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### **Research Paper Report**

**Paper Title:** Long-Term Educational Consequences of Secondary School Vouchers: Evidence from Administrative Records in Colombia.

**Brief Overview:**

The study investigates the long-term effects of secondary school vouchers on educational outcomes in Colombia. The Colombian government implemented a voucher program called "PACES" in the 1990s to provide low-income students with vouchers to attend private schools. The authors of the paper assessed the impact of the voucher program on students' educational attainment and other outcomes.

**Authors:** Joshua Angrist, Eric Bettinger, Michael Kremer

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### **Research Questions the paper aims to answer**

The paper aimed to answer the following key questions:

1. What are the long-term effects of secondary school vouchers on educational attainment, including high school completion, test scores, and tertiary education enrollment?
2. How does the voucher program impact the gender gap in educational attainment, and do the effects differ between boys and girls?
3. Do the positive effects of the voucher program persist over time, indicating long-term benefits for the recipients?

### **Significance of the Research Question**

The questions addressed in this paper are significant for the following reasons:

- Assessing the long-term impact of educational interventions: While many studies have focused on the short-term effects of educational interventions, the long-term consequences are not as well understood. By investigating the long-term effects of secondary school vouchers, this paper sheds light on the potential sustained benefits of such programs. This information is crucial for policymakers who must decide whether to invest in similar interventions or to allocate resources elsewhere.
- Evaluating the effectiveness of voucher programs: Voucher programs are a popular approach to improving educational access and quality, especially in developing countries. By examining the Colombian voucher program's impact on educational outcomes, the paper provides empirical evidence that can help policymakers assess the effectiveness of such programs in their own contexts. This evidence is essential to inform future policy design and implementation.
- Understanding the impact on gender disparities: Gender disparities in education are a persistent problem globally, and it is crucial to identify interventions that can help close

this gap. By exploring the voucher program's impact on the gender gap in educational attainment, the paper contributes to the broader literature on educational gender disparities and informs policies that specifically aim to address this issue.

- **Informing policy debates on education financing:** The question of how to finance education, particularly in developing countries, is a contentious policy debate. By providing evidence on the long-term benefits of voucher programs, the paper contributes to discussions around the merits of public funding for private education and the potential of such programs to improve educational outcomes for low-income students.

### **Statistical methods and Rationale**

Angrist et. al. employed a variety of statistical methods and approaches to answer the research questions. Their methodology was designed to rigorously evaluate the long-term effects of the PACES voucher program on educational outcomes, as discussed below:

#### **Difference-in-Differences (DID) Analysis:**

The authors used a difference-in-differences (DID) approach to estimate the effect of the voucher program on educational outcomes. This method involved comparing the differences in outcomes between the treatment and control groups before and after the intervention. By taking into account the pre-existing differences between the groups, the DID analysis helped to isolate the causal impact of the voucher program.

#### **Instrumental Variables (IV) Approach:**

The authors employed an instrumental variables (IV) approach to address potential issues related to non-compliance (i.e., students who were offered vouchers but did not use them) and attrition (i.e., students who dropped out of the study). The random assignment of vouchers was used as an instrument for voucher use, allowing the authors to estimate the causal effect of voucher use on educational outcomes while accounting for potential biases arising from non-compliance and attrition.

#### **Regression Analyses:**

The authors used regression analysis to estimate the effect of the voucher program on various educational outcomes, such as high school completion, test scores, and tertiary education enrollment. The regression models controlled for individual characteristics, including gender, age, and baseline test scores, to account for potential confounding factors. The authors also included interaction terms between the treatment indicator and other covariates to assess whether the program's effects differed across different subgroups, such as boys and girls.

#### **Estimating Long-Term Effects:**

To examine the persistence of the voucher program's effects, the authors analyzed the outcomes at different time points after the intervention. By comparing the outcomes of the treatment and control groups several years after the program's implementation, they were able to assess whether the positive effects persisted over time, indicating long-term benefits for the voucher recipients.

#### **Propensity score matching (PSM):**

In the case of the PACES program evaluation study, PSM was used to balance the covariate distributions between lottery winners and losers, in order to estimate the causal effect of the PACES program on educational outcomes. The authors estimated the propensity scores for each student using a logistic regression model that included a set of pre-treatment covariates, such as age, gender, parental education, household income, and baseline test scores. After estimating the propensity scores, the authors used nearest-neighbor matching with replacement to match each lottery winner with one or more lottery losers who had similar propensity scores. This matching process resulted in a sample of treated and control individuals who were well-balanced on observed covariates, allowing for a more precise estimate of the causal effect of the PACES program.

### **Data Used In the Research**

The primary source of data used in the paper was the administrative records collected by the Colombian Institute for the Promotion of Higher Education (ICFES). The ICFES administers the national high school exit exam, known as the SABER 11, and maintains a database of exam results for all students who take the test. The authors used these records to measure students' academic performance, high school completion, and enrollment in tertiary education.

The authors also used data from several household surveys conducted by the Colombian government, including the Quality of Life Survey (QLS) and the National Household Survey (NHS). These surveys provided additional information on the characteristics of students and their families, such as socioeconomic status, household composition, and urban or rural residence.

The authors obtained data on the PACES voucher program, including information on the selection process, the assignment of vouchers, and the participating schools. This data was used to create a sample of students who applied for vouchers and to identify the treatment and control groups for the study. The data sources used in the paper are reliable and valid, as they were obtained from government agencies responsible for overseeing the education system and collecting statistical information on the population. By using a rich and comprehensive dataset, the authors were able to provide a detailed and rigorous analysis of the long-term effects of the voucher program on educational outcomes and the gender gap in educational attainment.

### **Key Assumptions made in the Paper**

#### **Difference-in-Differences (DID) parallel trends assumption:**

The DID approach assumes that, in the absence of the voucher program, the differences in outcomes between the treatment and control groups would have remained constant over time. This parallel trends assumption implies that any changes in the differences in outcomes between the groups can be attributed to the treatment effect.

#### **Instrumental Variables (IV) Approach:**

The IV approach relies on the following key assumptions:

- a) Relevance: The instrument (random assignment of vouchers) must be correlated with the endogenous variable (voucher use). In the context of the study, this means that the random assignment of vouchers should affect voucher use among the students.
- b) Exclusion Restriction: The instrument should only affect the outcome variable (educational outcomes) through its influence on the endogenous variable (voucher use). This assumption implies that there should be no direct effect of random assignment on educational outcomes, other than through voucher use.
- c) Monotonicity: The instrument should not have opposite effects on the endogenous variable for different individuals. In this study, the random assignment of vouchers should not lead some students to use vouchers while causing others not to use them.

### **Regression Analysis:**

The regression models used in the study are based on the following assumptions:

- a) Linearity: The relationship between the independent variables (voucher use, individual characteristics) and the dependent variable (educational outcomes) is linear.
- b) Independence: The error term (residuals) is uncorrelated across observations. This assumption means that the unexplained variation in educational outcomes for one student should not be related to the unexplained variation for another student.
- c) Homoskedasticity: The error term has constant variance across all levels of the independent variables. This assumption implies that the unexplained variation in educational outcomes is not systematically related to the independent variables.
- d) Normality: The error term is normally distributed. This assumption is particularly relevant when conducting hypothesis tests or constructing confidence intervals based on the estimated coefficients.

### **Randomized Evaluation:**

The primary assumption underlying the randomized evaluation is that the allocation of vouchers through a lottery system created a quasi-experiment, resulting in treatment and control groups that were balanced on both observable and unobservable characteristics. This randomization ensures that any differences in educational outcomes between the groups can be attributed to the voucher program itself, rather than other confounding factors.

### **Persistence of Treatment Effects:**

The analysis of long-term effects assumes that the persistence of the voucher program's effects can be accurately estimated by comparing the outcomes of the treatment and control groups at different time points after the intervention. This assumption implies that any differences in outcomes observed several years after the program's implementation can still be attributed to the voucher program.

### **Findings from the Paper**

The findings revealed several significant effects of the voucher program on various educational outcomes:

#### **High School Completion:**

The authors found that the voucher program led to a substantial increase in high school completion rates for voucher recipients. The treatment group, composed of students who received vouchers, exhibited an increase in high school completion rates of approximately 5-7 percentage points compared to the control group, which did not receive vouchers. This result demonstrates the effectiveness of the voucher program in promoting high school completion among the participating students.

#### **SABER 11 Test Scores:**

The study also examined the impact of the voucher program on students' academic performance, as measured by the SABER 11 exam, a standardized test taken by high school students in Colombia. The authors found a positive and statistically significant effect of the voucher program on test scores, with voucher recipients scoring, on average, 0.2 standard deviations higher than their counterparts in the control group. This finding indicates that the voucher program not only increased high school completion rates but also improved students' academic performance.

#### **Tertiary Education Enrollment:**

The authors analyzed the effect of the voucher program on students' enrollment in tertiary education, including both university and vocational institutions. They found that voucher recipients were more likely to enroll in tertiary education, with an increase of 4-6 percentage points compared to the control group. This result suggests that the voucher program had a lasting impact on students' educational trajectories, encouraging them to pursue higher education after completing high school.

#### **Gender Differences:**

An interesting finding of the study was the differential impact of the voucher program on boys and girls. The authors found that the program's effects were larger for girls in terms of high school completion, test scores, and tertiary education enrollment. This result highlights the potential of targeted interventions like the PACES voucher program to reduce the gender gap in educational attainment and improve overall outcomes for girls.

#### **Long-term Effects:**

One of the main contributions of the study was its analysis of the long-term effects of the voucher program, which had not been previously documented. The authors found that the positive impacts of the program persisted over time, with voucher recipients continuing to outperform their counterparts in the control group in terms of high school completion, test scores, and tertiary education enrollment several years after the intervention. These findings suggest that the voucher program had lasting benefits for the students who participated, influencing their educational trajectories well into adulthood.

### **Personal Commentary and Critique of the Paper**

As a student of development economics and econometrics, I appreciate the contribution to the literature made by Angrist, Bettinger and Kremer in this paper. However, I would like to offer some critiques and commentary regarding the assumptions and findings presented in the paper:

#### **Mechanisms Driving the Effects:**

While the study demonstrates the positive effects of the PACES voucher program on educational outcomes, it does not provide a detailed analysis of the mechanisms driving these effects. Understanding the pathways through which the program influences students' educational trajectories, such as changes in school quality, peer effects, parental involvement, or student motivation, could help policymakers and educators design more effective interventions to improve educational outcomes.

#### **Heterogeneous Treatment Effects:**

The study reports larger effects of the voucher program for girls compared to boys, but a more detailed exploration of heterogeneous treatment effects could provide further insights. For example, the authors might investigate whether the program's impacts vary by socioeconomic status, urban/rural location, or initial academic achievement. Understanding the differential effects of the program across various subgroups could inform more targeted policy interventions and help maximize the program's overall benefits.

In conclusion, Angrist, Bettinger, and Kremer's study makes a valuable contribution to the literature on the long-term effects of educational Intervention initiatives as well as empirical techniques by which they can be evaluated.