



Master's Thesis

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**The Impact of meditation on school performance.
Evidence from Colombia.**

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Abstract

This paper examines whether the practice of transcendental meditation influences different educational outcomes in a school located in the department of Antioquia, Colombia. For this purpose, a meditation project implemented during three years in secondary students is considered as a case of study. The results suggest that for this particular school the different educational outcomes are not strongly positively influenced by the meditation technique, and there is even a negative impact on the philosophy scores and the various school rates. Potential explanations for the observed outcomes are provided.

1. Introduction

In the last two decades, Colombia's public policy has made a significant effort to improve education throughout the country. Indeed, compared to 20 years ago, it has been more than doubled the enrollment rates for early childhood and tertiary education, and children spent two more years in school (OECD, 2016). However, despite the impressive progress Colombia has made in educational terms, it still requires some effort to ensuring that all children have access to a quality education and for having an educational system that achieves the same standards of those from global economies.

Andreas Schleicher, OECD Director for Education and Skills, presenting a report in Barranquilla with Colombia's previous Minister of Education, Gina Parody, in reference to Colombia education challenges for the incoming years, said: "As Colombia enters the global economy, its educational success will be measured by boosting national standards so that Colombian children match up with children around the world. This challenge will

require ambitious common learning standards, prioritizing access to early childhood education for the most disadvantaged and empowering teachers to lead this transformation.”

In particular, Colombia has two main challenges to face: It needs to be reduced the remaining participation gaps, and it needs to be raised the quality of education for everyone. Moreover, all these challenges should be reached independently of the students’ socioeconomic background or the school they attend to. Especially, if we take into account that for the poorest background population, the school life expectancy is just six years and only 9% enroll tertiary education, while for the richest the life expectancy is 12 years and 53% enroll tertiary education (OECD, 2016).

Different approaches need to be considered to reach a successful progress in the educational system, such as improving quality and giving more relevance to learning outcomes, improving equity in the educational opportunities, collecting and using data to guide future improvements, and designing and implementing effective policies. This study focuses on one approach that enhances cognitive and non-cognitive skills, and consequently, it might improve academic performance as well.

In a more detailed review of the education’s scope in the social development of a country, it is possible to appreciate the importance of intervening in both the formation of cognitive and non-cognitive skills of a child. In fact, it has been shown that noncognitive skills such as conscientiousness, persistence, and self-control are more important than sheer brainpower at the moment of getting success (Tough, 2013).

Some projects have been carried out to strengthen and increase profits or returns derived from basic training at school. For instance, increasing the school day’s length and providing schools with better resources. However, although these initiatives have proven to be effective in influencing educational outcomes, they fall short when generating significant effects on the student’s achievement at school, and other long-term variables (Murnane & Ganimian, 2014). In consequence, the educational system has started to look for other alternatives that may be more efficient regarding improving cognitive and noncognitive skills and in a second place, different educational outcomes.

Educational institutions have started to incentivize different skills by using alternative areas such as sports, art, and culture, which have proven to cause a direct and positive effect on cognitive development and improvement of short- and long-term skills. For instance, sports have demonstrated to have not only psychological benefits like improving self-esteem and self-confidence but also cognitive benefits such as thinking skills and concentration (Taylor et al., 2015). Hence, these are two main channels at the moment of determining educational behavior and attainment. Notwithstanding the success of these alternative methods, there is another activity that over the last decade has been gradually incorporated into the West and

whose effects on different cognitive and non-cognitive skills have been highlighted; its origin can be traced back to very ancient times in Asian countries: Meditation.

It is worth noting that there is poor scientific evidence for adult clinical populations that support the positive impact of meditation on different dimensions such as anxiety, depression, and pain. Moreover, there is very few or even insufficient evidence that supports the effect of meditation on other aspects such as positive mood, attention, substance use, eating, sleep, and weight. In particular, a study done by numerous researchers from Johns Hopkins University in 2014 showed that out of all the studies that have been done in meditation only very few of them can be trusted due to different bias present during the studies. Moreover, the ones that can be trusted only predict positive effects of Mindfulness Meditation on anxiety and depression (Goyal, et al., 2014). Additionally, Transcendental Meditation has only been found to be effective as a treatment for hypertension (Brook, et al 2013), relaxation and mental health (Ospina, et al, 2007).

However, although the before mentioned results correspond to studies developed only over adult clinical populations, their key findings can be taken to explain some of the meditation's effects observed in younger populations and also suggest the need for analyzing carefully the results obtained from other populations.

In particular, there is some evidence for the United States that supports the effects of meditation in children and adolescents who are studying in school on their academic performance, health conditions and crime rates (Barnes, et al., 2003; Schonert-Reichl, et al., 2010; Flook et al., 2010; Napoli et al., 2005). In Colombia, there have been a few number of schools where meditation has been included in the scholar's curriculum as an intervention for improving pupil's skills and other educational outcomes as well.

However, although meditation has been introduced in a few number of schools in Colombia, up to my knowledge, no follow-up activities have been done to analyze the tangible effects of meditation on school performance. This study opens a new window of discussion not only for the case of Colombia but also provides evidence of meditation's effects on educational outcomes. In particular, it discusses the challenges associated with this type of implementations and the potential results that might be derived from it concerning educational outcomes.

In the present study, it is analyzed a project of transcendental meditation (TM) that was executed during the years 2006-2008 with secondary students in a school located at La Estrella, Antioquia. Hence, by using a combination of other schools in Antioquia to construct a synthetic control school, which resembles relevant socioeconomic characteristics of the school in La Estrella before the project of meditation, this study aims to test the following research questions: first, does meditation affect school performance,

i.e. ICFES scores? Moreover, second, does meditation have an impact on school's approval rates, repetition rates, and dropout rates?

The remainder of this paper is organized as follows: in the following section, a brief definition of meditation together with the main findings from meditation in the framework of education is presented. Section 3 describes how the project of meditation in La Estrella was executed. Section 4 introduces the methodological method used for analyzing the project's impact and section 5 describes the data used for doing so. Finally, session 6 presents the final results, and session 7 discusses them.

2. Meditation

2.1 Definition

According to The National Center for Complementary and integrative health meditation is defined as a “mind-body” method that can be used to facilitate the mind's ability to change body functions and symptoms. Mind-body techniques center their attention on the interactions between the brain, body, and behavior (NCCIH, 2017). Numerous people believe meditation creates a greater state of calmness, psychological balance, and physical relaxation. Additionally, meditation is one of the most important elements of all the major world contemplative spiritual and philosophical traditions (Goleman, 1988; Walsh, 1999).

Nowadays, many people use meditation as a treatment for stress and stress-related conditions. Hence, a national survey in 2008 showed that approximately 10 percent of the population has some experience with meditation (Barnes, et al, 2008).

2.2 Forms of Meditation

Different meditation techniques are taught in a secular way without being attached to any cultural or religious belief. Although the various techniques of meditation might differ in different aspects, they all share four common elements. A peaceful location to avoid any external distraction as much as possible, a comfortable posture (this can be lying down, walking, sitting or in any other position), a focus of attention (this can be a word, a sound, an object or a body sensation) and a disposition to have an open attitude (being willing to let distractions come and go without any judgement) (NCCIH, 2017).

The meditation training programs can differ in several ways. For instance, they can be focused towards religion and spirituality, the amount and nature of training, the kind of mental activity or the presence and qualifications of an instructor. Meditation techniques have been categorized as stressing mindfulness, concentration and automatic self-transcendence (Barnes, et al, 2008).

Transcendental Meditation (TM) is one of the most popular techniques. This technique highlights the use of a mantra¹ in a way that allows the person to transcend to an effortless state where there is no more need of focusing the attention anymore (Barnes, PM. Et al, 2008). Another known technique is mindfulness-based stress reduction (MBSR). This technique is classified in the category of mindfulness, and it is centered on training in present-focused awareness. There is not an agreement on the different effects of both techniques on psychological stress outcomes.

2.3 Evidence to Date

In the literature for adult clinical populations, it has been shown that both types of meditation, i.e. mindfulness and mantra, can decrease different emotional symptoms such as anxiety, depression, and stress, and also that both can reduce some physical symptoms such as pain in different degrees (Bohlmeijer, et al., 2010; Chen, et al., 2012). However, most of the results obtained in the meditation literature need to be analyzed carefully. In particular, a significant amount of these studies are either uncontrolled or have control groups with no additional treatment (i.e., the patients continued with their usual care, or they were on a waiting list) (Barnes, et al, 2008). In the case of the waiting list control group, patients were receiving their usual care while expecting to receive the intervention in the future. Therefore, it is hard to say if the observed positive effect of meditation corresponds to the meditation by itself, or if it is the result of the expectations patients created towards receiving the treatment in the future.

Furthermore, another problem these studies have is that they usually require subjects to be involved for an extended period and also to have effort levels continuously. Hence, this yields to additional benefits derived from the extra attention levels, group participation and support received during the treatment. That is, it ends up improving the symptoms as a consequence of the extra effort, and not as a result of the treatment (Chambless, et al., 1998; Hollon, et al., 2010).

In general, the meditation research has quite some limitations regarding deficient control comparisons. In particular, in many of the studies, the differences between the control and the treatment group are not only the meditation technique but also some other nonspecific factors that are very likely to bias the outcomes. Although in an observational study it is hard to control for all these possible confounders, in the present study a synthetic school is built to ensure that the control and treatment group are as close as possible, having the meditation treatment as the only difference between them.

A group of researchers from Johns Hopkins University accounted for all the problems related to the meditation research for only a clinical adult population. Out of 17,801 unique

¹ It is a sacred utterance, numinous sound, or a syllable, word, phonemes, or group of words believed by some to have psychological and spiritual power (By Wikipedia).

citations, they ended up with 41 articles that satisfied their criteria in terms of the target population, control groups, length of the treatment, the risk of bias, study characteristics, participant characteristics, eligibility criteria and outcomes (for more details about the selection criteria please refer to the original article: Barnes, et al, 2008). From this 41 studies, they concluded that mindfulness meditation has a moderate strength of evidence for decreasing levels of anxiety, depression, and pain; and low or almost insufficient strength of evidence for decreasing levels of stress and improving mental health associated with quality of life, and improving positive mood and attention. It is also worth noting that none of the studies reported harm of the intervention (Barnes, et al, 2008).

Similarly, different studies have highlighted the direct effect of meditation on academic performance in both college and school students (Barnes, et al., 2003; Schonert-Reichl, et al., 2010; Flook et al., 2010; Napoli et al., 2005; Hall, 1999). Nevertheless, most of these studies have a weak control group, in some cases, the control was simply doing nothing instead of meditating (Hall, 1999). In other cases, as in the case of the study done by Barnes and colleagues (2003), the control group was subject to a health education program instead of meditation, meaning that both groups had similar expectations of benefits in health at the pre-intervention. In this study, it was observed a decrease in absentee periods, rule infractions and suspension days for the group exposed to transcendental meditation in comparison to the health education group. However, no difference in academic performance was observed between both groups (Barnes, et al., 2003).

A study done by Schonert-Reichl and colleagues (2010) tested the impact of mindfulness meditation on students in the 4th to 7th grade by using a wait-list control. The authors observed improvement in self-concept for the pre adolescents in the treatment group (Schonert-Reichl, et al., 2010). One study at an elementary school in Los Angeles used a silent reading period as a control instead of the mindfulness meditation intervention for second and third-grade students. The results showed improvements in behavioral regulation, metacognition, and overall global executive control (Flook et al., 2010). Another study in a U.S. Southwestern city tried to check the impact of mindfulness on different dimensions of attention, they used a read/quiet group as a control for students in first, second and third grades, and the treatment group was focused on helping students to learn to focus and pay attention. Their results showed some improvements in attention measurements (Napoli et al., 2005).

There are different channels through which meditation might influence educational outcomes. Although the scientific evidence does not strongly support a positive effect on attention, it seems that the main positive impact meditation can have on school performance is by helping pupils to manage academic-related stress and anxiety. Although some degrees of stress can contribute to enhancing academic performance, higher levels of stress can be very prejudicial because they can inhibit cognitive faculties that are crucial during the

learning process. Moreover, elevated levels of stress can even cause memory impairment whose effects on learning can be severe (Bremner & Narayan, 1998).

Furthermore, regarding meditation's effect on health aspects, there are some important facts that are worth to be mentioned. It has been found that transcendental meditation helps to maintain a healthy blood pressure level, which is important in people with hypertension (Brook et. al. 2013). This is an important result since blood pressure is the leading cause of heart disease, heart attacks, strokes, and kidney failure events. Also, meditation allows the brain to develop neuroplasticity, and people who meditate often have thicker cortical walls and have significantly greater telomerase activity compared to others. Consequently, meditation helps to have a lower aging rate and to improve memory and attention (Lazar et al. 2005).

This paper focuses on one single type of meditation because it was the technique used during the project: Transcendental Meditation (TM). TM integrate elements of both types of meditation: on the one hand, this technique uses mantra as a focus point, and on the other hand, it also allows to concentrate on other stimuli before returning the attention to the attention's object, when the stimuli become predominant.

3. The Intervention: Consejo Municipal de La Estrella .

The intervention took place in a school located in the municipality of La Estrella, a conflictive zone situated only 15 minutes by car from Medellin, Colombia. The project began as an initiative of the mayor of La Estrella at that moment, Loska Carlos, who is a bioenergetics doctor. He contacted the Maharishi Foundation Colombia² for executing the meditation project in the school Consejo Municipal de La Estrella. Once the project was approved by the Secretary of Education and the Ministry of National Education the program began.

The practice of transcendental meditation was executed during the years 2006, 2007, 2008 and early 2009. It commenced in September 2006 and ended up in May 2009. There were two instructors from the Foundation Maharishi who were in charge of the whole project's implementation during those three years and a half. I got in direct contact with one of the instructors that were in charge of the project to obtain detailed information about the project's implementation. Additionally, to get more information about the project I also had contact with the school's director that was in charge at the time the project was executed.

Before starting the implementation in the whole school, the instructors started by providing instructions to the teachers about the methodology. Teachers were taught about the physiological and brain implications arising from TM, and after TM was common knowledge among professors, they continued with the students' training.

² They define themselves as an organization that promotes global knowledge of education and total knowledge programs of Vedic Maharishi University originally founded by Maharishi Mahesh Yogi.

Pupils and parents were given two lectures regarding the meaning of TM and its scientifically proven advantages. Additionally, parents were asked to authorize their children to be part of this project, and there were very few who refused to let their children participate in this project because of their religious beliefs. Once the informed consent was signed, the training of students started. Consequently, the instructors were passing from classroom to classroom to teach the meditation technique to the students. Additionally, students were asked to take a personality questionnaire to be analyzed and assigned to an appropriate mantra according to their personality. The purpose of this mantra was to be repeated continuously during the meditation practice as a focal point of attention during the practice. Finally, once the TM technique was clear among teachers and students, the project began.

In particular, at the beginning of the school journey, from 6:45 to 7:00 a.m., it was included a 15 minutes space and another 15 minutes at the end of the academic journey. This 15 minutes originally corresponded to 10 minutes of the recess time students had before starting class and the other 5 minutes were taken from the first-morning class. However, given time constraints in the school, the 15 minutes of silence in the afternoon only lasted for the first year (2008), after that it was only implemented the 15 minutes of silence in the morning. The practice was applied to all high school students and in primary only for students in the fifth grade. The meditation was executed within the school's halls, and the pupils' professors led it. It is also worth noting that students had yoga classes as well once a week in their sports class. Additionally, according to the school's directives during the years of the project's implementation, no additional academic inputs were installed in the school.



Figure 1. Students meditating during their 15 minutes of silence during the morning.

According to the school's directives and the foundation Maharishi, the two main goals of this project were: the short-term goal was to induce in students a mind-body integration mechanism that allows them to act responsibly in each assignment they need to face. Additionally, the long-term goal was to achieve a reduction of anxiety, stress, hyperactivity, substance abuse, inappropriate behavior and school violence among students.

The project was executed during almost four years without any external monitoring or any pre-test or post-test measurement regarding the project's initial conditions and outcomes. Nevertheless, it is worth noting that one of the biggest advantages about the project's execution was that it was an order given by the Education Secretary, forcing every worker at the school to participate in the project even if they were against it. Indeed, this ensured and allowed the project's execution and success.

According to the meditation instructors and school's directives these were some of the results obtained from the meditation project: "The 3-year experience at the school showed a significant increase in academic performance, less drug abuse, less peer violence, greater respect for teachers, and less stress for the educators." Said Maria Teresa, meditation project's coordinator and instructor from the Foundation Maharishi. "The students at that time with characteristics of aggressiveness, depression, drugs, indifference and apathy in their academic work, problems of conviction, among others; Manage to assimilate and motivate themselves in this project. Today, after two years of appropriation of this experience, the results are filled to remedy many of these characteristics; Textual phrases of them: "Meditation takes away the stress of people", "before used drugs, not today", "meditation improves learning and concentration ability", "meditation helps us to know better", "I had never heard meditation, but I thank the meditation group ". Said Hugo Ruiz Medina, Institution coordinator at that time.

Taking advantage of the existence of such a project in Colombia, the present paper studies the possible effects of meditation on academic performance. Additionally, the resulting outcomes might contribute to a recent line of research regarding the incursion of new tools within schools, with the aim of maximizing education's returns not only in the short term but also long term. Additionally, the present study uses a methodology for analyzing the impact of meditation never used before in meditation research. Hence, the method proposed here accounts for the different challenges most of the studies in meditation face concerning precarious control groups.

4. Data

It is collected data on both school performance and general school characteristics to examine the effect of meditation on different educational outcomes, data on both school performance and general school characteristics. The former is collected by using data from the ICFES (Colombian Institute for the Promotion of Higher Education) for the period 2004-2012 for the department of Antioquia. This dataset contains information at the

individual level for the ICFES scores in mathematics, language, and philosophy. Hence, these scores are used as the outcome variables to measure the school performance. Furthermore, the ICFES data set also includes information about students' social background such as their parents' education, parents' occupation, and family monthly income. These categorical variables are considered separately for each category and transformed into percentages at the school level. Later in the following section, those variables are used as predictors of the different educational outcomes. Importantly, to build the panel at the school level, all the variables are collapsed at the school level, so it is obtained one observation per school for each academic year.

In the annex session, Table A.1 shows the balanced panel's descriptive statistics for the whole period 2004-2012. The columns with the value 1 represent the values of the school of La Estrella and the columns with the ones with the value 0 represent the values for the rest of the schools in Antioquia. For the ICFES scores, the average mean scores of mathematics, philosophy, and language for the school of La Estrella, i.e. 44.32, 41.32 and 47.08 respectively, are always slightly lower than the average scores for the rest of the schools in Antioquia i.e. 44.36, 43.66 and 48.09 respectively. It is worth to notice that the mean scores presented in this session are average scores that are calculated excluding the highest and lowest 5% of the scores. For the parent's educational background, it is observed the following values for the school of La Estrella: 19% of the mothers and 16% of the fathers have secondary education; 5% of the mothers and 13% of the fathers have primary school and 30% of the mothers, and 21% of the fathers have tertiary education. For the rest of the schools in Antioquia, the percentages are opposite for the secondary and tertiary education. That is, 37% of the mothers and 26% of the fathers have secondary education; 14% of the mothers and 19% of the fathers have primary education and 14% of the mothers, and 16% of the fathers have tertiary education. Concerning the parents' work status, there are fewer differences between the school of La Estrella and the rest of the schools in Antioquia. Specifically, the majority of mothers are housewives for the school of La Estrella and the rest, 17% and 39% respectively. Similarly, the majority of fathers are a laborer for both the school of La Estrella and the rest, 14% and 11% respectively. For the Sisben level, most of the students are in Sisben level 2 in both, the school of La Estrella and the rest of the schools in Antioquia, 5% and 6% respectively. Likewise, for the level of income both have on average an income level between one and two minimum wages, 31% and 37% respectively. Finally, regarding the schools' characteristics, it can be seen that the school of La Estrella is mixed, offers academic and technical education and it is a public school. Similarly, for the rest of the schools in Antioquia, 90% are mixed schools, 83% offer academic and technical education, and 80% are public schools.

Table A.3 describes the same variables presented in Table A.1, but for three different time periods. That is, for the term of time before the meditation project started, i.e. pre-treatment period (2004-2006), the period during the meditation project, i.e. treatment period (2007-

2009), and the period after the meditation project, i.e. post-treatment period (2010-2012). In particular, comparing the ICFES scores for the school of La Estrella and the rest of the schools in Antioquia for the three different time periods, it is observed that the highest difference in scores between both schools is during the treatment period. Also, the scores for the school of La Estrella are always lower than the scores for the rest of the schools in Antioquia. Similar to the values reported by Table A.1, in most of the social background dimension both groups of schools differ in the three time periods. These observed differences suggest the need for carefully choosing a comparison control group to the school of La Estrella when analyzing the effect of meditation during the treatment period.

The C600³ is used for obtaining different school characteristics information. This data set includes information at school level about the school type (i.e. private or public), the zone where is located the school, the academic calendar, the level of education and the gender of the population attending. These variables of the school characteristics and the students' social background are used as predictors of the different educational outcomes for constructing the synthetic control school. The C600 also includes information about the number of students per class and per grade, failure rates, approval rates and drop-out rates. These variables are also used as potential educational outcomes in the synthetic control analysis.

In the annex session, Table A.2 describes the failures, approval and dropout rates for the school of La Estrella and the rest of the schools in Antioquia for the period 2004-2011. For the failure rates is observed that the values are always higher for the school of La Estrella. Hence, for the secondary grade, the failure rate for the school of La Estrella is 12,42%, whereas for the rest of the schools in Antioquia is only 5,6%. For the approval rates, a similar behavior is observed. That is, slightly lower approval rates for the school of La Estrella when compared to the approval rates of the rest of the schools in Antioquia. Finally, regarding the dropout rates, it can be seen that the rates are always lower for the school of La Estrella.

Table 4.A shows the different rates for the three different time periods, i.e. pre-treatment, treatment, and post-treatment. For the failure and approval rates, the same pattern observed in Table 3.A is maintained, and the differences between both groups of schools are also kept during the three different time periods. However, only for the dropout rates, a different pattern during the treatment period is observed. In particular, the dropout rates seem to get closer during the treatment period, and this difference is slightly kept during the post-treatment period. These potential differences are analyzed in detail by using the methodology described in the following session.

³ Registry of Educational Institutions, Students and Teachers of Preschool, Basic (Elementary and Secondary) and Average, according to Law 715 of 2001

5. Empirical Strategy and Results

This section is divided into two parts. In the first part, the methodology used to analyze the data is described, i.e. the synthetic control. In the second part, the results obtained from the synthetic control are discussed separately for each of the educational outcomes that were used.

5.1 Synthetic control.

Given the nature of the present study, it is difficult to analyze the effect of meditation on educational outcomes because there is not a control group to be compared with. In particular, a pure time-series study of the effect of meditation on school performance at the school of La Estrella will be contaminated by all the different external factors that occurred during the years of intervention in the school. Additionally, at the moment of the meditation intervention, the school of La Estrella differed from the other schools in Antioquia in different dimension that are believed to be related to various educational outcomes. Therefore, a simple comparison of the progress of the school of La Estrella educational outcomes and educational outcomes in other schools in Antioquia will reflect not only the impact of meditation but also the impact of pre-meditation differences in educational outcomes.

To account for the before mentioned problem the empirical strategy follows the same strategy as the one used by Abadie and Gardeazabal (2003). That is, a combination of other schools in Antioquia is used to construct a synthetic control school which resembles essential educational and socioeconomic characteristics of the school of La Estrella before the meditation project had taken place. Consequently, the counterfactual school of La Estrella without meditation is compared to the experience of the school of La Estrella with meditation.

For constructing the counterfactual school of La Estrella without meditation, it is constructed a weighted combination of other schools in Antioquia chosen to resemble the characteristics of the school of La Estrella before meditation. The weighted average of other schools in Antioquia is referred as the synthetic school of La Estrella without meditation, against which it is compared the actual school of La Estrella with meditation.

In formal terms, let J be the number of control schools available at Antioquia (97 schools different from the school of La Estrella), and $W = (w_1, \dots, w_J)'$ a $(J \times 1)$ vector of nonnegative weights which sum to one. The scalar w_j ($j = 1, \dots, J$) is the weight of the school j in the synthetic school of La Estrella control. Each different value of W generates a different synthetic school of La Estrella, and accordingly the selection of the credible subset of control schools is deposited in the selection of the weights W .

As mentioned before, the weights are selected in a way that the synthetic school of La Estrella looks as close as possible to the actual one before meditation. Let X_1 be a $(K \times 1)$ vector of pre-meditation values of k school characteristic predictors (See Table **, column 3). Let X_0 be a $(K \times J)$ matrix which has the values of the same variables for the J possible control schools. Let V be a diagonal matrix with nonnegative components whose values represent the relative importance of the different school characteristic predictors. The vector of weights W^* is the one that minimizes $(X_1 - X_0W)'V(X_1 - X_0W)$ subject to $w_j \geq 0$ ($j = 1, 2, \dots, J$) and $w_1 + \dots + w_J = 1$. The vector W^* is the combination of non-meditation control schools in Antioquia which best resemble to the school of La Estrella in educational outcomes predictors at the outset of meditation⁴.

As can be seen in the minimization the resulted W^* depends on V ; therefore, something needs to be said about V . In particular, V is chosen in a way that the educational outcomes path for the school of La Estrella during the pre-treatment years is best reproduced by the obtained counterfactual school of La Estrella.

As a robustness check exercise a prior preprocessing data technique called entropy balance was also used. In particular, the balance obtained from both methodologies, i.e. synthetic control and entropy balance, were compared. The conclusion was that from both techniques a good balance in the covariates for the pre-treatment period is obtained. However, only the synthetic control allows using a bigger number of covariates. Therefore, the obtained weights in the synthetic control resemble better the actual school of La Estrella before the meditation intervention. The results achieved from the entropy balance method are shown in the appendix session.

5.2 Synthetic control results

Different educational outcomes are considered to study the effect of the meditation technique in the school of La Estrella. On the one hand, school performance is measured by the scores students obtained in the exam SB11 when they were finishing their secondary. On the other hand, measurements of approval rates, repetition rates, and dropout rates are analyzed as well. It is worth noting that since the synthetic school control of La Estrella is different for each of the mentioned outcome variables, it is required to analyze and discuss each case separately, as it is done in this section.

The school directives report that during the years of the meditation's project execution the school's reputation improved and this phenomenon attracted students from many other external schools in the surround areas. Some of the new students were good students, but some others were not. Unfortunately, given the constraints in the data available for this study, it is not possible to identify which students were new at the school. Since these new

⁴ To a more detailed explanation about this methodology please refer to (Abadie, A., & Gardeazabal, J, 2003).

students probably influenced the ICFES scores at the school of La Estrella, a way of controlling a part of this phenomenon is to analyze the ICFES scores excluding the 5% of the highest and lowest scores. For this purpose, the average ICFES scores per school analyzed in this section are average scores that were calculated without the 5% highest and lowest scores. For observing the patterns of the scores without this adjustment, please refer to the appendix.

Additionally, the school's directives also reported that before the meditation's project the school's reputation was deplorable. In particular, the worst students of the region or the ones that were expelled from other schools use to end up in the school of La Estrella. Therefore, adjusting the scores at the 5% allows controlling for this factor as well.

5.2.1 Mathematic ICFES Score

For the mathematic ICFES score, the optimal weights, W^* , are positive for 5 schools in Antioquia, with values 0.676, 0.061, 0.056, 0.117 and 0.089. Contrary the optimal weights take the value of zero for the other potential control schools. The column 3 in Table 2 shows the education outcome predictors for the synthetic school of La Estrella before the meditation project, i.e. $X_1^* = X_0 W^*$. This column reflects how well the weighted combination of schools in Antioquia reproduces the educational outcome predictors for the school of La Estrella before meditation. As can be seen in Table 3, the synthetic school of La Estrella looks very similar to the actual one in most of the predictors and the differences between the predictors become smaller when compared to the rest of the schools in Antioquia (see Table 2, column 2).

Let Y_1 be a $(T \times 1)$ vector whose elements represent the values of the mathematic ICFES score for the school of La Estrella during T time periods. Let Y_0 be a $(T \times J)$ matrix whose elements are the values of the same variables for the control schools. The main goal is to approximate the mathematic ICFES score path that the school of La Estrella would have had without meditation, that is during the years after the treatment was implemented. As it was mentioned before, from this process the counterfactual mathematic ICFES score path is obtained, or in other words the mathematic ICFES score of the synthetic school of La Estrella, $Y_1^* = Y_0 W^*$.

Table 2- Pre-Meditation Characteristics for the Mathematics Score, 2004-2006

	School of La Estrella	Antioquia	"Synthetic" School of La Estrella
	(1)	(2)	(3)
Mathematics Score	42.280	43.190	43.049
Secondary Educ. Mother	33.407%	47.389%	32.515%
Secondary Educ. Father	33.368%	31.380%	8.061%
Primary Educ. Mother	0.009%	15.994%	0.015%
Primary Educ. Father	26.244%	21.516%	20.270%
Tertiary Educ. Mother	60.713%	16.876%	57.054%
Tertiary Educ. Father	30.744%	22.982%	34.675%
Employee worker Father	0.000%	3.984%	3.109%
Employee worker Mother	25.286%	3.437%	24.337%
Home Worker Mother	0.050%	40.187%	3.476%
Laborer Father	0.050%	11.986%	2.843%
Laborer Mother	0.013%	4.388%	0.030%
Income, 1-2 sm	28.174%	38.504%	34.868%
Income, 2-3 sm	32.132%	21.416%	44.177%
Mixed School	1	0.901	0.999
Academic and Technic. School	1	0.847	0.999
Public School	1	0.806	0.999

Source: Author's computations from Sb11 data set.⁵

Figure 1 shows Y_1 and Y_1^* for the period 2004-2012. From 2004 to 2005 the school of La Estrella and the synthetic school behave similarly. From 2006 on, Y_1 and Y_1^* differ, and this difference becomes even stronger during the treatment years 2008 and 2009. It is worth noting that the project of meditation starts at the end of 2006, but 2007 is the first year where the implementation is done properly. Hence, the starting treatment period is 2007, where the dotted vertical line is. During the first year of complete implementation, 2007, there is a slight improvement, but it is no bigger than 1 point in the mathematics score. However, in the following year, there is a decline in the mathematic score of the school of

⁵ Secondary Educ. Mother: Percentage of students with a mother with a secondary degree

Secondary Educ. Father: Percentage of students with a father with a secondary degree

Primary Educ. Mother: Percentage of students with a mother with a primary degree

Primary Educ. Father: Percentage of students with a father with a primary degree

Tertiary Educ. Mother: Percentage of students with a mother with a tertiary degree

Tertiary Educ. Father: Percentage of students with a father with a tertiary degree

Employee worker Mother: Percentage of students with a mother who is an employee worker

Employee worker Father: Percentage of students with a father who is an employee worker

Home Worker Mother: Percentage of students with a mother who is a housewife

Laborer Mother: Percentage of students with a mother who works as a laborer

Laborer Father: Percentage of students with a father who works as a laborer

Income, 1-2 sm: Percentage of students with an income between 1 and 2 minimum wages

Income, 2-3 sm: Percentage of students with an income between 2 and 3 minimum wages

Mixed School: Dummy variable that takes the value of 1 when the school gender is mixed

Academic and Technic. School: Dummy variable that takes the value of 1 when the school is academic an/or technical

Public School: Dummy variable that takes the value of 1 when the school is public.

La Estrella only. Interestingly, between 2008 and 2009 there is a decrease of 8 points in the mathematic score of the synthetic school of La Estrella but not in the school of La Estrella. This difference in behavior during the last year of the project's execution, i.e. 2009, could reflect that the meditation project helped the school of La Estrella to avoid this strong decline in score.

In the following years after the project, i.e. from 2010 onwards, the difference between the school of La Estrella and the synthetic one disappears, revealing the weakness in the long term effects of meditation.

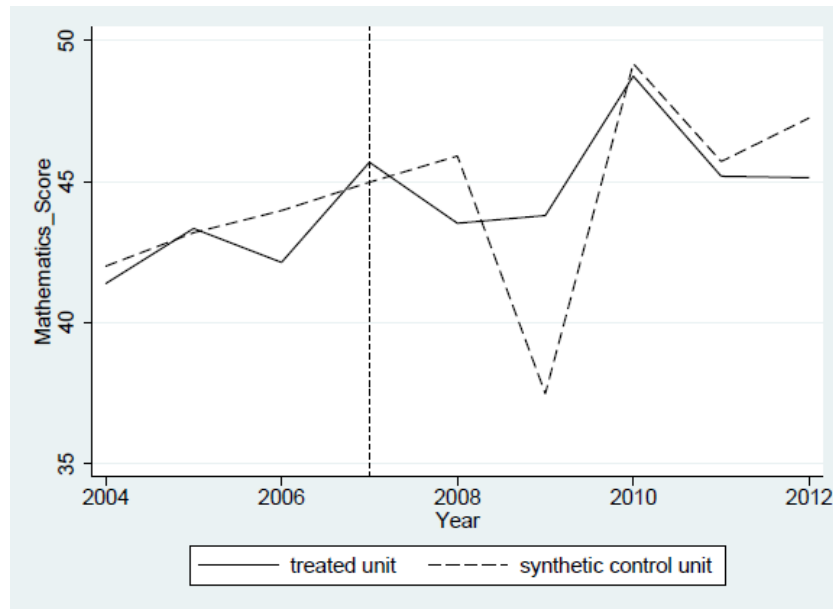


Figure 1. Mathematics Score for the school of La Estrella versus the Synthetic control school (dotted line).

5.2.2 Philosophy ICFES Score

For the philosophy ICFES score, the optimal weights, W^* , are positive for six schools in Antioquia, with values 0.752, 0.107, 0.012, 0.01, 0.098 and 0.02; and zero for the other potential control schools. Table 3 shows in column 3 the education outcome predictors for the synthetic school of La Estrella before the meditation project, i.e. $X_1^* = X_0 W^*$. Comparing columns 1 and 3 it can be seen how well the weighted combination of schools in Antioquia reproduces the educational outcome predictors for the school of La Estrella before meditation. In particular, the synthetic school of La Estrella looks closer to the school of La Estrella than all the other schools in Antioquia (see Table 3, column 2). Although for some predictors the school of La Estrella and the synthetic school do not converge very close, in Figure 2 can be seen how well the philosophy score converge for both the treated and the control school for the period 2004-2006.

Table 3- Pre-Meditation Characteristics for the Philosophy Score, 2004-2006

	School of la Estrella	Antioquia	"Synthetic" School of la Estrella
	(1)	(2)	(3)
Philosophy Score	44.652	45.032	44.225
Secondary Educ. Mother	33.407%	47.389%	33.859%
Secondary Educ. Father	33.368%	31.380%	14.352%
Primary Educ. Mother	0.000%	15.994%	0.335%
Primary Educ. Father	26.235%	21.516%	22.883%
Tertiary Educ. Mother	60.713%	16.876%	57.094%
Tertiary Educ. Father	30.744%	22.982%	30.635%
Employee worker Father	0.000%	3.984%	2.606%
Employee worker Mother	25.286%	3.437%	23.590%
Home Worker Mother	0.050%	40.187%	3.592%
Laborer Father	0.050%	11.986%	2.309%
Laborer Mother	0.013%	4.388%	1.542%
Income, 1-2 sm	28.174%	38.504%	31.401%
Income, 2-3 sm	32.132%	21.416%	52.596%
Mixed School	1	0.901	0.999
Academic and Technic. School	1	0.847	0.989
Public School	1	0.806	0.979

Source: Author's computations from Sb11 data set.

Figure 2 plots Y_1 and Y_1^* for the period 2004-2012, where the elements of Y_1 and Y_1^* represent the values of the philosophy ICFES score for the school of La Estrella and the synthetic school control respectively. For the first year of implementation, there is no difference between the Y_1 and Y_1^* . However, for the following two years of the project, i.e. 2008 and 2009, the philosophy ICFES score drastically decreases for the school of La Estrella, and the difference between Y_1 and Y_1^* becomes even stronger during the 2009, i.e. 7 points of difference in the score. In the years that follow the meditation's project the difference between both seems to disappear or to decrease.

5.2.3 Language ICFES Score

For the language ICFES score, the optimal weights, W^* , are positive for 7 schools in Antioquia, with values 0.819, 0.016, 0.102, 0.023, 0.005, 0.031 and 0.004; and zero for the other potential control schools. Column 3 in Table 4 describes the education outcome predictors for the synthetic school of La Estrella before the meditation project, i.e. $X_1^* = X_0 W^*$. Looking at columns 1 and 3 it can be seen that the synthetic school of La Estrella looks closer to the school of La Estrella than all the other schools in Antioquia do for most of the predictors (see Table 3, column 2). Although few predictors of the school of La Estrella and the synthetic control school do not converge very close, in Figure 3 can be seen how well the language score converge for both the treated and the control school for the period 2004-2006.

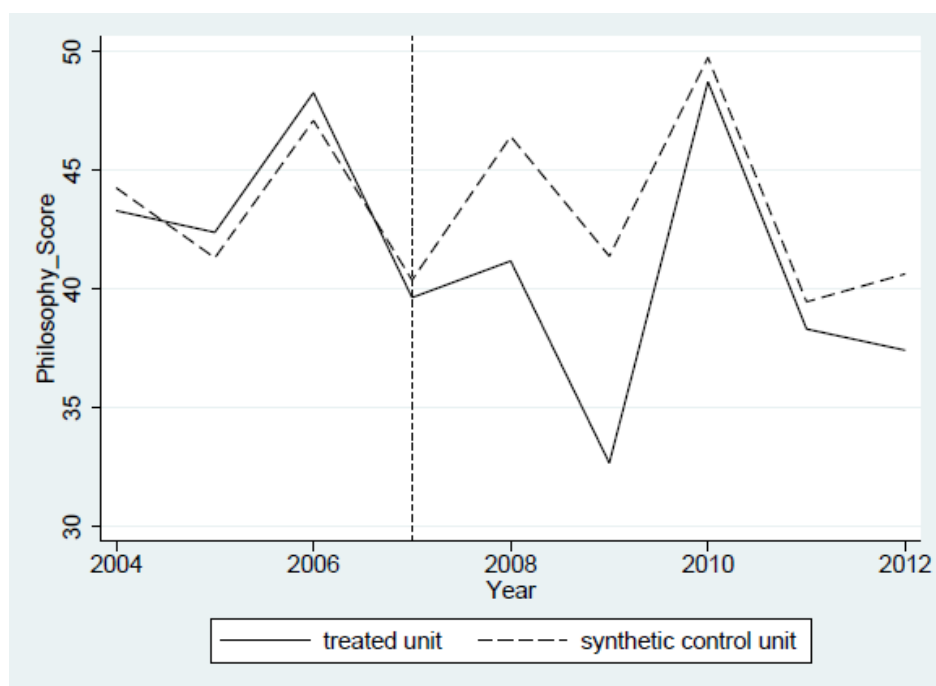


Figure 2. Philosophy Score for the school of La Estrella versus the Synthetic control school (dotted line).

Table 4- Pre-Meditation Characteristics for the Language Score, 2004-2006

	School of La Estrella (1)	Antioquia (2)	"Synthetic" School of La Estrella (3)
Language Score	42.280	48.807	43.049
Secondary Educ. Mother	33.407%	47.389%	33.780%
Secondary Educ. Father	33.368%	31.380%	11.747%
Primary Educ. Mother	0.000%	15.994%	0.168%
Primary Educ. Father	26.235%	21.516%	24.722%
Tertiary Educ. Mother	60.713%	16.876%	58.000%
Tertiary Educ. Father	30.744%	22.982%	28.457%
Employee worker Father	0.000%	3.984%	0.825%
Employee worker Mother	25.286%	3.437%	23.692%
Home Worker Mother	0.050%	40.187%	1.814%
Laborer Father	0.050%	11.986%	1.781%
Laborer Mother	0.013%	4.388%	0.323%
Income, 1-2 sm	28.174%	38.504%	30.932%
Income, 2-3 sm	32.132%	21.416%	55.898%
Mixed School	1	0.901	1.000
Academic and Technic. School	1	0.847	0.995
Public School	1	0.806	0.996

Source: Author's computations from the Sb11 data set.

Figure 3 plots Y_1 and Y_1^* for the period 2004-2012, where the elements of Y_1 and Y_1^* are the values of the language ICFES score for the school of La Estrella and the synthetic school control respectively. For the first year of implementation, i.e. 2007, both scores decrease. In the following year, Y_1 continues decreasing, and Y_1^* recovers slightly from the fall of the previous year. However, for the last year of the meditation's project, the philosophy ICFES score improves for the school of La Estrella in 4 points in the score. Contrary, for the synthetic control school the philosophy ICFES score gets worst compared to the previous year and also to the school of La Estrella. Finally, during the years that follow the meditation's project, the difference between both schools seems to be maintained, with a distinct advantage for the synthetic control school.

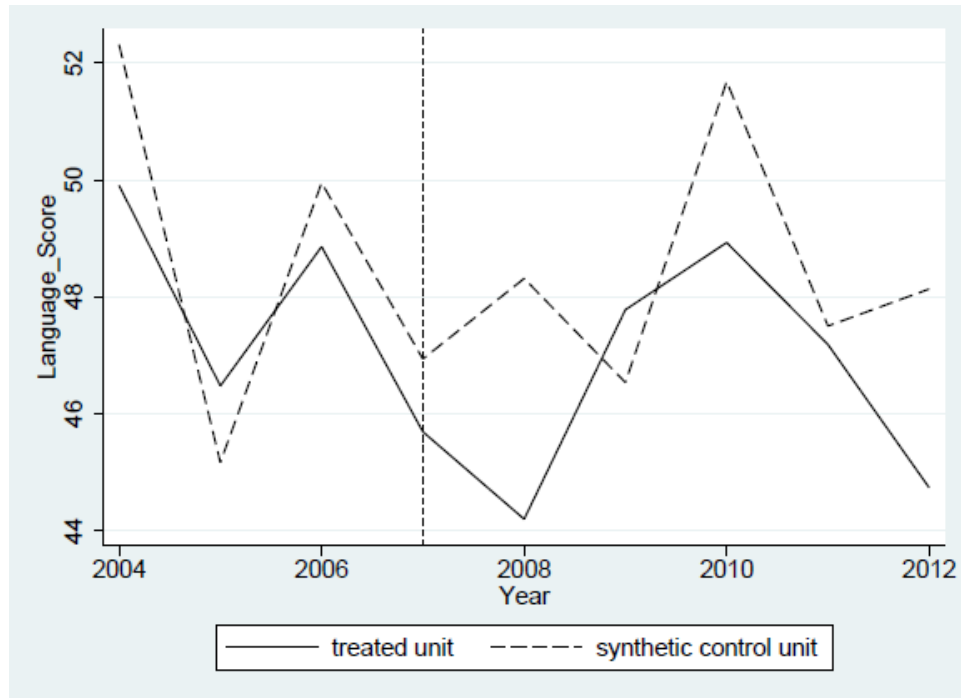


Figure 3. Language Score for the school of La Estrella versus the Synthetic control school (dotted line).

In conclusion, for the three different ICFES scores, i.e. mathematics, philosophy, and language, it is observed that both the synthetic control school and the school of La Estrella differ during the treatment period, i.e. 2007-2009. This difference does not seem to reflect any strong positive impact of meditation on the scores. For the three scores, there is not much difference between the synthetic school and the school of La Estrella during the first complete year of implementation, i.e. 2007. However, in the following year of implementation, i.e. 2008, the performance of the synthetic school was better than the one at the school of La Estrella in the three scores, suggesting a negative impact of meditation on these three scores for that year. The year after, i.e. 2009, the mathematics and language scores significantly improved in the school of La Estrella, when compared to the synthetic school. In particular, for the synthetic school during 2009, there is a strong fall in the

mathematics and language scores, whereas for the school of La Estrella is the opposite situation, there is an increase in both scores. More importantly, this increase in the school of La Estrella managed to surpass the scores of the synthetic school, even though the scores of the synthetic school were higher the year before. In the following years to the project, the difference between both schools converges, suggesting that there are not long run effects of the meditation project.

For the philosophy, the score is observed that during the whole treatment period, although the performance of the school of La Estrella has the same tendency as the one in the synthetic school, it is always worst in the school of La Estrella. This result proposes a negative impact of the meditation project on the philosophy score for the school of La Estrella.

5.2.4 Approval Rate

In this subsection, it is only analyzed the approval rate for the secondary degree because it compresses the approval rates for all the school degrees that had the meditation technique. In case you want to check by yourself separately the approval rates for each school degree please refer to the appendix.

For the secondary approval rate, the optimal weights, W^* , are positive for five schools in Antioquia, with values 0.162, 0.037, 0.742, 0.034 and 0.025; and zero for the other potential control schools. Column 3 in table 5 shows the education outcome predictors for the synthetic school of La Estrella before the meditation project, i.e. $X_1^* = X_0 W^*$. Looking at columns 1 and 3, it can be seen that the synthetic school of La Estrella looks closer to the school of La Estrella only in some predictors. However, for most of the predictors, the weighted combination of schools gets closer to the school of La Estrella than the rest of the schools in Antioquia, and particularly also for the secondary approval rate.

The convergence between the counterfactual and the actual school is not as good for the approval rates as it is for the ICFES scores. However, this difference is present even before the whole estimation of the weights. Particularly, the school of La Estrella seems to strongly differ from the rest of the schools in Antioquia regarding approval rates. Therefore, closing the gap between the synthetic school and the school of La Estrella becomes harder. Nevertheless, it is worth the analysis because the weighted school seems to recover the same tendency in the rate for the pre-treatment period.

Figure 4 shows Y_1 and Y_1^* for the period 2004-2011, where the elements of Y_1 and Y_1^* are the values of the secondary approval rates for the school of La Estrella and the synthetic school control respectively. For the first year of complete implementation, i.e. 2007, both approval rates decrease, but the fall is stronger for the school of La Estrella. However, in the following year, the approval rates recover for both schools, and the recovery for the school of La Estrella is drastically when compared to the synthetic control school recover.

During the last year of implementation, i.e. 2009, both approval rates decrease again. Finally, during the years that follow the meditation's project the difference between both schools is maintained, with higher approval rates for the synthetic school.

Table 5- Pre-Meditation Characteristics for the Secondary Approval Rate, 2004-2006

	School of La Estrella	Antioquia	"Synthetic" School of La Estrella
	(1)	(2)	(3)
Approval Rate for Secondary	81.619%	87.533%	85.617%
Secondary Educ. Mother	33.407%	47.389%	29.987%
Secondary Educ. Father	33.368%	31.380%	38.514%
Primary Educ. Mother	0.009%	15.994%	0.763%
Primary Educ. Father	26.244%	21.516%	0.808%
Tertiary Educ. Mother	60.713%	16.876%	54.658%
Tertiary Educ. Father	30.744%	22.982%	45.640%
Employee worker Father	0.000%	3.984%	19.728%
Employee worker Mother	25.286%	3.437%	17.983%
Home Worker Mother	0.050%	40.187%	22.893%
Laborer Father	0.050%	11.986%	5.110%
Laborer Mother	0.013%	4.388%	3.012%
Income, 1-2 sm	28.174%	38.504%	50.803%
Income, 2-3 sm	32.132%	21.416%	9.541%
Mixed School	1	0.901	0.966
Academic and Technic. School	1	0.847	1
Public School	1	0.806	0.941

Source: Author's computations from the Sb11 and c600 data sets.

Although it is clear that regarding the approval rate the school of La Estrella behaves worse than the synthetic control school, it is important to note that this difference is maintained during all the pre-meditation, meditation and post-meditation period. Only during the first year of implementation, i.e. 2007, the difference of the approval rate between the school of La Estrella and the synthetic control school seems to strongly change. This strong fall during the year 2007 could reflect how the entrance of new students due to the meditation's project affected the approval rates for that year. In particular, the project attracted at the beginning many new students to the school, some of them bad students who certainly affected the approval rates at the school.

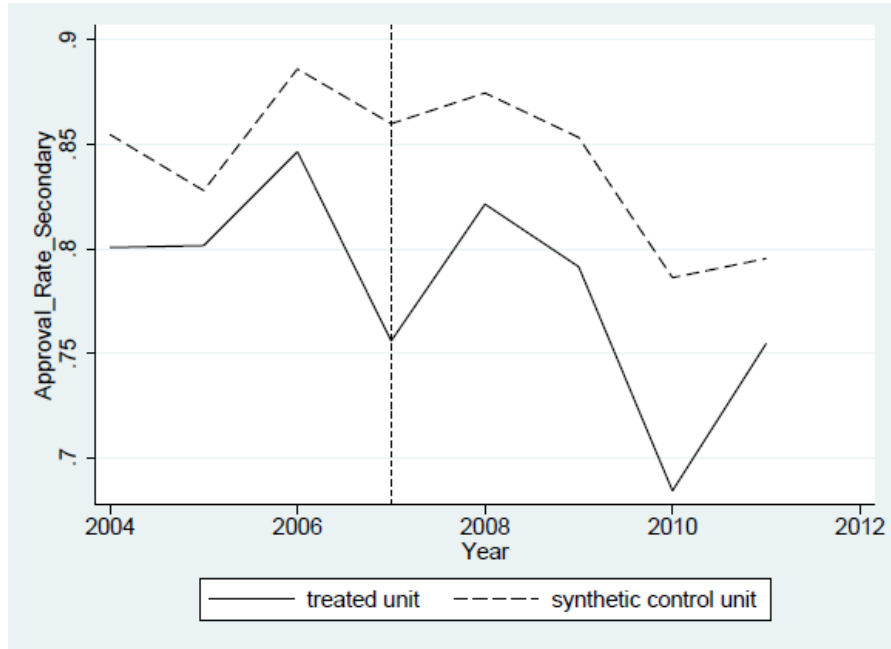


Figure 4. Approval Rate at secondary level for the school of La Estrella versus the Synthetic control school (dotted line).

5.2.5 Failure Rate

As in the previous subsection, here it is only analyzed the failure rate for the secondary degree as well. In case you want to check by yourself separately the failure rates for each school degree please refer to the appendix.

For the secondary failure rate⁶, the optimal weights, W^* , are positive for seven schools in Antioquia, with values 0.199, 0.035, 0.376, 0.17, 0.002, 0.146 and 0.073; and zero for the other potential control schools. For the failure rate the Table 6 shows in column 3 the education outcome predictors for the synthetic school of La Estrella before the meditation project, i.e. $X_1^* = X_0 W^*$. Comparing columns 1 and 3 it can be observed how weak the weighted combination of schools in Antioquia reproduces the educational outcome predictors for the school of La Estrella before meditation. In particular, for very few predictors the difference between the school of La Estrella and the synthetic control school is small. Additionally, Figure 5 also shows that the similitude between the school of La Estrella and the synthetic control school is very small during the pre-treatment period.

⁶ It is calculated as the number of students that fail in the secondary degree, i.e. for 6° to 11°, over the total number of student enrolled in secondary for the specific year.

Table 6- Pre-Meditation Characteristics for the Secondary Failure Rate, 2004-2006

	School of La Estrella	Antioquia	"Synthetic" School of La Estrella
	(1)	(2)	(3)
Failure Rate	11.307%	5.477%	5.437%
Secondary Educ. Mother	33.407%	47.389%	31.826%
Secondary Educ. Father	33.368%	31.380%	38.824%
Primary Educ. Mother	0.009%	15.994%	0.835%
Primary Educ. Father	26.244%	21.516%	14.648%
Tertiary Educ. Mother	60.713%	16.876%	42.797%
Tertiary Educ. Father	30.744%	22.982%	35.375%
Employee worker Father	0.000%	3.984%	9.996%
Employee worker Mother	25.286%	3.437%	12.108%
Home Worker Mother	0.050%	40.187%	31.430%
Laborer Father	0.050%	11.986%	15.352%
Laborer Mother	0.013%	4.388%	1.897%
Income, 1-2 sm	28.174%	38.504%	33.577%
Income, 2-3 sm	32.132%	21.416%	21.251%
Mixed School	1	0.901	0.855
Academic and Technic. School	1	0.847	1.001
Public School	1	0.806	0.928

Source: Author's computations from the Sb11 and c600 data sets.

Figure 5 shows Y_1 and Y_1^* for the period 2004-2011, where the elements of Y_1 and Y_1^* are the values of the secondary failure rates for the school of La Estrella and the synthetic school control respectively. In general, the school of La Estrella has higher failure rates than the synthetic control school during the whole period (2004-2011). Similar to the behavior observed for the approval rates, during the year 2007 there is a strong increase in the failure rate. This peak in 2007 is probably also driven by the arrival of new students to the school of La Estrella. During the following year the failure rate seems to recover, but the next 3 years the tendency is again back to high level of failure rates.

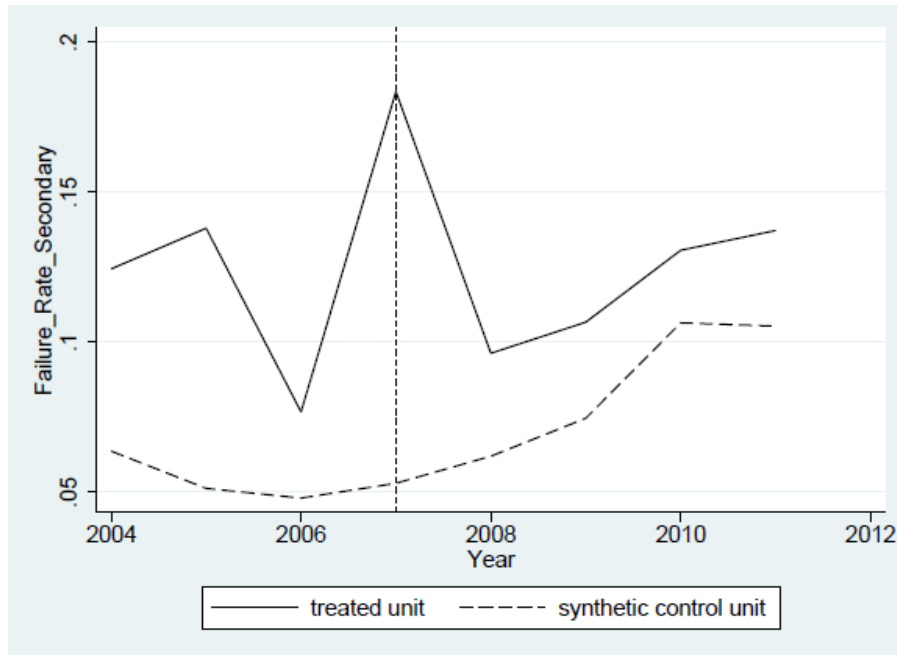


Figure 5. Failure Rate at secondary level for the school of La Estrella versus the Synthetic control school (dotted line).

5.2.6 Dropout Rate

In this subsection is only analyzed the dropout rate for the secondary degree as well. In case you want to check by yourself separately the dropout rates for each school degree please refer to the appendix.

For the secondary dropout rate⁷, the optimal weights, W^* , are positive for six schools in Antioquia, with values 0.008, 0.238, 0.05, 0.362, 0.144 and 0.196; and zero for the other potential control schools. The Table 7 shows in column 3 the education outcome predictors for the dropout rate for the synthetic school of La Estrella before the meditation project, i.e. $X_1^* = X_0 W^*$. Comparing columns 1 and 3 it can be seen that the weighted combination of schools in Antioquia does not perfectly reproduces all the educational outcome predictors for the school of La Estrella before meditation. However, as in the case of the approval rate the synthetic control school captures the same behavior for dropout rate for the pre-treatment period (see Figure 6).

⁷ It is calculated as the number of students that dropout in the secondary degree, i.e. for 6° to 11°, over the total number of student enrolled in secondary for the specific year.

Table 7- Pre-Meditation Characteristics for the Secondary Dropout Rate, 2004-2006

	School of La Estrella	Antioquia	"Synthetic" School of La Estrella
	(1)	(2)	(3)
Dropout Rate	0.41%	4.33%	4.40%
Secondary Educ. Mother	33.407%	47.389%	31.331%
Secondary Educ. Father	33.368%	31.380%	38.894%
Primary Educ. Mother	0.009%	15.994%	1.275%
Primary Educ. Father	26.244%	21.516%	17.938%
Tertiary Educ. Mother	60.713%	16.876%	46.881%
Tertiary Educ. Father	30.744%	22.982%	34.936%
Employee worker Father	0.000%	3.984%	9.623%
Employee worker Mother	25.286%	3.437%	8.773%
Home Worker Mother	0.050%	40.187%	22.226%
Laborer Father	0.050%	11.986%	17.604%
Laborer Mother	0.013%	4.388%	5.020%
Income, 1-2 sm	28.174%	38.504%	27.312%
Income, 2-3 sm	32.132%	21.416%	23.124%
Mixed School Academic and Technic. School	1	0.901	0.998
Public School	1	0.847	0.998
	1	0.806	0.802

Source: Author's computations from the Sb11 and c600 data sets

Figure 6 plots Y_1 and Y_1^* for the period 2004-2011, where the elements of Y_1 and Y_1^* are the values of the secondary dropout rates for the school of La Estrella and the synthetic school control respectively. For the first two years of the project's implementation, i.e. 2007 and 2008, the dropout rates increase 0.03% and 0.02% respectively. In the following years, the dropout rates continue with an oscillatory behavior.

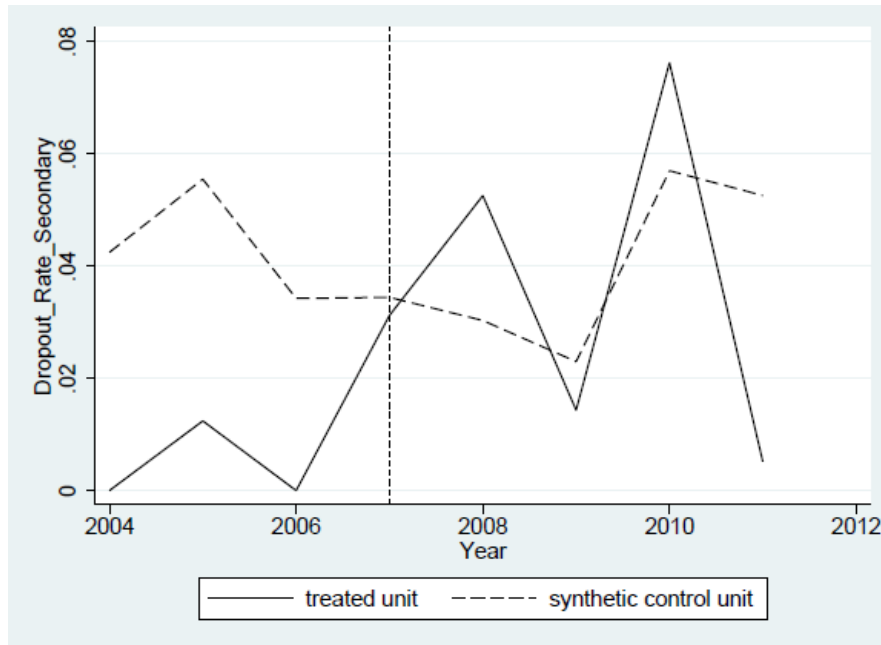


Figure 6. Failure Rate at secondary level for the school of La Estrella versus the Synthetic control school (dotted line).

In summary, the results provided for the approval, failure and dropout rates for secondary degree suggest that for the first year of implementation, i.e. 2007, there is a harmful effect of meditation on the different rates. In particular, the approval rate has a strong decrease in the school of La Estrella. Moreover, the failure and dropout rates significantly increase in 2007. During the second year of implementation, i.e. 2008, it seems to be improvements in the school of La Estrella concerning the approval and failure rates, but this improvement is partly reversed in the following year. Contrary, the dropout rate continues to increase during the 2008, but in 2009 it has a strong decrease. Finally, in the following two years to the meditation project, i.e. 2010 and 2011, the difference between the school of La Estrella and the synthetic control school is maintained, with poorer rates for the school of La Estrella.

6. Conclusions

This paper studies the impact of the practice of transcendental meditation on different educational outcomes for a school located in the municipality of La Estrella, in Antioquia Colombia. Most of the research on meditation has big limitations concerning deficient control comparisons to analyze the impact of meditation on adult and teenage populations. Up to my knowledge, this is the first study to account for this problem by building a counterfactual control group as a reference. In particular, following the methodology used by Abadie and Gardeazabal (2003), a combination of other schools in Antioquia is used to build a synthetic control school for every educational outcome. The synthetic school resembles important educational and socioeconomic characteristics of the school of La Estrella before the meditation project had taken place. Afterward, a comparison between

the counterfactual school of La Estrella without meditation and the experience of the school of La Estrella with meditation is done.

The results described in the previous session suggest that the impact of the meditation project is weak regarding the school's performance and approval, failure and dropout rates at the school of La Estrella. Specifically, only during the last year of intervention, i.e. 2009, it seems to be an improvement in the mathematics and language score thanks to the meditation technique. This outcome is intuitive since the meditation technique has proven to influence different cognitive aspects, such as increased ability to focus attention on a specific task and faster speed for processing information, which are crucial tools when doing logical reasoning in mathematical thinking and comprehension analysis for language. Although it was expected to observe a positive effect from the beginning of the project, it seems like the different challenges concerning the project's execution and implementation did not allow this. Specifically, the project improved the school's external perception, and this phenomenon attracted many students from other schools. The arrival of new students influenced the different educational outcomes at the school. Unfortunately, giving the lack of information for the current study it was not possible to account for all these new students during the treatment period.

During the years of the meditation project, a negative impact on the philosophy score is observed. Particularly, for the three years of intervention, the score of the school of La Estrella is significantly smaller than the score for the synthetic school control. This result could suggest that during the years of meditation, subjects considered less important by the school's directives, such as philosophy, were forgotten in a way because the attention was given to the act of meditation. One more explanation for this observed behavior could be that the arrival of new students specifically affected the most the philosophy score. Finally, one could also believe that the meditation technique replaced in a way the knowledge students believed to acquire from the philosophy class. Therefore, they were paying less attention to the philosophy lectures at the school.

The approval, failure and dropout rates also reflect the effect of new students in the school. Particularly, during the first year of implementation, all three rates deteriorate. Besides, even though the approval and failure rate seems to slightly improve during the second year of the intervention, the effect is reversed during the following years. These results reflect the need of doing an adequate monitoring of all types of interventions in educational institutions. Even when the motivation behind the intervention is good, if the project does not receive enough monitoring from the school's directives and the institutional side, it is likely that the project does not thrive. In the case of the school of La Estrella, it seems like the meditation project could have had better potential outcomes if there would have been a better accompaniment on the part of the directives of the school. Especially, a better monitoring of the new incoming students was needed.

It is worth to notice that since the time spent in meditation used to correspond to 15 minutes of class, the observed effect in the different educational outcomes could be attributed to changes in the distribution of time and not to the meditation. For accounting for this problem, it would be needed to have a comparison group were another activity instead of meditation was done during the 15 minutes. However, for this study, it was not possible to find such a control group as a comparison to the school of La Estrella.

Last but not least, it is worth to mention that according to the literature the strongest effects of meditation are reflected in levels of depression and anxiety. Different measurements of depression and anxiety were missing in this study to account for this possible channel in students. Also, according to the school directives, most of the students were very problematic concerning the coexistence with the other students and professors, but this situation completely changed thanks to the meditation technique. However, none of these changes in students' behavior and school environment were measured neither, and the data used for measuring educational outcomes stay short in accounting for those effects. Therefore, it is hard to contradict or confirm the observed behavior by the school's directives.

7. Bibliography

Barnes, V. A., Bauza, L. B., & Treiber, F. A. (2003). Impact of stress reduction on negative school behavior in adolescents. *Health and Quality of Life Outcomes*, 1(10), 1-7.

Barnes PM, Bloom B, Nahin RL. Complementary and alternative medicine use among adults and children: United States, 2007. *Natl Health Stat Rep*. 2008;(12):1-23.

Bohlmeijer E, Prenger R, Taal E, et al. The effects of mindfulness-based stress reduction therapy on mental health of adults with a chronic medical disease: a meta-analysis. *J Psychosom Res*. 2010; 68(6): 539-44.

Bremner, J. D. & Narayan, M. (1998). The effects of stress on memory and the hippocampus throughout the life cycle: Implications for childhood development and aging. *Development & Psychopathology*, 10, 871–885.

Brook, R. D., Appel, L. J., Rubenfire, M., Ogedegbe, G., Bisognano, J. D., Elliott, W. J., . & Rajagopalan, S. (2013). on behalf of the American Heart Association Professional Education Committee of the Council for High Blood Pressure Research, Council on Cardiovascular and Stroke Nursing, Council on Epidemiology and Prevention, and Council on Nutrition, Physical Activity, et al. Beyond medications and diet: alternative approaches to lowering blood pressure: a scientific statement from the American Heart Association. *Hypertension*, 61(6), 1360-1383.

Chambless DL, Hollon SD. Defining empirically supported therapies. *J Consult Clin Psychol.* 1998; 66(1): 7-18.

Chen KW, Berger CC, Manheimer E, et al. Meditative therapies for reducing anxiety: a systematic review and meta-analysis of randomized controlled trials. *Depress Anxiety.* 2012; 29(7):545-62.

Diamond AJ, Sekhon J (2006). "Genetic Matching for Causal Effects: A General Multivariate Matching Method for Achieving Balance in Observational Studies." Working Paper.

Flook, Lisa, Smalley, Susan L., Kitil, M. Jennifer, Galla, Brian M, Kaiser-Greenland, Susan, Locke, Jill. Ishikima, Eric and Kasari, Connie(2010) "Effects of Mindful Awareness Practices on Executive Functions in Elementary School Children", *Journal of Applied School Psychology*, 26: 1, 70-95.

Goleman, D. (1972). The Buddha on meditation and states of consciousness, Part I: The teachings. *The Journal of Transpersonal Psychology*, 4(1), 1.

Goleman, D. (1988). *The meditation mind*. Los Angeles: Tarcher.

Goyal, M., Singh, S., Sibinga, E. M., Gould, N. F., Rowland-Seymour, A., Sharma, R., ... & anasinghe, P. D. (2014). Meditation programs for psychological stress and well-being: a systematic review and meta-analysis. *JAMA internal medicine*, 174(3), 357-368.

Hainmueller, J. (2011). Entropy balancing for causal effects: A multivariate reweighting method to produce balanced samples in observational studies. *Political Analysis*, mpr025.

Hainmueller, J., & Xu, Y. (2013). Ebalance: A Stata package for entropy balancing. *Journal of Statistical Software*, 54(7).

Hall, P. D. (1999). The effect of meditation on the academic performance of African American college students. *Journal of Black Studies*, 29 (3), 408–415.

Hollon SD, Ponniah K. A review of empirically supported psychological therapies for mood disorders in adults. *Depress Anxiety.* 2010; 27(10): 891-932.

Iacus S, King G, Porro G (2012). "Causal Inference without Balance Checking: Coarsened Exact Matching." *Political Analysis*, 20(1), 1-24.

Jha, A., Krompinger, J., & Baime, M. J. (2007). Mindfulness training modifies subsystems of attention. *Cognitive, Affective, & Behavioral Neuroscience*, 7, 109–119.

Lazar, S. W., Kerr, C. E., Wasserman, R. H., Gray, J. R., Greve, D. N., Treadway, M. T., ... & Fischl, B. (2005). Meditation experience is associated with increased cortical thickness. *Neuroreport*, 16(17), 1893-1897.

Murnane, R. J., & Ganimian, A. J. (2014). *Improving educational outcomes in developing countries: Lessons from rigorous evaluations* (No. w20284). National Bureau of Economic Research.

Napoli, M., Krech, P. R., & Holley, L. C. (2005). Mindfulness training for elementary school students: The attention academy. *Journal of Applied School Psychology*, 21(1), 99-125.

National Center for Complementary and Alternative Medicine (NCCAM) [Web Page]. <http://nccam.nih.gov>. Accessed June 2017.

OECD (2016), *Education in Colombia*, OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/9789264250604-en>

Ospina, M. B., Bond, K., Karkhaneh, M., Tjosvold, L., Vandermeer, B., Liang, Y., ... & Klassen, T. P. (2007). Meditation practices for health: state of the research. *Evid Rep Technol Assess (Full Rep)*, 155(155), 1-263.

Shapiro, S. L., Brown, K. W., & Astin, J. A. (2008). Toward the integration of meditation into higher education: A review of research. *The Center for Contemplative Mind in Society*. Retrieved from <http://www.contemplativemind.org/admin/wp-content/uploads/2012/09/MedandHigherEd.pdf>.

Schonert-Reichl, K. A., & Lawlor, M. S. (2010). The effects of a mindfulness-based education program on pre-and early adolescents' well-being and social and emotional competence. *Mindfulness*, 1(3), 137-151.

Tough, P. (2013). *How children succeed*. Random House.

Taylor, P., Davies, L., Wells, P., Gilbertson, J., & Tayleur, W. (2015). A review of the Social Impacts of Culture and Sport.

Walsh, R. (1999). *Essential spirituality: The seven central practices*. New York: Wiley & Sons.

8. Annexes

Table A.1: Descriptive statistics for the period 2004-2012

Variable	Mean		sd		Max		Min		N	
	1	0	1	0	1	0	1	0	1	0
La Estrella School										
ICFES Score										
Mathematics score	44.320	44.366	2.182	4.064	48.733	70.941	41.377	31.075	9	582
Philosophy Score	41.324	43.663	5.123	3.676	48.727	58.980	32.675	32.480	9	582
Language Score	47.083	48.091	1.974	3.749	49.906	60.033	44.196	36.658	9	582
Parents' education										
Secondary Educ. Mother	0.191	0.377	0.314	0.390	1	1	0.001	0	9	582
Secondary Educ. Father	0.165	0.260	0.318	0.356	1	1	0	0	9	582
Primary Educ. Mother	0.052	0.145	0.062	0.290	0.183	1	0	0	9	582
Primary Educ. Father	0.138	0.197	0.252	0.327	0.787	1	0	0	9	582
Tertiary Educ. Mother	0.300	0.140	0.443	0.291	0.916	1	0	0	9	582
Tertiary Educ. Father	0.213	0.167	0.381	0.325	0.916	1	0	0	9	582
Parents' work status										
Employee worker Father	0.011	0.031	0.026	0.136	0.079	1	0	0	9	582
Employee worker Mother	0.085	0.029	0.253	0.135	0.759	0.905	0	0	9	582
Home Worker Mother	0.174	0.394	0.187	0.394	0.466	1	0	0	9	582
Laborer Father	0.144	0.117	0.152	0.251	0.389	1	0	0	9	582
Laborer Mother	0.039	0.042	0.043	0.165	0.122	1	0	0	9	582
Sisben Level										
Sisben level 1	0.001	0.029	0.003	0.123	0.009	1	0	0	9	582
Sisben level 2	0.058	0.064	0.116	0.167	0.286	1	0	0	9	582
Sisben level 3	0.000	0.021	0.000	0.105	0.000	0.931	0	0	9	582
Income										
Income, 1 sm	0.011	0.090	0.021	0.250	0.065	1	0	0	9	582
Income, 1-2 sm	0.316	0.371	0.287	0.390	0.845	1	0	0	9	582
Income, 2-3 sm	0.209	0.161	0.360	0.301	0.9575	1	0	0	9	582
School Characteristics										
Mixed School	1	0.905	0	0.293	1	1	1	0	9	582
Academic and Technic. School	1	0.835	0	0.371	1	1	1	0	9	582
Public School	1	0.804	0	0.397	1	1	1	0	9	582

Table A.2: Descriptive statistics for failures, approval and dropout rates for the period 2004-2012

Variable	Mean		sd		Max		Min		N	
	1	0	1	0	1	0	1	0	1	0
La Estrella School										
Failure Rates										
6°	0.1311	0.063	0.050	0.049	0.198	0.303	0.081	0	8	573
7°	0.1389	0.061	0.053	0.046	0.246	0.341	0.065	0	8	574
8°	0.1413	0.059	0.047	0.050	0.213	0.415	0.073	0	8	572
9°	0.1743	0.049	0.083	0.044	0.298	0.230	0.080	0	8	570
10°	0.0829	0.063	0.048	0.059	0.169	0.341	0.026	0	8	556
11°	0.0276	0.024	0.018	0.045	0.047	0.571	0	0	8	555
Secondary	0.1242	0.056	0.032	0.030	0.183	0.225	0.077	0	8	543
Approval Rates										
6°	0.7629	0.851	0.058	0.096	0.863	1	0.703	0.457	8	573
7°	0.7659	0.862	0.067	0.082	0.838	1	0.637	0.463	8	574
8°	0.7524	0.868	0.099	0.080	0.865	1	0.602	0.477	8	572
9°	0.7296	0.881	0.083	0.076	0.850	1	0.645	0.500	8	570
10°	0.8278	0.863	0.061	0.088	0.921	1	0.711	0.444	8	556
11°	0.9238	0.942	0.033	0.066	0.969	1	0.859	0.393	8	555
Secondary	0.7820	0.873	0.050	0.061	0.846	1	0.684	0.641	8	543
Dropout Rates										
6°	0.0300	0.048	0.033	0.059	0.094	0.364	0	0	8	573
7°	0.0159	0.040	0.022	0.049	0.065	0.28	0	0	8	574
8°	0.0286	0.037	0.039	0.047	0.105	0.333	0	0	8	572
9°	0.0279	0.036	0.023	0.045	0.059	0.333	0	0	8	570
10°	0.0265	0.039	0.044	0.049	0.119	0.261	0	0	8	556
11°	0.0123	0.021	0.021	0.039	0.059	0.421	0	0	8	555
Secondary	0.0240	0.038	0.028	0.039	0.076	0.258	0	0	8	543

Table A.3: Descriptive statistics for the pre-treatment (2004-2006), treatment (2007-2009) and post-treatment period (2010-2012).

Variable	Pre-Treatment		Treatment		Post-Treatment	
La Estrella School	1	0	1	0	1	0
ICFES Score						
Mathematics score	42.281	43.211	44.331	45.526	46.350	47.314
Philosophy Score	44.652	45.046	37.832	42.286	41.488	43.665
Language Score	48.413	48.848	45.889	47.362	46.949	48.485
Parents education						
Secondary Educ. Mother	0.334	0.475	0.106	0.279	0.131	0.138
Secondary Educ. Father	0.334	0.314	0.038	0.207	0.125	0.100
Primary Educ. Mother	0.000	0.162	0.074	0.128	0.081	0.088
Primary Educ. Father	0.262	0.215	0.082	0.180	0.071	0.099
Tertiary Educ. Mother	0.607	0.164	0.284	0.115	0.009	0.047
Tertiary Educ. Father	0.307	0.229	0.322	0.105	0.011	0.035
Parents work status						
Employee worker Father	0	0.040	0.026	0.022	0.007	0.011
Employee worker Mother	0.253	0.032	0.000	0.026	0.001	0.009
Home Worker Mother	0.001	0.406	0.243	0.382	0.279	0.359
Laborer Father	0.001	0.121	0.177	0.112	0.253	0.086
Laborer Mother	0.000	0.044	0.057	0.039	0.061	0.018
Sisben Level						
Sisben level 1	0	0	0.003	0.058	0	0
Sisben level 2	0	0	0.175	0.127	0	0
Sisben level 3	0	0	0.000	0.042	0	0
Income						
Income, 1 sm	0	0.08	0.006	0.095	0.028	0.133
Income, 1-2 sm	0.282	0.39	0.281	0.356	0.385	0.307
Income, 2-3 sm	0.321	0.21	0.263	0.109	0.042	0.042
School Characteristics						
Mixed School	1	0.90	1	0.911	1	0.907
Academic and Technic. School	1	0.85	1	0.825	1	0.990
Public School	1	0.80	1	0.804	1	0.804

Table A.4: Descriptive statistics for failures, approval and dropout rates for the pre-treatment (2004-2006), treatment (2007-2009) and post-treatment period (2010-2012).

Variable	Pre-Treatment		Treatment		Post-Treatment	
La Estrella School	1	0	1	0	1	0
Failure Rates						
6°	0.159	0.063	0.110	0.062	0.122	0.134
7°	0.126	0.059	0.140	0.063	0.157	0.129
8°	0.097	0.058	0.148	0.059	0.197	0.121
9°	0.162	0.045	0.210	0.052	0.139	0.113
10°	0.068	0.060	0.082	0.066	0.107	0.103
11°	0.024	0.022	0.023	0.025	0.040	0.035
Secondary	0.113	0.054	0.129	0.057	0.134	0.101
Approval Rates						
6°	0.753	0.852	0.805	0.849	0.715	0.761
7°	0.792	0.870	0.795	0.855	0.684	0.768
8°	0.853	0.872	0.739	0.865	0.621	0.784
9°	0.750	0.884	0.714	0.878	0.723	0.806
10°	0.872	0.869	0.828	0.860	0.761	0.813
11°	0.933	0.943	0.937	0.940	0.889	0.928
Secondary	0.816	0.876	0.790	0.869	0.720	0.814
Dropout Rates						
6°	0.005	0.054	0.041	0.042	0.052	0.044
7°	0.003	0.045	0.018	0.034	0.033	0.039
8°	0.003	0.042	0.035	0.032	0.057	0.039
9°	0.010	0.043	0.042	0.028	0.034	0.035
10°	0.004	0.045	0.045	0.033	0.033	0.032
11°	0.000	0.025	0.013	0.018	0.030	0.014
Secondary	0.004	0.044	0.033	0.033	0.041	0.038

9. Appendix

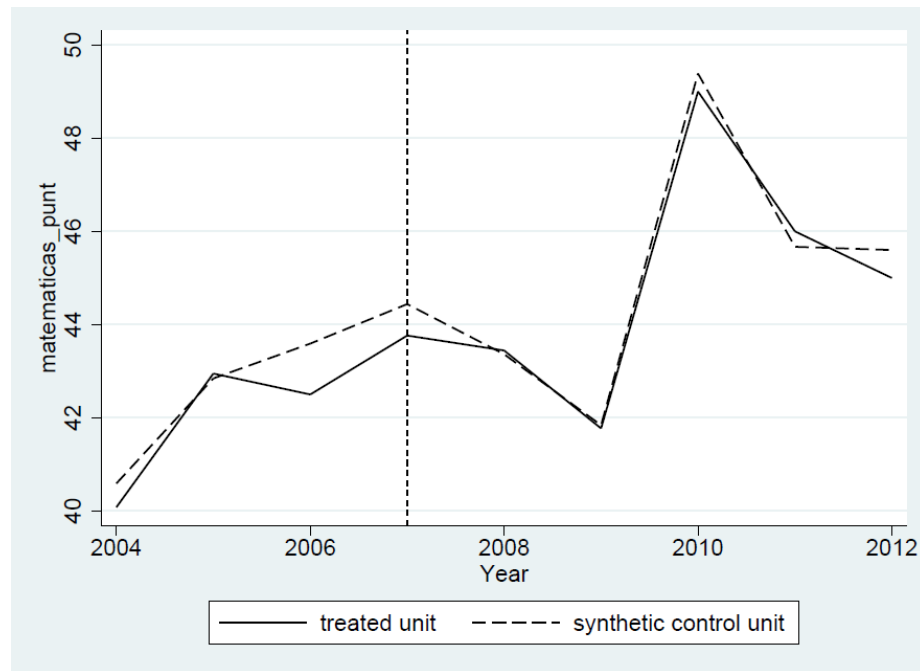


Figure 1a. Mathematics Score without subtracting the 5% highest and lowest scores for the school of La Estrella versus the Synthetic control school (dotted line).

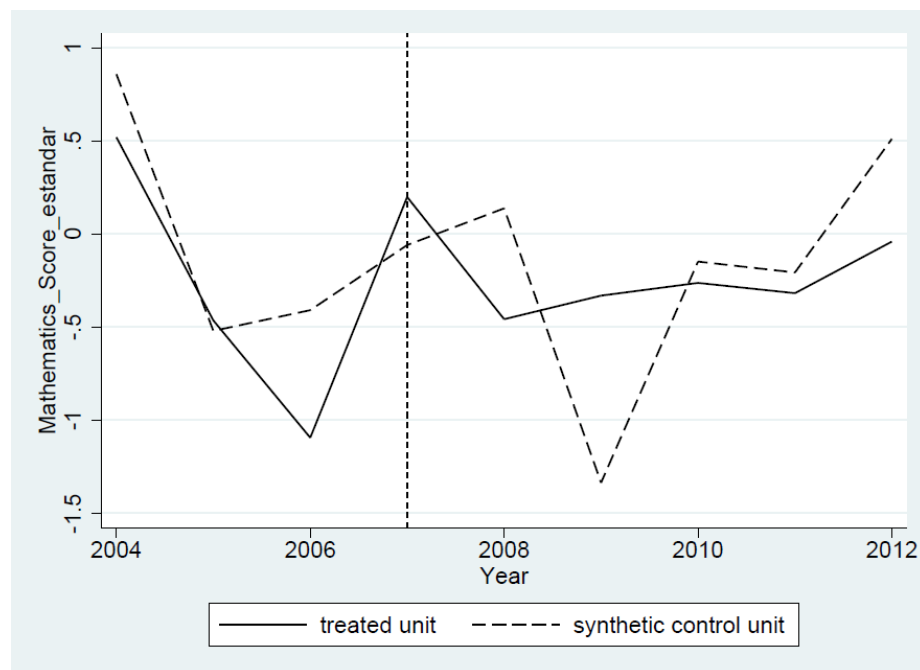


Figure 1b. Standardized Mathematics Score for the school of La Estrella versus the Synthetic control school (dotted line).

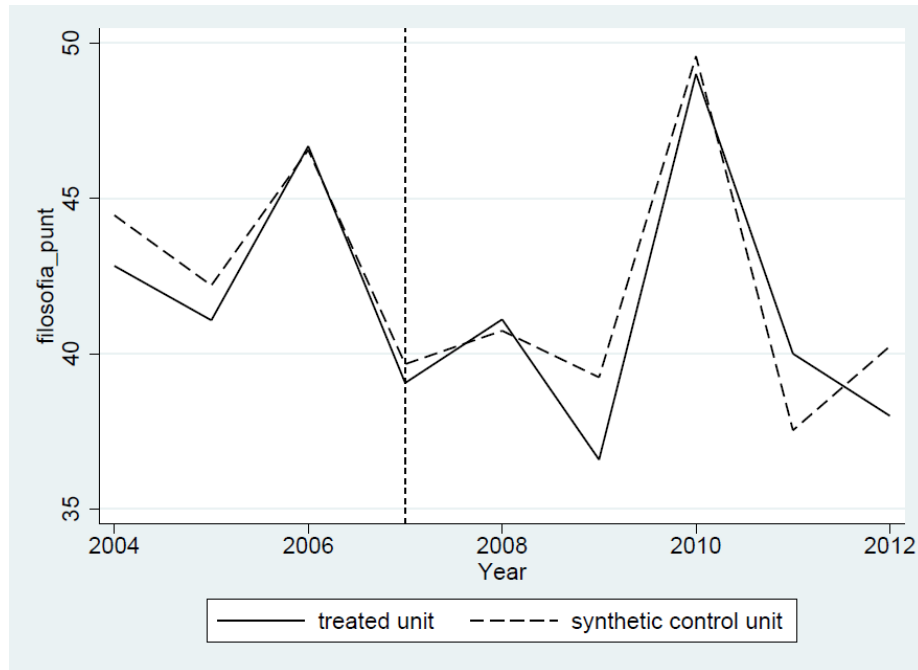


Figure 2a. Philosophy Score without subtracting the 5% highest and lowest scores for the school of La Estrella versus the Synthetic control school (dotted line).

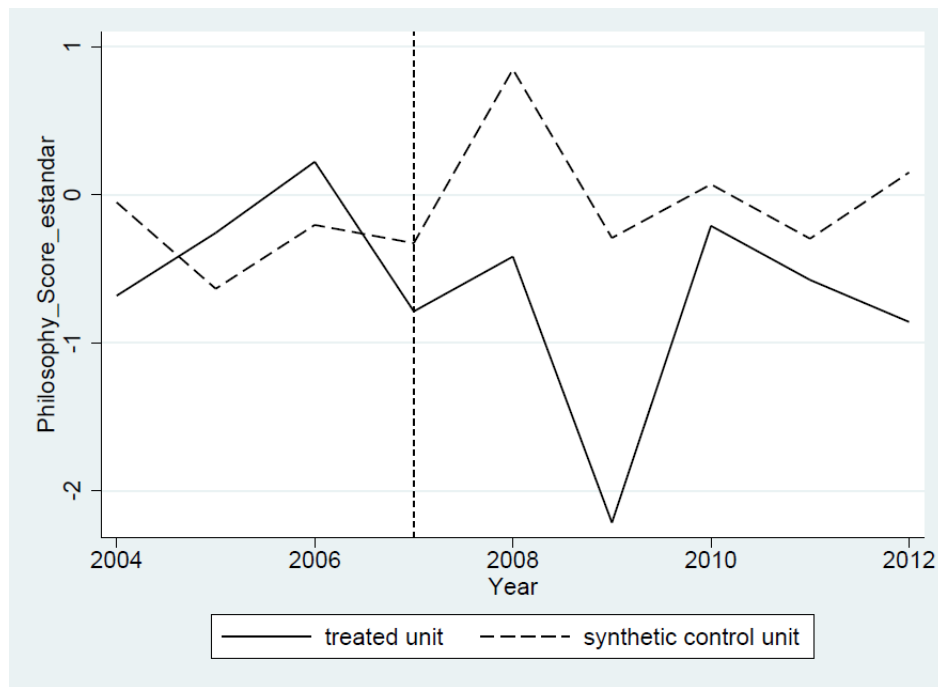


Figure 1b. Standardized Philosophy Score for the school of La Estrella versus the Synthetic control school (dotted line).

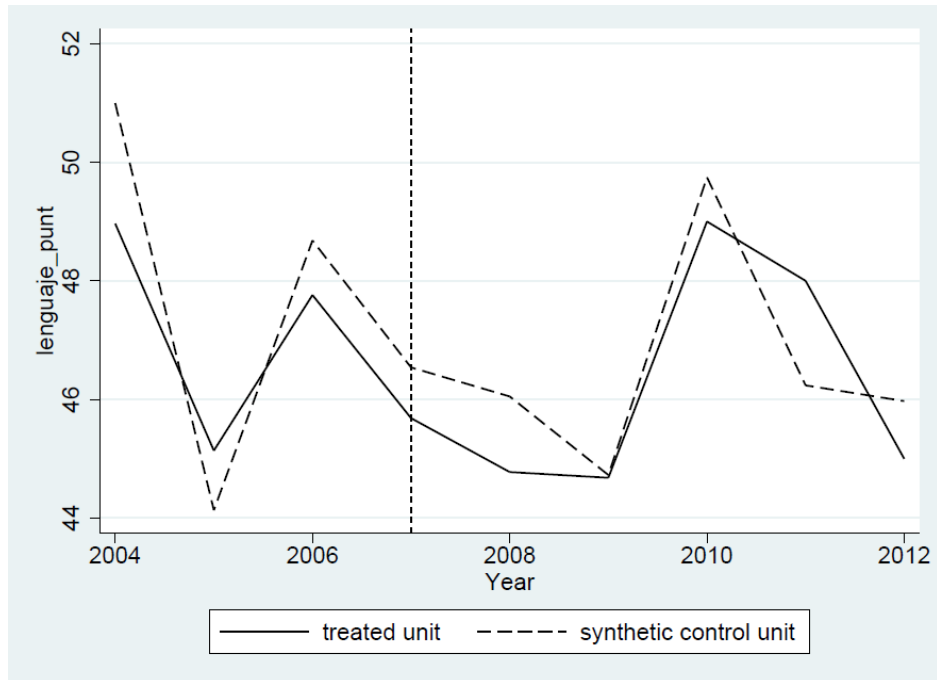


Figure 3a. Language Score without subtracting the 5% highest and lowest scores for the school of La Estrella versus the Synthetic control school (dotted line).

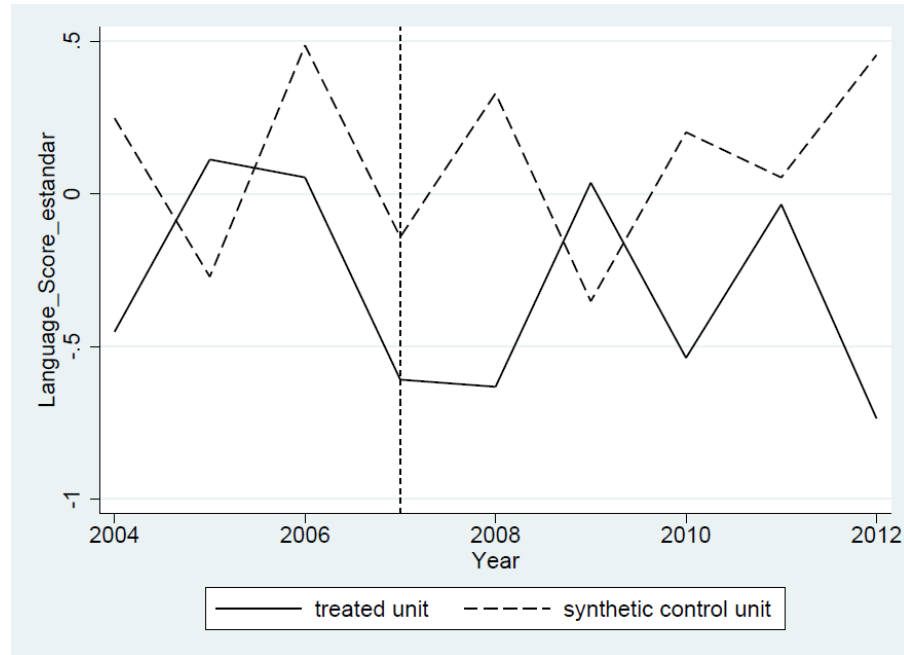


Figure 1b. Standardized Language Score for the school of La Estrella versus the Synthetic control school (dotted line).

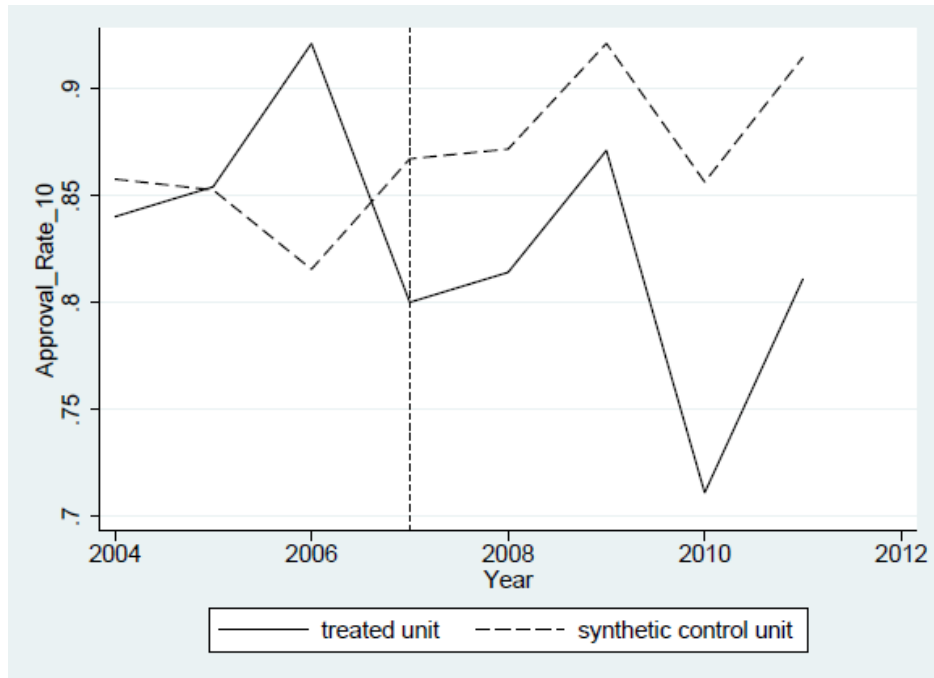


Figure 4a. Approval Rate at the 10° degree for the school of La Estrella versus the Synthetic control school (dotted line).

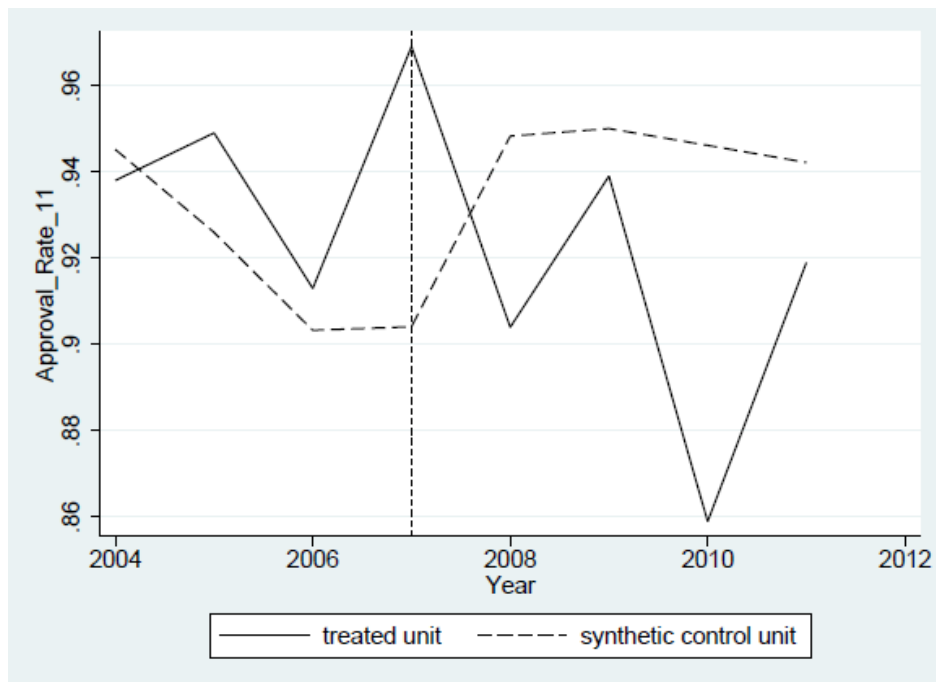


Figure 4b. Approval Rate at the 11° degree for the school of La Estrella versus the Synthetic control school (dotted line).

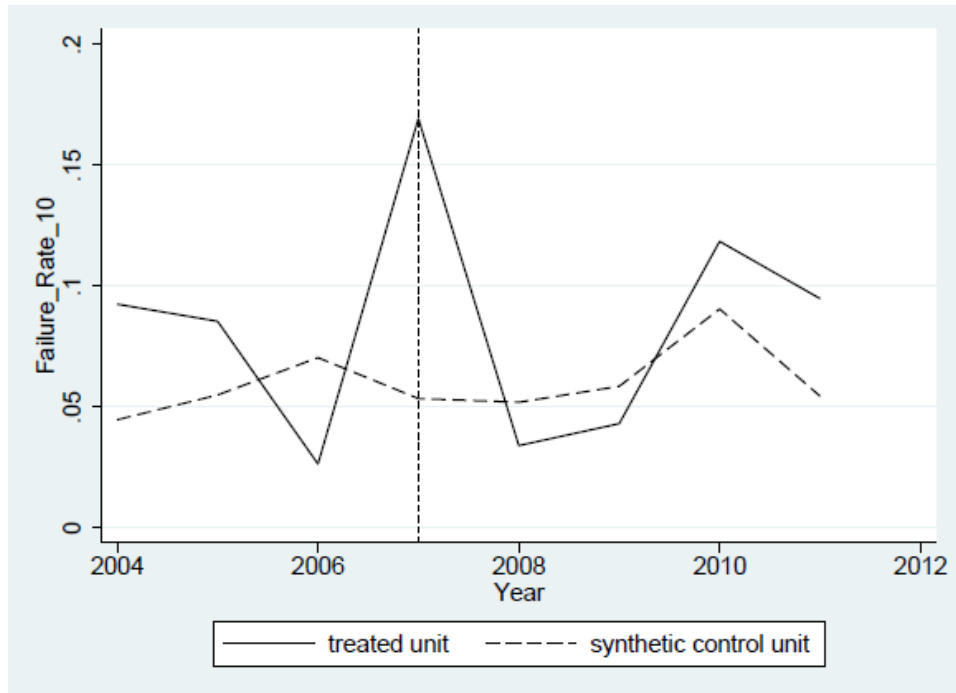


Figure 5a. Failure Rate at 10° degree for the school of La Estrella versus the Synthetic control school (dotted line).

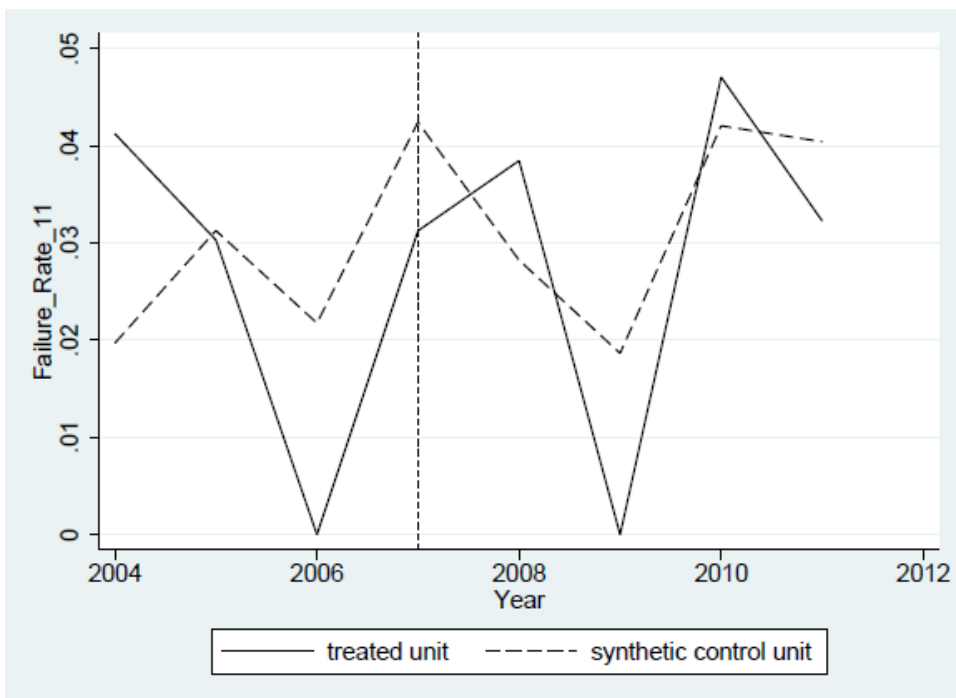


Figure 5b. Failure Rate at 11° degree for the school of La Estrella versus the Synthetic control school (dotted line).

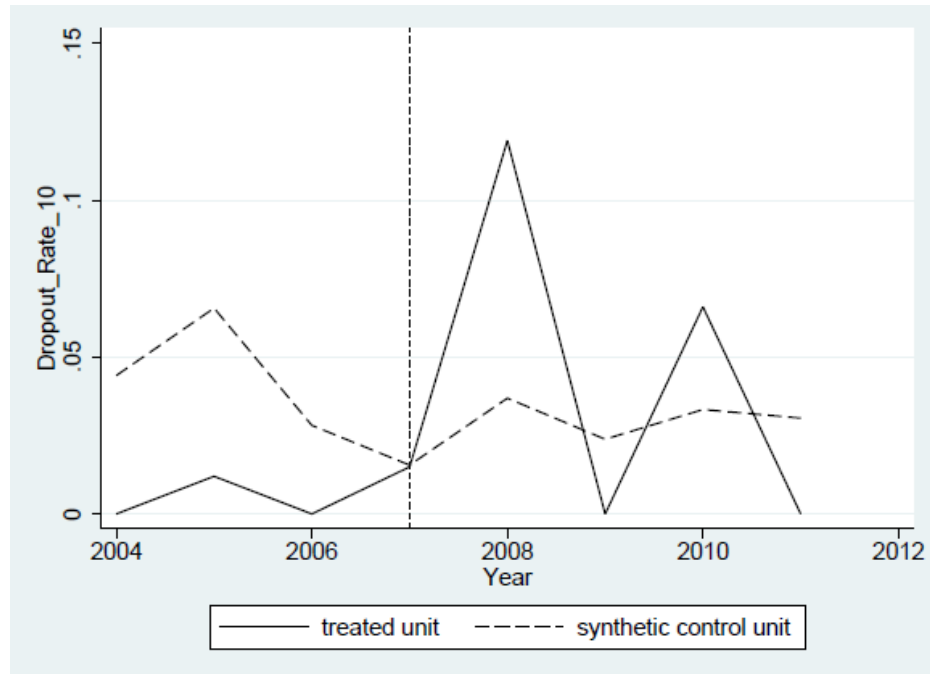


Figure 6a. Failure Rate at 10° degree for the school of La Estrella versus the Synthetic control school (dotted line).

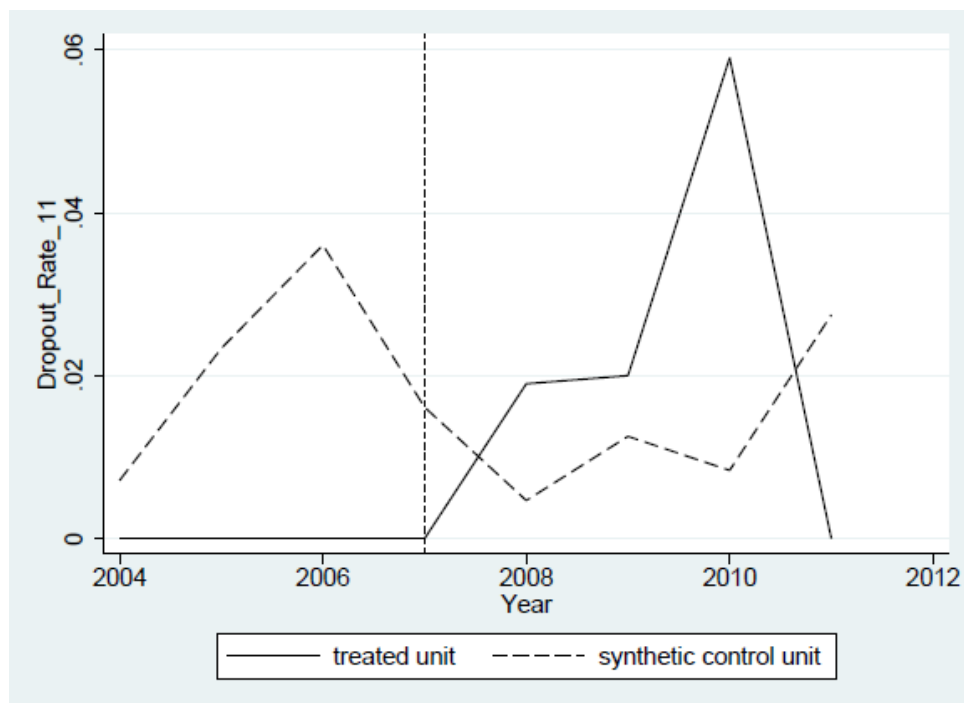


Figure 6b. Failure Rate at 11° degree for the school of La Estrella versus the Synthetic control school (dotted line).

Table A.5: Variable moment conditions before and after entropy balance procedure

Before: withouth weighting				
	Treat		Control	
variable	mean	mean	variance	skewness
Mathematics score	42.28	43.14	3.548	0.1326
Philosophy score	44.65	45	4.047	-0.1077
Language score	48.41	48.83	8.438	-0.01215
Approval Secondary Rate	0.8162	0.8782	0.0024	-0.3988
Secondary Educ. Mother	0.3341	0.4828	0.1057	0.123
Secondary Educ. Father	0.3337	0.3192	0.07948	0.5759
Primary Educ. Father	0.2624	0.2111	0.07177	1.362
Tertiary Educ. Father	0.3074	0.2276	0.07786	1.145
Employee worker Father	0	0.03869	0.00913	2.536
Employee worker Mother	0.2529	0.03057	0.008113	3.435
Income, 1-2 sm	0.2817	0.3742	0.1038	0.4322
Mixed School	1	0.9003	0.0864	-2.698

After: with weighting				
	Treat		Control	
variable	mean	mean	variance	skewness
Mathematics score	42.28	42.29	2.094	0.8877
Philosophy score	44.65	44.66	2.378	-0.3511
Language score	48.41	48.42	4.685	0.1731
Approval Secondary Rate	0.8162	0.8163	0.002	1.622
Secondary Educ. Mother	0.3341	0.334	0.05043	0.6834
Secondary Educ. Father	0.3337	0.3335	0.05063	0.3195
Primary Educ. Father	0.2624	0.262	0.0934	1.11
Tertiary Educ. Father	0.3074	0.3076	0.08887	0.1021
Employee worker Father	0	0.0003723	0.0000202	46.94
Employee worker Mother	0.2529	0.2525	0.0606	0.2483
Income, 1-2 sm	0.2817	0.2817	0.1111	0.9021
Mixed School	1	0.9994	0.0003724	-38.84