' families have different incomes, because higher-income families were more or less likely to choose the treatment)

If this occurs, then the outcomes of comparison of students incorrectly estimate the counterfactual

Thus, a simple difference in the average outcomes of treatment and comparison students can yield a misleading estimate of the treatment's causal effect, and is said to suffer from selection bias

Economists use two broad approaches, usually in combination, to ensure that members of treatment and control/comparison groups are similar, on average

1. They make statistical controls for observed differences between students, often using regression analysis
2. They influence how students are assigned to treatment and control groups

Cause-testing research is often lumped into three broad categories: experimental, quasi-experimental, and nonexperimental

The essential difference among categories is the degree of control exerted by the researcher over who is assigned to the policy treatment (whether students, teachers, schools, districts, or states), and who is assigned to the control/comparison group

Experimental research – referred to as a Randomized Controlled Trial (RCT)

- The assignment is entirely determined by luck or the draw, as in a researcher's flip of a coin

Quasi-experimental research

- Assignment may contain elements of randomness or purposeful assignment by the researcher, but some might be due to the individual choices of students, parents, or administrators (called selection)

Nonexperimental research

- The researcher exerts absolutely no influence, and assignment is entirely due to selection

When greater control is exerted, the causal results often possess greater internal validity

METHODS FOR ANSWERING CAUSAL QUESTIONS

Suppose that researchers collect nonexperimental data from students who attend either private or public schools. The causal question is whether attending private school improves test scores.

- A naïve researcher would simply estimate the difference between the average test scores of private students and public students, and ascribe it to the causal effect of school type
- But the difference could be explained by preexisting differences in students that are the result of selection – private students in tuition-paying schools have higher incomes, on average, which might be associated with higher test scores

METHODS FOR ANSWERING CAUSAL QUESTIONS

Statistical controls for observed variables

- Regression analysis
- Propensity score matching
- Randomized assignment
- Discontinuity assignment
- Instrumental variables
- Difference-in-Differences
- Combining methods to improve causal inference

REGRESSION ANALYSIS

- In education policy, it is common to apply multilevel or hierarchical models (Raudenbush and Bryk, 2002) that model error components and account for the potential correlation of errors within classrooms, schools, communities, or states
- Economists are more likely to report OLS coefficient estimates accompanied by adjusted Huber-White standard errors that allow for arbitrary correlations among units within clusters (Wooldridge, 2002)
- A basic regression model can be writtern as:

$$A_i = \beta_0 + \beta_1 P_i + \beta_2 X_i + \varepsilon_i$$

Where A_i represents the test score of each student in the entire sample; P_i indicates whether a student attends a private school (P=1) or public school (P=0); X_i indicates the value of a control variable, like family income, that one wishes to hold constant, and is an error term unique to each student

$$A_i = \beta_0 + \beta_1 P_i + \beta_2 X_i + \varepsilon_i$$

The causal interpretation rests on an assumption of regression analysis: that private school attendance controlling for X, is uncorrelated with positive or negative shocks in test scores captured in the error term $(cov(P_i, \varepsilon_i) = 0)$

What could produce such correlations?

Suppose that an unmeasured variable M, gauges parent motivation. Further suppose that children of motivated parents disproportionately attend private schools (M and P are positively correlated, even controlling for X) and that the children of motivated parents obtain higher test scores (M and A are positively correlated, even controlling for X)

In regression that do not control for M, the net result is that attending private schools tends to be accompanied by positive shocks in students' test scores, the (noncausal) influence of greater unobserved motivation among their parents

In this example, estimates of the coefficient β_1 would be too big because of selection bias, leading to overly optimistic causal conclusions about private school effects

$$A_i = \beta_0 + \beta_1 P_i + \beta_2 X_i + \varepsilon_i$$

Selection bias could work in the opposite direction, depending on the sign of partial correlations between the excluded variable(s), the dependent variables (A) and the key treatment variable (P)

Omitted variables creates no bias in β_1 if

1) the omitted variables are uncorrelated with A
2) the omitted variables are uncorrelated with P

PROPENSITY SCORE MATCHING

Researchers first estimate a propensity score for each student in the sample (Rosenbaum and Rubin, 1983)

- The score is predicted probability that students receive a treatment, given their observed characteristics
- Researchers would estimate probabilities, using logit regression, that students attend a private school, given their family income (X) and other observed variables thought to influence propensities
- Private students would then matched to similar public students, based exclusively on values of their propensity scores
- If students cannot be matched to a counterpart, then they are discarded from the sample
- Estimates of private school effects are based on comparisons of average outcomes across students in propensity-score matched treatment and control groups

The method's virtues are at least twofold (Ravallion, 2005)

1. It imposes no arbitrary assumption of linearity on the relationships between outcomes, policy variables, and other controls, as in most regression models
2. It removes treated (or untreated) students from the samples that have no obvious match in the other group

The observed uniqueness of such students implies that they are also unique in unobserved ways that could introduce selection bias

Like regression analysis, the causal interpretation of PSM results rests on the unverifiable assumption that no unobserved variables are correlated with outcomes and with the probability of receiving a treatment

RANDOMIZED ASSIGNMENT

- The essential point is that students or other units have well-defined probabilities of being assigned to the treatment
- To obtain an internally valid estimate of causal effects, one estimates the mean difference between the outcomes of treated and untreated units
- One could further apply regression analysis to control for observed differences between groups
- If randomization proceeded without a hitch, then doing so is not strictly necessary to eliminate selection bias, although it reduces the standard errors of estimates of causal effects

Common critique:

1. Attrition from treatment or control groups could reintroduce selection bias into experimental estimates
2. Experiments especially small scale ones, yield causal conclusions of limited external validity (Shadish et al., 2002)

Researchers with large enough samples can estimate causal effects within subsamples of students, perhaps dividing them by location, income, or race. Yet, even average effects in experimental sample may not be generalizable to the average student in the entire population, since initial samples are not always a random draw.

Many research studies begin with volunteers, either students or schools. Results from volunteer students or schools may be harder to generalize to the broader population

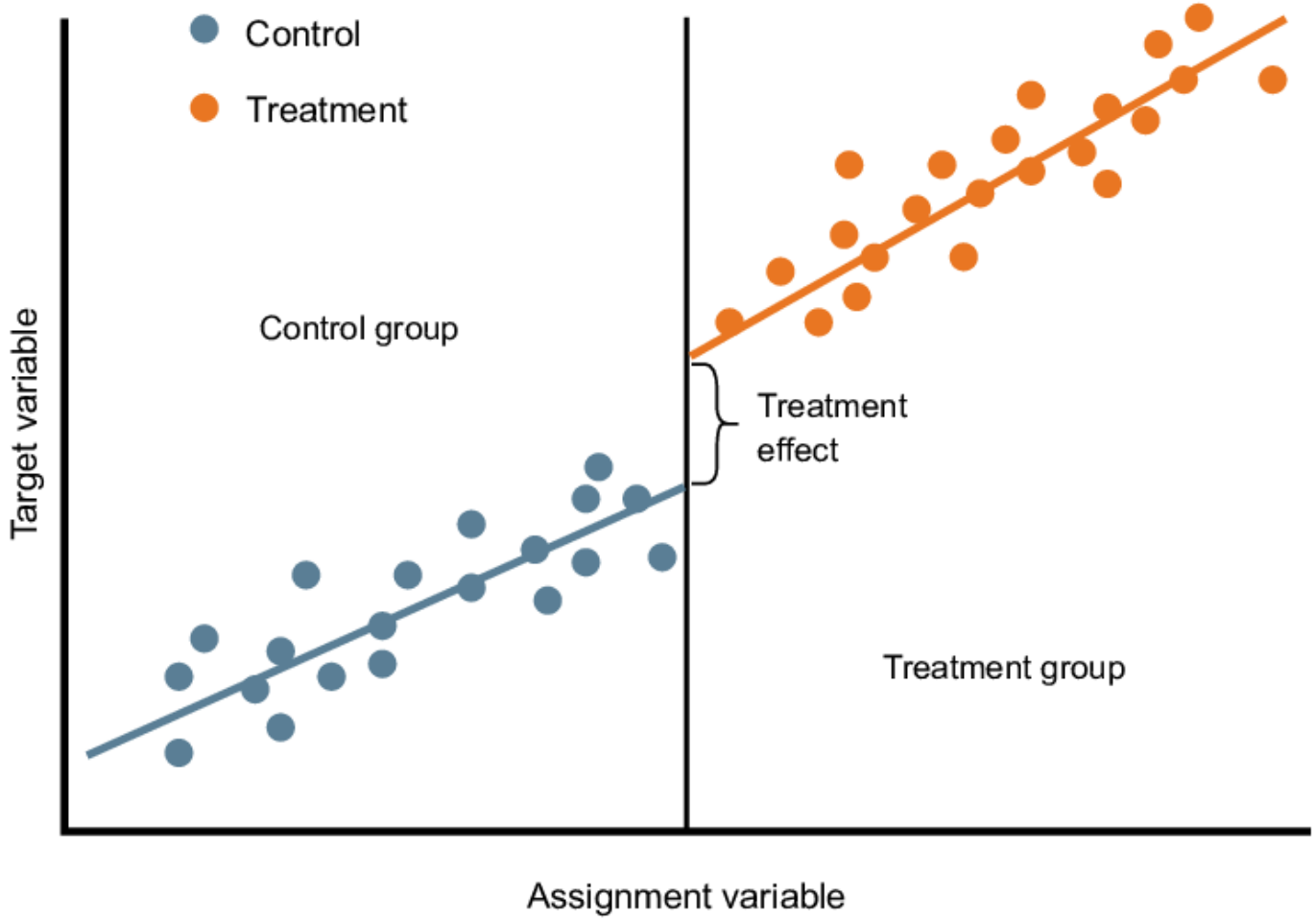
DISCONTINUITY ASSIGNMENT

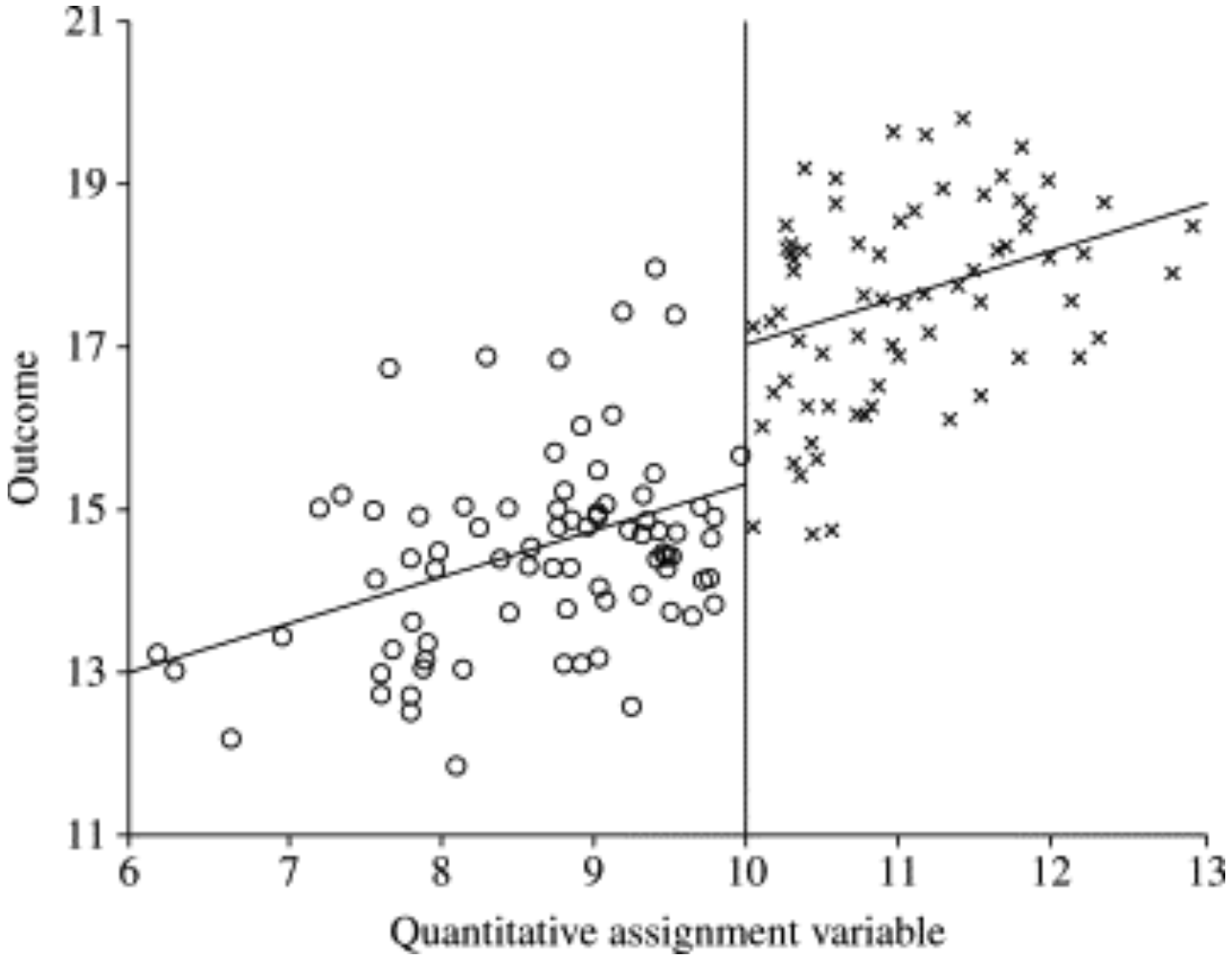
- Quasi-experimental method – the regression-discontinuity design (RDD) (Hahn et al., 2001; Shadish et al., 2002)
- In the RDD, researchers assign students to treatment or control groups on the basis of a single assignment variable – a test score – and a specified cutoff value
- E.g. Suppose that a thousand of students vie for college financial aid by taking a pretest (the assignment variable) – students with scores of 50 or above (the cutoff) receive aid, and those with scores below 50 do not
  - Note that the assignment is not randomized, as in the flip of coin, but neither is it due to selection
  - This provides sufficient leverage to identify the causal effect of financial aid on some students' subsequent outcomes

- A hallmark of recent paper is that researchers do not specify cutoffs or implement the assignment process
- Instead, researchers take advantage of cutoff-based assignment that administrators used to allocate resources in a transparent, fair or efficient way (e.g. needy or meritorious students receive financial aid, low-scoring schools receive assistance or sanctions, and high scoring ones receive rewards, less-effective teachers receive training)

Potential pitfalls :

- The most serious, related to internal validity, is that students, or other subject to discontinuity assignment, are familiar with the potential intervention, the assignment variable, and the value of the cutoff – if they have incentives to receive the treatment, or not, then they may well attempt to manipulate their values of the assignment variable (Lee, 2008)


Control
Treatment
Control group
Treatment
effect
Treatment group
Target variable
Assignment variable


21
19
17
15
13
11
Outcome
6
7
8
9
10
11
12
13
Quantitative assignment variable

INSTRUMENTAL VARIABLES (IV)

In nonexperimental data, the receipt of policy treatments is usually correlated with unobserved characteristics of individuals that affect outcomes – therein lies the empirical dilemma

The challenge is to base estimates of causal effects entirely on clean variation in treatment status – that is variation uncorrelated with unobserved characteristics that affect outcomes

One must identify an IV that fulfills two conditions (Wooldridge, 2002)

1. It must be strongly correlated with the probability of receiving an intervention – IV induces students or schools to alter their treatment status
2. IV cannot be correlated with unexplained variation in the outcome variable – the variation in outcomes that remains after controlling for other independent variables

IVs are often related to features of geography or students 'location, which are assumed to be random in some regard, and thus viable candidates to fulfill the second condition

Estimating private school effect

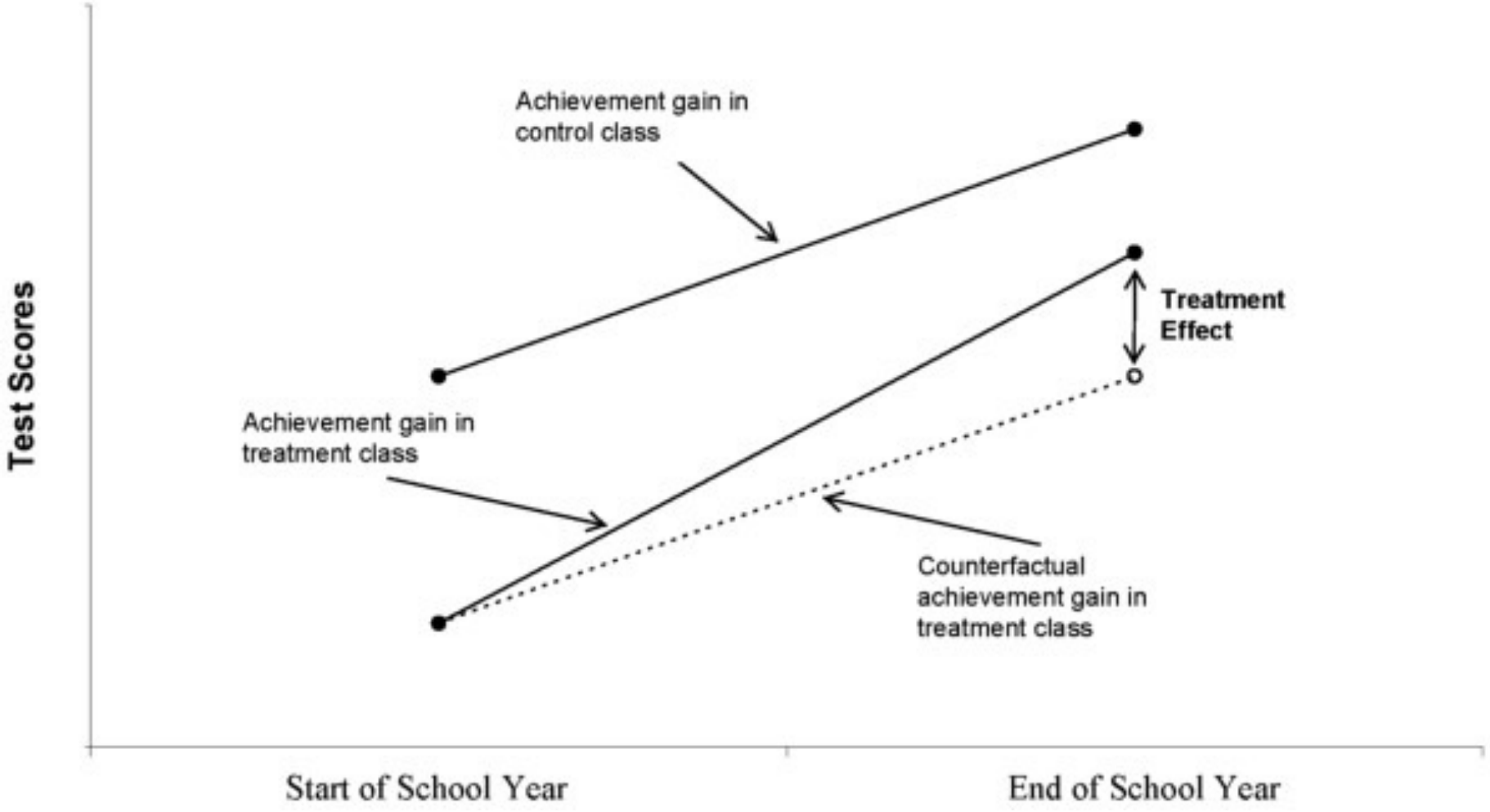
Figlio and Ludwig (2000) show that the availability of subway transportation in metropolitan areas affects the probability that families, especially poorer ones, choose private schools

- Using this as an IV, their analysis suggests that private school attendance has strong effects on reducing some risky teenage behavior
- Given the second IV condition, they must assume that transportation availability is uncorrelated with student outcomes, after controlling for other variables like family income
- The validity of this condition is hard to prove – do metropolitan areas with extensive subways have progressive mayors that invest in public schools
- In the most convincing IV analyzes, there are a priori reasons to believe that instruments are uncorrelated with unexplained outcomes

DIFFERENCE-IN-DIFFERENCES (DD)

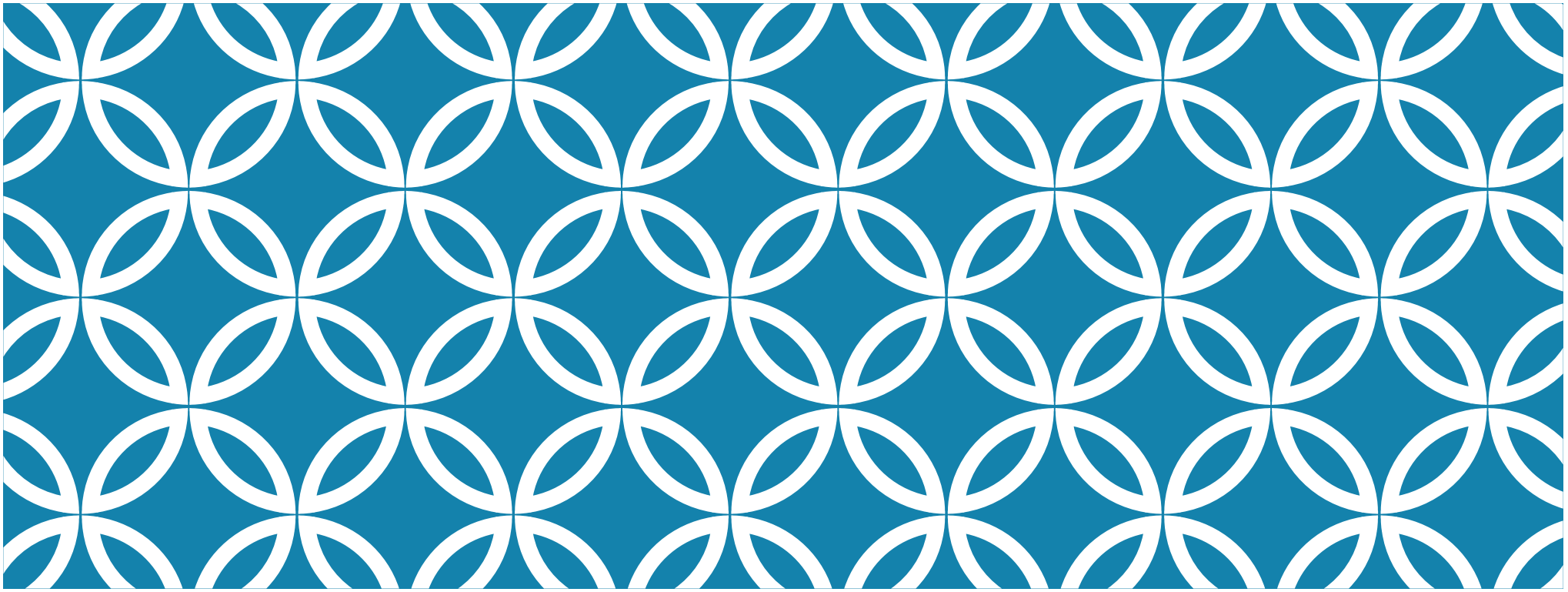
- DD methods attempt to control for unobserved variables that bias estimates of causal effects ,aided by longitudinal data collected from students, school, districts, or states
- One of the best ways to assess the internal validity of DD results is to compare the trends of outcome variables across treatment and control groups before application of the treatment

- Dee and Levine (2004) estimated the effect of Massachusetts's state finance reform on districts' per-pupil state revenues As controls, they used districts in Maine and Connecticut, which did not apply reforms, over the same pre- and post- reform period
  - DD estimates showed significant effects of the reform on local revenues
  - To support the use of these comparison groups, they showed that the outcome variables had similar trends in the three states in years prior to the reform


Test Scores
Achievement gain in control class
Treatment Effect
Achievement gain in treatment class
Counterfactual achievement gain in treatment class
Start of School Year
End of School Year

- The DiD is implemented by taking two differences between group means in a specific way.
- The first difference is the difference in the mean of the outcome variable between the two periods for each of the groups. In the hypothetical example, the first difference simply corresponds to the change in average test scores for each group between the beginning and the end of the school year.
- The second difference is the difference between the differences calculated for the two groups in the first stage (which is why the DiD method is sometimes also labeled “double differencing” strategy). This second difference measures how the change in outcome differs between the two groups, which is interpreted as the causal effect of the causing variable.
- Hence, in our example, the effect of afternoon lessons on student learning is identified by comparing the gains in average test scores over the school year between the two classes.

- The identification assumption of the DiD approach is that the group-specific trends in the outcome of interest would be identical in the absence of treatment. In terms of the hypothetical example, the identifying assumption is that both classes would have experienced the same increase in test scores over the school year in the absence of afternoon lessons. The assumption that the treatment class would have experienced a counterfactual achievement gain identical to the observed achievement gain in the control class is illustrated by the dotted line in Figure.
- The plausibility of this identifying assumption depends on the specific setting to which DiD estimation is applied. If possible, researchers show that outcomes in the treatment and the control group prior to the treatment moved in parallel, which supports the assumption of parallel trends over the introduction of the treatment.
- In any case, the identifying assumption of the DiD approach is less restrictive than the assumption implicitly made in standard traditional methods, namely that the two groups are identical in terms of all relevant unobserved factors.



DATA IN THE ECONOMICS OF EDUCATION

OVERVIEW

Before describing the available datasets, it is importance to provide a general overview of the type of research questions economists of education focus on, and how these data sources may be used to answer them

Some basic questions posed by economists of education are

1. what are the effects of education inputs (e.g. class size, teachers' qualifications and professional development), competition among schools (e.g. vouchers), and accountabiity measures on academic achievement
2. of cognitive abilities and education on earnings
3. of pay incentives, school characteristics, and testing on teacher characteristics
4. of family background characteristics (e.g. income and parental education) on student academic attainment?

- Researchers need state or nationally representative data on student test scores, class and school size, characteristics of peers, teacher education and experience, incentives associated to the federal and state accountability system, and/or family background

- Researchers need to be able to link these different variables with each others, which means linking students to teachers, students to peers, and/or follow students over time

SUMMARY ON NATIONAL DATA SYSTEMS

Dataset	Acronym	Census or sample	Data frequency
Common core of data	CCD	Census	Annually
Private school survey	PPS	Census	Annually
Longitudinal school district fiscal-nonfiscal file	FNF	Census	Annually
National assessment of educational progress	NAEP	Sample	Annually until 1979, then every 2 years
National longitudinal study of 1972	NLS-72	Sample	Variably
National education longitudinal study of 1988	NELS:88	Sample	Variably
Education longitudinal study of 2002	ELS: 2002	Sample	Variably
Crime and safety surveys	CSS	Sample	Variably
Current population survey, October supplement	CPS	Sample	Annually

LINKS TO INTERNATIONAL DATA SYSTEMS

Dataset	Acronym
Trends in international mathematics and science study	TIMSS
Progress in international reading literacy study	PIRLS
Program for international student assessment	PISA

SOURCE

Brewer, Dominic and Patrick J. McEwan (2010). *Economics of Education*. New York: Elsevier