Three essays on the economics of education*

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1 Introduction

The dissertation is about how educational outcomes of children are affected when there are changes in rural areas. The focus is Colombia.

2 Objectives

- Analyze the effect of the program of aerial spraying on coca crops on educational outcomes of children in Colombia.
- Analyze the mechanisms through which aerial spraying can affect children
- Explore if the aerial spraying program also affects academic performance of students.
- Measure the effect of the overlap between the agricultural and the school calendars on educational outcomes in Colombia.

3 First chapter: Unintended effects of aerial spraying of glyphosate on educational outcomes. Evidence from Colombia

3.1 Motivation

Coca is a plant that is used to produce cocaine. This is a plant used by indigenous communities in the Andean countries, however since the 60's it has been considered an illegal plant, therefore some Andean countries decided to implement policies to decrease its

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cultivation. Colombia became the biggest coca producer in mid 90's and it is the only coca producer country that has used airplanes to spray a herbicide to kill coca crops.

Rural communities face many problems: poverty, no roads, violence by illegal armed groups, poor educational infrastructure, etc. Many families cultivate coca because they get a higher income than in cultivating other types of crops, but also because they are forced by illegal armed groups. These families don't only have to face these difficulties, but also the fact that the Colombian State implements the aerial spraying program that affects negatively their income as well as their health.

Some reasons used by politicians to start the aerial spraying program were that children can consume the drugs produced with these plants, and also that coca cultivation is linked to violence, illegal armed groups and these are factors that have a negative effect on children. However, there is no clear evidence on how this policy can affect children, specially on their educational outcomes. The only paper that does this is Rodriguez (2020) who finds that aerial spraying of glyphosate decreases the probability of school attendance. I want to continue this line of research, but I am proposing another estimation strategy as well as the use of another dataset.

3.2 Research questions

- What is the effect of the aerial spraying program on coca crops on enrollment, dropout and the number of students who are transferred out of the school?
- What is the effect of this program on household income?
- What is the effect on health?

3.3 Background

Aerial spraying of herbicides was a policy first used in 1978 to fight cultivation of poppy. It was used sporadically until 1994. But in this year this policy was established as a national program, now specially designed to decrease coca crops.

This is how this program has worked in general. The National Police uses some military bases as well as some commercial airports to store the herbicide they are going to spray. The herbicide used is glyphosate, which is mixed with adjuvants and water, and then it is loaded to a small airplane. When the airplane takes off and arrives to the coordinates it was given, the pilot analyzes if he can spray the herbicide. The max height when spraying is 50 mts over the crops, the maximum release of the herbicide is 10,4 lts, the wind speed has to be below 5 knots and the max temperature is 35°C.

The coordinates the pilot receives are given by the National Police who has analyzed the characteristics of the land regarding levels of violence, whether it is a protected area (for example, if it is inside a national park) and most important, if it has coca crops. The information about the presence of coca comes from satellite images gathered by the United Nations Office on Drugs and Crime (UNODC) in Colombia, and field work by the National Police.

3.4 Theory

Aerial spraying implies a negative shock on household income. It does not only affect coca plants, but it also kills other crops. When there are credit constraints and income level decreases children' level of education decreases.

There is evidence that glyphosate is carcinogenic (International Agency for Research on Cancer, 2017), and it is also related to respiratory and dermatological illnesses (Camacho and Mejía, 2017). When children are sick, school attendance decreases.

Also there is a negative health impact on parents, which can decrease their income as they are not able to work, therefore it exacerbates the effect on education of children.

3.5 Empirical strategy

The identification strategy is a difference in differences estimation with a staggered adoption. The treatment variable is the number of hectares sprayed around the school[1]. The equation to estimate is:

$$y_{st} = \lambda_s + \lambda_t + \phi_1 ha\_sprayed\_around_{st} + \phi_2 X_{st} + \nu_{st} \quad (1)$$

Where $ha\_sprayed\_around_{st}$ is the number of hectares sprayed around school s in year t. λ_s denotes school fixed effects, λ_t denotes year fixed effects, and y_{st} is the educational outcome of students in school.

3.6 Contributions

There are papers that have analyzed the effects of aerial spraying on coca cultivation (Bogliacino and Naranjo, 2012, Reyes, 2014), on welfare (Rozo Villarraga, 2015) and on education (Rodriguez, 2020). However none of these use the difference in differences estimator. Also, the level of treatment in these papers is at the municipality level. Instead I am using a treatment that happens at the school level.

Another contribution is a more precise estimation as I am using information which is representative of rural communities. The papers mentioned use household surveys which are not representative at the municipality level, and have in fact many problems as these surveys are not done in rural areas that face difficult situations like violence.

4 Second chapter: Agricultural seasonality and education: effects of the overlap of the agricultural and school calendars

4.1 Motivation

Colombia is a country in which agriculture is still important. According to the National Department of Statistics (DANE) almost 17% of the labor force are in the agriculture sector. Also, the level of poverty is higher in rural areas in comparison to urban areas. This high

[1] I can use different buffer zones: 1km, 2kms, etc

level of poverty is linked to the poor results in education. For example, according to DANE school enrollment is 75% in urban areas, while it is only 24% in rural areas.

Infrastructure investment is seen as a possible solution to diminish these gaps, specially investment in schools, teachers, etc. However this is an expensive solution. Is it possible to decrease these educational gaps through a change in the school calendar that fits better the agricultural calendar?

4.2 Research question

What is the effect of the overlap between the agricultural and school calendars on enrollment and dropout?

4.3 Background

There are two school calendars in Colombia: A and B. Schools in calendar A start classes in early February, they have a break between June and July, and their classes end in late November. Schools in calendar B start classes in late August, they have a break in December, and their classes end in June. Currently, all public schools are in calendar A. However, before 2008 all public schools in the Departamentos (A Departamento is similar to a State) of Nariño and Valle del Cauca were in calendar B. They decided to change the calendar, and this process finished in 2011. This transition could be used to compute the change in the overlap between the agricultural and school calendars.

4.4 Theory

Some children in rural areas have to decide to work in the agricultural sector or to attend school. The number of children who decide to work can increase when there is an important agricultural activity like sowing or harvesting, therefore the probability of dropout increases if children are working in moments in which they are supposed to attend school.

4.5 Empirical strategy

The estimator proposed is a difference in differences. The treatment variable is the number of months of overlap between the harvesting and the school calendar. The equation to estimate is:

$$y_{st} = \alpha_0 + \alpha_s + \alpha_t + \beta \times Overlap_{st} + \epsilon_{st} \tag{2}$$

Where $Overlap_{st}$ is a continuous variable that indicates the number of months of overlap in school s in year t, y_{st} is the educational outcome of the school. α_s denotes school fixed effects and α_t denotes year fixed effects.

4.6 Contribution

To my knowledge there is only one paper that analyzes how this overlap affects educational outcomes. Abu and Seito (2020) estimated that in Bangladesh, in States whose

agricultural production is based on Aman the decrease in the overlap due to the change in the academic calendar because of the ramadan decreased the number of students who dropped out. My contribution is to continue this novel line of research in Colombia, which is a country in which agricultural production is still important. This has not been done in Colombia.

5 Third chapter: Effects of the aerial spraying program on academic performance of students

5.1 Motivation

The datasets that I am using in the first chapter don't allow to estimate how the aerial spraying program affects academic performance of students, as there is a decree that does not allow that more than 5% of students fail the grade. However, the aerial spraying program can also affect the grades that students get at school, and it can have an effect on the long term.

5.2 Research question

What is the effect of the aerial spraying program on academic performance of students?

5.3 Background

The aerial spraying program has been implemented since 1994, however there is no evidence on how it affects children. Rural families don't only face violence and high levels of poverty, but also the force of the Colombian State that has decided to fight cultivation of coca crops. How does this policy affect the schooling decisions of children? how does it affect their academic performance? Are there long term effects?

There is a standardized test which is called Saber 11 that all students have to present when they finish high school. This exam is mandatory, otherwise the student can't graduate. This exam is also important during the admission process in higher education.

In 2009, and 2012 to 2017 there was a pilot that tried to measure academic performance in third, fifth and ninth grades. The exams were called Saber 3, 5 and 9. I will use these datasets to estimate how this program affects academic performance.

5.4 Theory

As I mentioned in the first chapter, the aerial spraying program decreases household income and it can also have negative effects on health. All of this can imply a negative effect on the academic performance of students, which can also last longer than the current academic year.

5.5 Empirical strategy

The identification strategy is a difference in differences estimation that initially can be done at the school level. This strategy can also be done at the student level, however I'm in the process of getting this information.

As the time range in which there is information about these tests is relatively short, there could be difficulties with the DID strategy, specially when showing the satisfaction of the parallel trends assumption. That is why I need to control for previous characteristics of schools or students.

The equation to estimate and the treatment variable are the same as in the first chapter.

5.6 Contribution

This is a question that has not been analyzed in the literature. Also, if I am able to get the information at the student level, I can have a relatively clean identification strategy.

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