Overlapping Calendars: Colonial Legacies and School-Agriculture Misalignment

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March 27, 2026

Abstract

Do colonial legacies shape the timing of schooling in the Global South—and at what cost? Using cross-country data, we document systematic overlap between academic calendars and local harvest seasons in countries in southern latitudes and show that these patterns are strongly associated with colonial institutional legacies rather than local climatic and agricultural conditions. Exploiting this variation, we estimate the causal effect of school–agriculture calendar overlap and find that greater overlap significantly increases school dropout in former colonies. We argue that this relationship operates through child labor: in agrarian economies, seasonally concentrated agricultural work allows households to reallocate children's time away from schooling when labor demand peaks. To test this mechanism, we exploit a natural experiment in Colombia in which a reform exogenously shifted school calendars, increasing overlap with local agricultural cycles. Using administrative school census data and a synthetic difference-in-differences design, we show that increased overlap reduces enrollment through higher dropout and lower grade progression, with effects concentrated in rural areas and accompanied by increases in child labor, as documented using household survey data. Our findings highlight school calendar timing as an important and underexplored institutional determinant of human capital accumulation, suggesting that better alignment with local economic conditions may offer a low-cost policy lever to improve educational outcomes.

Keywords: Seasonality, school calendar, dropout, colonial legacies, rural, Colombia.
JEL codes: I25, J22, J24, O12, O13, O43.

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1. Introduction

Do colonial legacies shape school-year timing, and what are the consequences when school calendars overlap with local agricultural calendars? A large literature has examined the enduring effects of colonial rule through the institutions it left behind—legal systems, state capacity, and political authority (Acemoglu et al., 2001). However, institutional inheritance may also operate through more subtle and overlooked channels: design choices that structure everyday economic behavior. One such design choice is the academic calendar. In many countries across the Global South, school calendars continue to mirror those historically institutionalized in Europe, reflecting colonial administrative standardization rather than adaptation to local climatic and agricultural conditions.

This temporal misalignment is not innocuous. In agrarian economies, school calendars that overlap with periods of peak labor demand increase the opportunity cost of education. When children are required to do household agricultural work, their academic progress suffers. This mechanism is particularly relevant in the global context of child labor: about 61 percent of child laborers work in agriculture, with even higher concentration among younger children aged 5–11 (International Labour Organization and UNICEF, 2025). Their activities range from harvesting to planting, gathering, processing, and livestock care, often within family production systems as unpaid labor. Because such work is seasonally concentrated yet flexible in timing, households can shift children's time away from schooling precisely when labor demand peaks, while work within the household further constrains time, physical and cognitive resources for education. Beyond direct labor substitution, peak agricultural seasons may also reduce learning through physically demanding task-related fatigue and reduced parental supervision (Ito and Shonchoy, 2026). Yet policy responses to school discontinuation have largely focused on resource-intensive interventions—such as cash transfers or school inputs—rather than considering whether the timing of schooling itself is part of the problem.

To explore this, we begin by documenting cross-country evidence showing that nations in the Global South exhibit systematic overlap between periods when schools are in session and local harvest seasons. We show that this overlap is not well explained by local climatic or agricultural conditions alone, but is strongly associated with colonial institutional legacies. In particular, former colonies often retain schooling calendars inherited from their colonizers, even when geographic and seasonal conditions differ substantially. This pattern is consistent with a broader view in which institutional transfers persist and continue to shape economic outcomes long after the colonial period ends.

We then estimate the consequences of this misalignment for educational outcomes. Using colonial institutional legacies as a source of identifying variation—specifically, the interaction between the school calendar of the colonizing country and the agricultural calendar predicted by latitude—we instrument for calendar overlap and estimate its causal effect on school dropout. Our results show that a one percentage point increase in the overlap between school and agricultural calendars raises the share of children out of school by approximately 0.3 to 0.4 percentage points. This relationship is driven almost entirely by former colonies: splitting

the sample reveals a steep positive gradient among countries with a colonial past and little to no correlation among those without one. We further show that this pattern reflects differences in the timing of independence. Countries colonized by France, the United Kingdom, Belgium, and the Netherlands—most of which gained independence after formal schooling systems had already been institutionalized—tend to retain inherited calendar structures. In contrast, Spanish and Portuguese colonies, which became independent much earlier, largely adapted their school calendars to local agricultural conditions.

While this cross-country evidence establishes a systematic relationship among colonial legacies, calendar misalignment, and educational outcomes, it does not, by itself, reveal the underlying impact mechanism. In particular, the aggregate analysis cannot distinguish whether higher dropout reflects general institutional differences or a direct response to seasonal labor demand. To isolate this mechanism and to provide micro-level evidence, we turn to a natural experiment in Colombia in which the timing of the school calendar changes exogenously, while all other aspects of schooling remain unchanged. Between 2008 and 2011, a policy reform shifted the academic calendars of public schools in two departments (equal to state systems in the USA)—Nariño and Valle del Cauca—from a September–June schedule, mirroring Northern Hemisphere systems, to a January–November calendar aligned with the rest of the country. Importantly, the reform did not alter curricula, assessments, or school resources; it changed only the timing of instruction and examinations. As a result, school activities increasingly overlapped with locally important agricultural harvesting seasons.

Using administrative school census data covering the universe of public rural schools between 2004 and 2018, and implementing a synthetic difference-in-differences (SDID) design, we estimate the causal effects of this calendar shift. We find that increased overlap led to a 2.5 percentage point increase in dropout rates—approximately a 50 percent rise relative to the pre-reform baseline—and a nearly 25 percent decline in total enrollment. The reform also reduced grade promotion, increasing grade retention by about 2.5 percentage points. These effects are economically large, persistent over time, and concentrated among primary-school-aged children, a group that in low-income rural settings remains highly responsive to household labor demands.

To examine the impact mechanism, we construct a granular measure of calendar overlap at the *vereda* level (a very granular geographic unit) in Colombia by combining school calendars with crop-specific harvesting schedules. We show that schools experiencing larger increases in overlap exhibit significantly larger increases in dropout and declines in enrollment. Consistent with these findings, using nationally representative household survey data from Colombia, we document that child labor participation rose in treated departments following the calendar reform, whereas it remained stable in other departments. This increase is concentrated among primary-school-aged children and those at the margin of school continuation, closely mirroring the impact pattern documented earlier. These findings, although suggestive, support the proposed mechanism: greater overlap between academic calendars and agricultural cycles raises the opportunity cost of schooling, leading households to substitute children's school attendance with labor supply during peak agricultural periods.

We subject our main estimates to several robustness checks. First, we show that the results are not sensitive to the definition of harvesting intensity: the findings remain stable whether we define peak harvest months as the single most intensive month or the two or three most intensive months of the annual harvesting distribution. Second, we assess the validity of the stable unit treatment value assumption (SUTVA) by examining transfer rates and migration patterns. We find no evidence of reform-induced increases in student transfers across departments, nor of differential migration trends between treated and untreated areas, suggesting that the reform did not contaminate the counterfactual through student relocation. Third, we re-estimate the main effects using a conventional difference-in-differences design with a manually constructed comparison group of untreated departments selected on the basis of agricultural specialization and pre-reform covariate similarity—specifically, Risaralda, Sucre, and Arauca. The resulting estimates closely mirror those obtained using the SDID procedure, providing further confidence in the robustness of our findings.

Our study contributes to three strands of the economics literature. First, we contribute to the literature on colonial legacies and institutional persistence. We show that even "mundane" administrative choices like the school calendar – often imposed by colonial powers – can persist long after independence, shaping local outcomes. In many former colonies, academic years still follow the European (Gregorian) template rather than the local agrarian cycle, illustrating the "transplanted" nature of colonial institutions. This extends classic work on colonial institution-building and legacies with meaningful implications for development (Acemoglu et al., 2001; Glaeser et al., 2004; Bolt and Bezemer, 2009)—documenting that academic-year timing was itself a colonizing artifact. To our knowledge, no prior study has traced how colonial calendars have been inherited and continued to affect human capital outcomes, particularly in the Global South.

Second, we speak to the education–child labor literature by isolating calendar misalignment as an important, under-explored mechanism driving school dropout in agrarian settings. Existing studies emphasize income and liquidity channels associated with harvest timing (Dillon, 2021) or examine short-term shifts in exam dates (Allen, 2024; Ito and Shonchoy, 2026). We build on this by showing, cross-nationally, that greater school-harvest overlap increases school dropout, and causally that shifting Colombia's school year into the harvest season sharply increased both dropout and child labor. Unlike previous studies on child labor and schooling that focus on income shocks or price changes, we highlight time constraints – the calendar-driven trade-off between schooling and peak farming demand – as a novel channel.

Third, we contribute methodologically to empirical education policy research. Our approach is twofold. At the macro level, we exploit historical variation in colonizer calendars and geography: we instrument a country's school-harvest overlap by interacting the colonizer's academic-year schedule with the colony's latitude (a proxy for its planting seasons). This cross-country IV strategy is new to the literature. To our knowledge, no existing work has combined these strategies or explicitly linked the institutional design of school calendars – inherited via colonial rule – to recent educational outcomes. Together, our findings imply that relatively low-cost timing reforms (adjusting school calendars to local agro-economic

conditions) can be a powerful policy lever to improve rural schooling outcomes

The remainder of the paper is organized as follows. Section 3 describes the institutional setting of the Colombian education system, its academic calendars, and introduces the calendar reform studied in this paper. Section 4 presents the data. Section 5 outlines the empirical strategy. Section 6 presents the main results, Section 6.4 presents robustness checks, and Section 8 concludes.

2. Worldwide Evidence on the Effects of Calendar Overlap

2.1. School Calendars Across Latitudes

School calendars were institutionalized during the 19th century, when European states assumed responsibility for public primary education through foundational school laws that established centralized, state-regulated systems, including standardized academic calendars.[1] These laws required municipalities to maintain public schools and defined the structure of the school year, limiting the time available for work outside the classroom. Compulsory attendance legislation came later, including the Mundella Act (1880) in the UK and the Jules Ferry Laws (1882) in France, but by then the institutional template of the school calendar had already been established (Lelièvre, 2021; Gold, 2002).

To maximize attendance, school calendars were designed to minimize conflicts with agricultural cycles by scheduling instruction during periods of low-harvesting seasons (Pedersen, 2012). As a result, the academic year typically began after the summer, allowing students and their families to participate in harvest activities.[2] Since then, and until current times, most Northern Hemisphere countries have adopted a school calendar that begins in September or October, following the summer, and ends around May or June.

However, the notion of "summer" does not translate uniformly across latitudes, which implies that school calendars need not follow the same structure everywhere. Equatorial countries lack clearly defined seasons, producing substantial within-country variation in climate and harvest schedules. Countries in the Southern Hemisphere experience summer from November to February, which would naturally imply a school calendar offset relative to northern countries.

Despite these differences, many countries in southern latitudes mirror the northern calendar by scheduling school breaks in July and August, which do not necessarily correspond to their local agricultural cycles. Appendix Figure A.1 illustrates this pattern by plotting current school calendars by country, sorted by latitude.[3] Northern countries align school breaks with the

[1] Particularly, France enacted the Loi Guizot in 1833, Belgium the Loi Nothomb in 1842, Spain the Ley Someruelos in 1838, the Netherlands the Schoolwet in 1806, and the United Kingdom the Forster Act in 1870.

[2] Additional evidence suggests that the emergence of summer breaks was also influenced by the aristocratic hunting season in France (Lelièvre, 2021), as well as by urban social habits, budgetary constraints, and the preferences of school officials in the United States (Gold, 2002; Weiss and Brown, 2003).

[3] School calendars were hand-collected from the official websites of the ministries of education, or equivalent government bodies, of each country in our sample, using the most recently available academic calendar at the time of data collection. More details are provided in Appendix B.

northern summer between June and August. Countries near the Equator, despite experiencing different climatic conditions, tend to follow a similar calendar structure, with school breaks taking place during the same months. In contrast, some countries in the Southern Hemisphere, particularly those with Spanish heritage such as Paraguay, Chile, and Argentina, align school breaks with the southern summer between December and February. Other countries in the South, especially those in Africa with French or British colonial heritage, do not follow this pattern and instead mirror northern calendars.

2.2. Colonial Origins of the School and Agricultural Calendar Overlap

These school calendar patterns in the Global South may be closely linked to colonial institutions, as many countries in equatorial and southern latitudes were historically colonized. In fact, school calendars in former colonies often reflect those of the colonizing country rather than the pattern suggested by latitude. Figure 1 plots the monthly share of school days in former colonies and compares them with those of their colonizers. Colonial calendars frequently persist despite substantial differences in climate and agricultural cycles. Countries colonized by France, the United Kingdom, Belgium, and the Netherlands show a high degree of persistence relative to the school calendar of their colonizer. In contrast, Spanish and Portuguese colonies appear to have adapted their school calendars to local conditions. These patterns suggest that school calendars in some southern countries could have been shaped more by the institutional practices of their colonizers rather than by local agricultural conditions.

The extent to which colonial calendars persisted seems to depend on the degree of institutional autonomy that former colonies had when their school calendars were established. For example, Spanish and Portuguese colonies, which gained independence early, were able to adapt their calendars to local agricultural conditions. In contrast, countries colonized by France, the United Kingdom, or the Netherlands, which achieved independence after school calendars had already been established by colonial authorities, were more likely to retain the inherited structures. This suggests that the timing of independence played a critical role in shaping the alignment between school calendars and local agricultural cycles.

Figure 2 provides empirical evidence for the relationship between independence timing and calendar persistence. It plots the similarity between the school calendars of colonies and their colonizer against the time elapsed between a country's independence and the institutionalization of its colonizer's education system.[4] We observe a strong positive correlation. Countries that gained independence later were more likely to retain colonial calendar structures, while those that gained independence earlier show lower degrees of calendar overlap.

Two notable examples of this mechanism are Spain and France. Most Spanish colonies, including Colombia which we will emphasize in Section 3, gained independence well before

[4]Similarity between both school calendars is computed as the share of vacation days in a year during which students in both the colony and the colonizing country are simultaneously out of school. We use vacation day overlap rather than school day overlap because the number of instructional days is similar across countries by construction, leaving little variation to exploit. Vacation timing, by contrast, reflects specific institutional choices more likely to carry the imprint of colonial educational transfer.

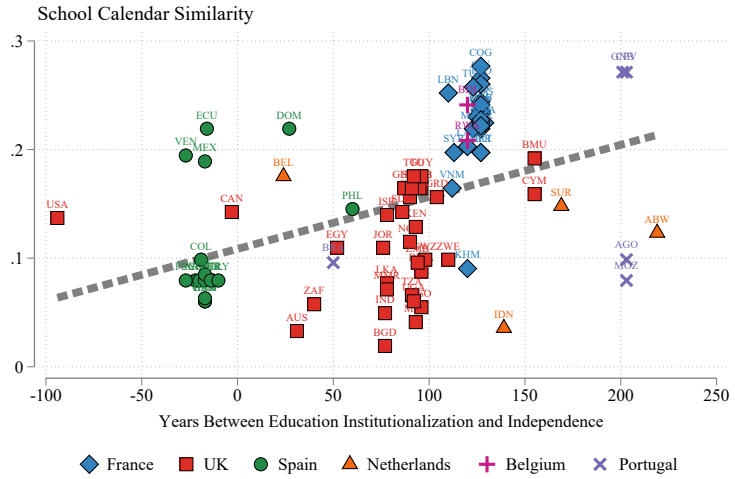
Figure 1: Monthly School-Day Shares by Colony and Colonizer



Notes: The figure shows the share of school days in each month. For each country, the information corresponds to the most recent school calendar data available. Source: Own elaboration based on official sources.

educational systems were formally institutionalized in Spain (in 1838). This early independence allowed these countries to establish their own calendars rather than inherit those of the colonizer. In contrast, former French colonies gained independence only after school systems had already been institutionalized in France and therefore tend to retain calendar structures

Figure 2: Colonial Legacy and School Calendar Overlap



Notes: The y-axis reports share of vacation days in a year during which students in both the colony and the colonizing country are simultaneously out of school. The x-axis displays an index capturing the difference between the independence date of each colony and the date on which the first educational law was enacted in the corresponding colonizer. The index is normalized to take a value of 1 for the largest observed difference and 0 when the difference is less than or equal to zero. Source: Own elaboration based on official and historical sources.

that closely mirror those of the former colonizer. These examples highlight how the timing of independence shapes the alignment between school calendars and local conditions, driving the broader pattern shown in Figure 2.

2.3. Calendar Overlap and School Dropout

The persistence of colonial school calendars has important consequences for education today. These historical patterns suggest a potential mismatch between school and agricultural calendars, particularly in formerly colonized countries located at different latitudes than their colonizers. Overlap between the two calendars increases the opportunity cost of schooling for rural students, particularly in the Global South. In agrarian-dominating economies, schooling decisions are strongly shaped by the timing of local labor demand and household liquidity constraints. Recent research shows that when academic calendars overlap with harvest periods, households respond by reallocating children's time to farm work, which may lead to dropping out of school (Ito and Shonchoy, 2026).

We formally evaluate this relationship by computing the share of days in the year in which the agricultural and school calendars overlap in each country i:

$$O_i = \frac{|\mathbb{S}_i \cap \mathbb{A}_i|}{|\mathbb{D}|},$$

where $\mathbb{D}$ denotes the set of days in a calendar year, $\mathbb{S}_i \subseteq \mathbb{D}$ denotes the set of days when school is in session in country i, and $\mathbb{A}_i$ denotes the set of days corresponding to the harvesting season of country i's main crop. The cardinality in the intersection of these two sets, $|\mathbb{S}_i \cap \mathbb{A}_i|$, captures the number of days in which students are required to attend school during periods of

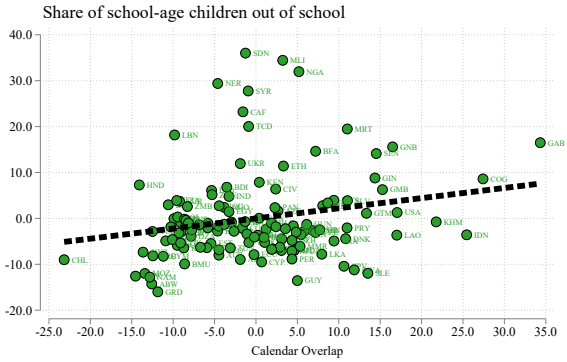
high agricultural activity.[5]

We use this measure and correlate it with country level school dropout rates and present the results in Figure 3a.[6] As expected, countries with greater overlap between the school and agricultural calendars experience higher school dropout rates.

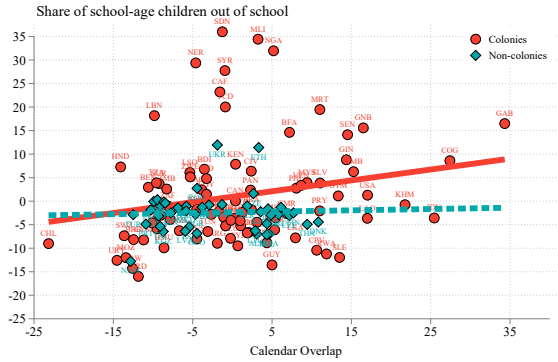
This positive relationship is almost entirely driven by countries with a colonial legacy. Figure 3b separates countries with and without a colonial past, revealing a steeper gradient among former colonies and little to no correlation among countries with no colonial history.[7] Calendar overlap is associated with school dropout primarily in contexts where the school calendar was inherited rather than locally designed.

Figure 3: School Dropout and the Overlap Between School and Agricultural Calendars

(a) All countries



(b) Colonies vs Non-Colonies



Notes: The figures shows a scatterplot between the the share of school-age children out of school and the measured overlapping between harvesting and school calendars according to equation 2.3.

These correlations, however, should not be interpreted as causal. Unobserved factors may influence both calendar structure and educational outcomes, generating omitted variable bias. In addition, dropout rates could themselves affect the design of school calendars, creating the potential for reverse causality.

To estimate causal effects, we exploit historical colonial legacies and instrument calendar overlap in former colonies using the intersection between the school calendar of the colonizing country and the agricultural calendar predicted by latitude. Let $c(i)$ denote the country that colonized country i and let $\mathbb{L}_i$ denote the set of countries located in the same latitude zone as country i.[8] We construct the following instrument:

$$Z_i = \frac{|\mathbb{S}_{c(i)} \cap \mathbb{A}_{\mathbb{L}_i}|}{|\mathbb{D}|},$$

[5] Agricultural calendars are constructed based on data from Sacks et al. (2010), which provides crop-specific harvesting dates at the country level. We use the calendar of the main crop in each country, defined as the crop with the largest harvested area. More details are provided in Appendix B.

[6] We condition on latitude and GDP (in logs) to isolate the variation that is not driven by geography and income level.

[7] Appendix Table A.2 shows this relationship when varying the set of controls used.

[8] Latitude zones are defined as: Equatorial (0–10°), Tropical (10–23.5°), Subtropical (23.5–35°), Temperate (35–50°), and Cool Temperate (50–66.5°).

where $\mathbb{S}_{c(i)}$ denotes the set of school days in the colonizing country $c(i)$, and $\mathbb{A}_{\mathbb{L}_i}$ corresponds to the set of days of high agricultural activity predicted by the latitude of country i.[9] For countries that were not colonized the instrument takes the value of zero.[10]

Using this instrument, we estimate the following equations:

$$\begin{aligned} O_i &= \alpha Z_i + u_i \\ Y_i &= \beta \hat{O}_i + \mathbf{X}_c' \boldsymbol{\gamma} + \varepsilon_i, \end{aligned} \tag{1}$$

where Y_i corresponds to the share of primary school age children who are out of school in country i, $\hat{O}_i$ denotes the predicted overlap between school and agricultural calendars, and $\mathbf{X}_i$ denotes a vector of country level controls.[11] Standard errors are heteroskedasticity-robust.

The coefficient $\hat{\beta}$ in Equation 1 is consistently estimated if the instrument Z_i satisfies the exclusion restriction. This requires that the school calendars of former colonial powers affect school dropout in their former colonies only through the school calendars that these colonies inherited, and not through any other channel. This assumption is plausible because colonial powers originally designed their domestic school calendars to reflect their own climatic and agricultural conditions rather than those of the territories they later administered. As a result, the timing of school terms in the colonizing country is unlikely to be directly related to contemporary educational outcomes in former colonies located at very different latitudes.

The instrument combines this colonial school calendar with agricultural cycles predicted by latitude. By using agricultural calendars derived from countries located at similar latitudes, the instrument captures the agricultural conditions that country i would likely face in the absence of colonial institutional influence. This construction prevents the instrument from being mechanically correlated with country specific agricultural patterns while isolating variation that arises from the interaction between inherited school calendars and local agricultural cycles. Under this interpretation, the instrument reflects the calendar structure that country i would have faced if its school calendar had followed the colonizer's institutional pattern while its agricultural conditions were determined by geography. As such, the instrument should affect school dropout only through its impact on the current overlap between school

[9] $\mathbb{A}_{\mathbb{L}_i}$ is constructed as a leave-one-out estimate of the probability that a country harvests on a given day of the year. For each day d, we estimate the probability that a country growing the same main crop as country i and located in the same latitude zone is actively harvesting on day d, using all countries in that peer group except country i itself. Formally, for each country-day cell we compute $\hat{p}_{id} = \sum_{j \in \mathbb{L}_i^c \setminus \{i\}} \mathbf{1}[\text{harvest}_{jd}]/(|\mathbb{L}_i^c| - 1)$, where $\mathbb{L}_i^c \subseteq \mathbb{L}_i$ denotes the set of countries sharing both the same main crop and the same latitude zone as country i. When the peer group contains fewer than two countries, we progressively widen the comparison group first to all countries in the same hemisphere growing the same crop, and then to all countries growing the same crop globally. The resulting daily measure $\hat{p}_{id} \in [0, 1]$ reflects the predicted probability of harvest on each day of the year for a country with similar agroclimatic conditions to country i, purged of country i's own harvest schedule to avoid mechanical correlation.

[10] In Appendix B.2 we consider a second instrument that combines the interaction between the school calendar of the colonizing country, the agricultural calendar predicted by their latitude, and the degree of exposition to colonial education institutions. This second instrument resembles a shift-share design with both the *shift* and the *share* components being arguably orthogonal. Our results are nearly identical using both designs.

[11] Controls include (i) latitude; (ii) GDP (in logs) and the consumption share of GDP; (iii) population and the employment-to-population ratio; and (iv) the share of trade in GDP and the total trade volume between each country and the set of colonizers, comprising Belgium, France, Portugal, Spain, the Netherlands, and the UK.

and agricultural calendars.

Table 1 presents the results of estimating Equation 1. The estimated coefficients are positive and precisely estimated across specifications. The results imply that a one percentage point increase in the overlap between school and agricultural calendars increases school dropout by approximately 0.3 to 0.4 percentage points. The estimates remain stable across different sets of controls, supporting a robust causal relationship between calendar overlap and school dropout.

Under this instrumental variable approach, these estimates should be understood as local average treatment effects. They capture the impact of calendar overlap in countries where school calendars were influenced by colonial institutions and therefore respond to the variation generated by the instrument. In such contexts, where inherited school calendars may not align with local agricultural conditions, students face higher opportunity costs of schooling and are more likely to drop out.

Table 1: Effect of Calendar Overlap on Dropout

	Dependent variable: Dropout rate				
	(1)	(2)	(3)	(4)	(5)
Panel A: Full sample					
Calendar Overlap	0.515***	0.385***	0.406***	0.405***	0.391***
	(0.101)	(0.097)	(0.095)	(0.095)	(0.095)
First-stage F	152.92	106.22	106.64	113.51	115.30
Observations	126	126	126	126	126
Panel B: Former colonies					
Calendar Overlap	0.319***	0.247***	0.320***	0.319***	0.306***
	(0.113)	(0.094)	(0.101)	(0.103)	(0.101)
First-stage F	88.41	85.63	73.31	74.70	76.85
Observations	84	84	84	84	84
Geographic controls	No	Yes	Yes	Yes	Yes
Macroeconomic controls	No	No	Yes	Yes	Yes
Demographic controls	No	No	No	Yes	Yes
Trade controls	No	No	No	No	Yes

Notes. The dropout rate is defined as the share of primary school-age children out of school. For each country, we use the latest available value during the 2010–2019 period. Geographic controls: country latitude. Macroeconomic controls: GDP (in logs) and consumption share of GDP. Demographic controls: population and employment-to-population ratio. Trade controls: share of trade in GDP and the total trade volume between each country and the set of colonizers, comprising Belgium, France, Portugal, Spain, the Netherlands, and the UK. Source: own elaboration based on administrative records, World Bank Indicators, Penn World Table version 11.0, and Sacks et al. (2010).

These results provide strong causal evidence of the relationship between calendar overlap and school dropout, driven by countries with a colonial past. However, while the instrumental variable strategy addresses potential endogeneity in school calendar design, cross-country estimates remain inherently aggregated and there interpretation might be limited. The analysis relies on national averages that mask substantial within-country heterogeneity in agricultural cycles, school calendars, and schooling decisions. In addition, both agricultural and school calendars might be measured with error at the country level, as harvesting seasons and school schedules often vary across regions within a country. For these reasons, we complement the

cross-country results with micro-level evidence in the following sections.

3. A Natural Experiment: Colombia's School Calendar Reform

Colombia is a country near the Equator that provides an ideal historical setting to study the relationship between school and agricultural calendars. The country was colonized by Spain and gained independence in 1819. Spain formally institutionalized its national school calendar only later, which allowed Colombian republican authorities to design their own school schedule after independence.[12] Because of substantial regional variation and political constraints, Colombia adopted a dual school calendar during the twentieth century, in which different areas of the country operated under two opposing school calendars. This system was unified in 2010 under a single national calendar. This reform increased the overlap between the school calendar and local agricultural harvesting periods in some regions of the country. We exploit this institutional change to estimate the effect of school and agricultural calendar overlap on school dropout.

3.1. The Colombian Education System and the Dual School Calendar

Education in Colombia is organized into four levels: (i) primary education (grades 1–5); (ii) lower secondary education (grades 6–9); and (iii) upper secondary education or high school (grades 10–11). Schooling is provided by both public and private institutions. In 2010, approximately 80% of all students were enrolled in public schools, and 31% attended schools located in rural areas.

Unlike countries with centralized and fixed school calendars, the academic year in Colombia can begin either in January and end in November or in September and end in June. The calendar that begins in January and ends in November is known as *Calendar A*, while the calendar that begins in September and ends in June is known as *Calendar B*.[13] Regardless of the calendar, all schools are required to complete 40 weeks of instruction per academic year (Congreso de la República de Colombia, 1994).

Since the early years of the Colombian republic, the academic calendar has undergone substantial transformations. During the colonial period (i.e., before 1810), education in the Spanish colonies was primarily provided by the Church in a decentralized manner and was accessible only to a small elite. In the late eighteenth century, the Spanish Crown introduced

[12] We date the institutionalization of Spain's education system to the *Ley de Instrucción Primaria* of 21 July 1838 (*Ley Someruelos*), which established the first functioning liberal primary school system in Spain, requiring municipalities to maintain public schools and introducing teacher certification and provincial supervision of education. This framework was later consolidated by the *Ley de Instrucción Pública* of 9 September 1857 (*Ley Moyano*), which introduced compulsory and free elementary schooling. Since most Spanish colonies, including Colombia, gained independence in the 1810s and 1820s, they did so well before either of these laws was enacted, giving Colombian republican authorities the freedom to design their own school calendar.

[13] School breaks depend on the adopted calendar. Schools following *Calendar A* have a one-month break between June and July and a longer break between November and January. Schools following *Calendar B* have a one-month break between December and January and a longer break between June and September. Both calendars include one-week breaks around April and October.

the Bourbon reforms to modernize state capacity in the colonies (Chiovelli et al., 2023). As part of these reforms, and influenced by Enlightenment ideas, Carlos III reduced the Church's influence over education and expand schooling among local and Indigenous populations (Anguita Osuna, 2019). During this period, however, the school calendar played little role in shaping educational access.

Following independence in the 1820s, the Colombian state made efforts to centralize and organize the education system. School calendars, however, were not a central component of these reforms and remained anchored to religious festivities. Archival evidence suggests that throughout the nineteenth century and the first half of the twentieth century, school calendars were not formally institutionalized and varied widely across regions.

The public school calendar in Colombia became explicit and institutionalized in the mid-twentieth century. Decree 75 of 1951 established a fixed academic calendar for public schools and formally introduced two regional calendar regimes. Schools in the Department of Cauca—which at the time included territories that later became the departments of Nariño and Valle del Cauca—were required to begin the school year in October, while schools in the rest of the country started in February. This decree marked the first nationwide recognition of a dual calendar structure and introduced regional differentiation in official school calendars.

Subsequent attempts to standardize class periods nationwide faced substantial opposition and were later revised through Decree 1902 of 1969.[14] The latter decree cited climatic conditions in Valle del Cauca, Nariño, and Cauca that rendered the proposed calendar impractical, as well as requests from principals, teachers, and parents for longer end-of-year vacations and shorter mid-year breaks. This resistance from communities in the southwest suggests that climatic, cultural, and logistical factors played a central role in sustaining regional differentiation in academic calendars. Consequently, since the mid-twentieth century, all public schools in Colombia followed the January–November calendar, except those in the southwest, where public schools traditionally operated under the September–June calendar.[15]

The school calendar reform. Law 715 of 2001 introduced a decentralization reform that assigned local education authorities responsibility for organizing education provision, including defining the academic calendar, while granting certified municipalities autonomy over education provision.

This increased flexibility led authorities in Nariño and Valle del Cauca to modify the public school calendar. After 2010, all public schools in these two departments were required to transition to the January–November calendar to align the school year with national planning and budget execution cycles (De Roux and Riehl, 2022; Santiago de Cali. Secretaría de Educación Municipal, 2008). During this transition, public schools maintained the required

[14] Most notably, Decree 1816 of 1967 established uniform academic semesters nationwide, regardless of the calendar followed; the only difference concerned the semester in which schools began. The first semester started on the third Monday of January and lasted 95 instructional days (excluding Saturdays), followed by a mid-year vacation until the Sunday preceding the fourth Monday of July. The second semester began on the fourth Monday of July and also lasted 95 instructional days, with the end-of-year vacation extending until the Sunday preceding the third Monday of January.

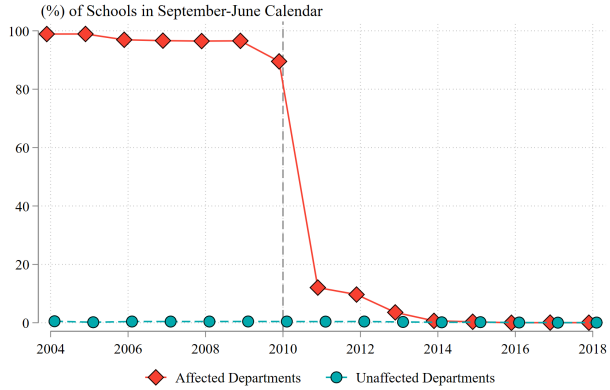
[15] Appendix C provides a detailed description of the legal evolution of school calendars since the colonial period.

40 weeks of instructional time. Private schools, by contrast, have always been free to choose which calendar to adopt nationwide.[16]

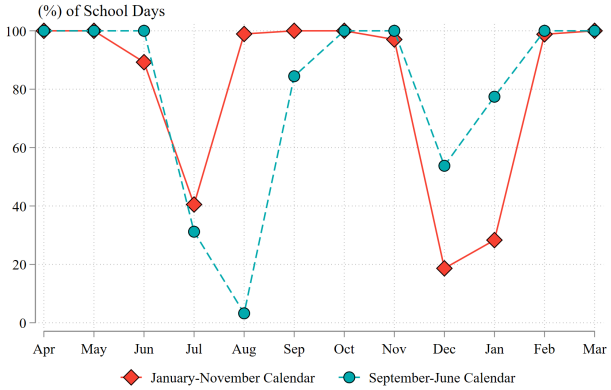
Figure 4a plots the share of public schools adopting the September-June calendar in the departments of Nariño and Valle del Cauca (here onward "affected" departments) compared with the rest of the country. Prior to 2010—the period preceding the calendar reform—virtually all public schools in the affected departments operated under under the September-June calendar, whereas public schools in the rest of the country consistently followed the January-November one. Beginning 2011, and following the implementation of the calendar reform, all public schools in Nariño and Valle del Cauca transitioned to the January-November calendar, aligning their academic schedules with those used elsewhere in the country.

Figure 4: The School Calendar Reform

(a) Schools (%) under Sept.-June Calendar



(b) Calendar Shift in Affected Departments



Notes: Panel (a) shows, for each year, the share of public rural schools operating under the September–June calendar. The shares are reported separately for schools in Nariño and Valle del Cauca (red dots) and for schools in the rest of the country (blue dots). Panel (b) plots the proportion of school days (i.e., days of instruction) in each month as a share of total monthly workdays. The plotted values correspond to the average across the affected departments of Nariño and Valle del Cauca. Source: Own elaboration based on data from the Colombian School Census (Form C-600) and the Secretaries of Education of Nariño and Valle del Cauca.

The school calendar reform induced changes in the distribution of instructional days across months. Figure 4b presents the average monthly share of instructional days under the September—June calendar prior to the reform and under the January–November calendar adopted thereafter in affected departments. The reform substantially altered the timing of school holidays throughout the year. Prior to the reform, the bulk of vacation time occurred in July and August, with shorter breaks in January and December, closely resembling academic calendars in Northern Hemisphere countries. Following the reform, vacation time became concentrated in January and December, with a markedly shorter mid-year break, primarily in June.

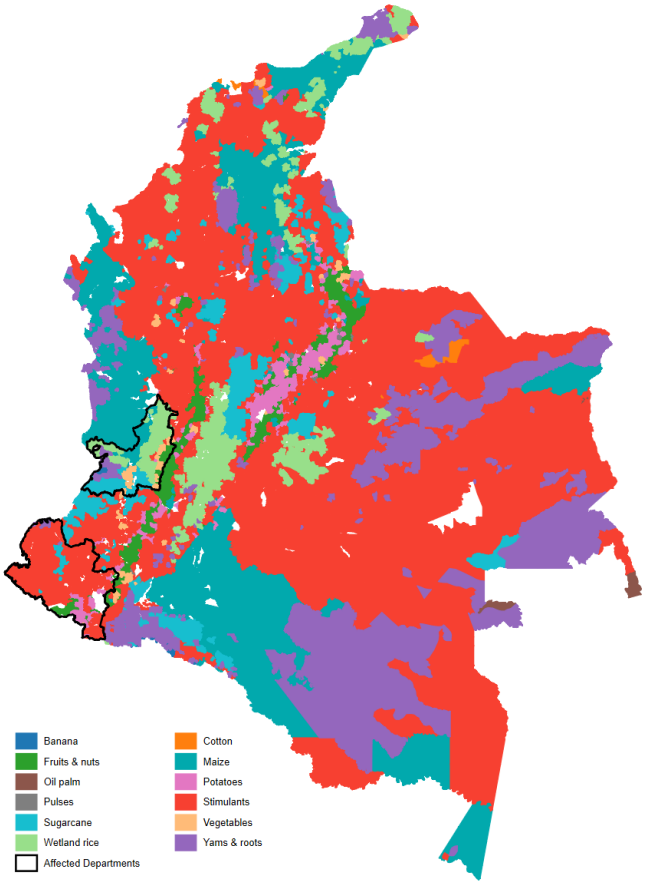
As a consequence, schools in the affected departments abruptly modified their academic calendars, altering the timing of instruction in specific regions of the country. Departments not covered by the reform were unaffected and therefore continued to operate under the existing school calendar.

[16] De Roux and Riehl (2022) provide a more detailed discussion of the school calendar reform.

3.2. Agricultural Activity

Colombia is a middle income country where around 23% lives in rural areas and 22% of the workforce is employed in the agricultural sector. Agricultural production varies depending on the area of the country, with coffee, rice, and maize being the most common agricultural products. Affected departments are intensive in the production of stimulants (mainly coffee), rice, maize, fruits and nuts, and sugarcane, whereas the rest of the country specializes in stimulants, maize, rice, yams and roots, and sugarcane. Figure 5 plots the main crop at the vereda level for all the country and highlights the two affected departments.

Figure 5: Main Crop by *Vereda*



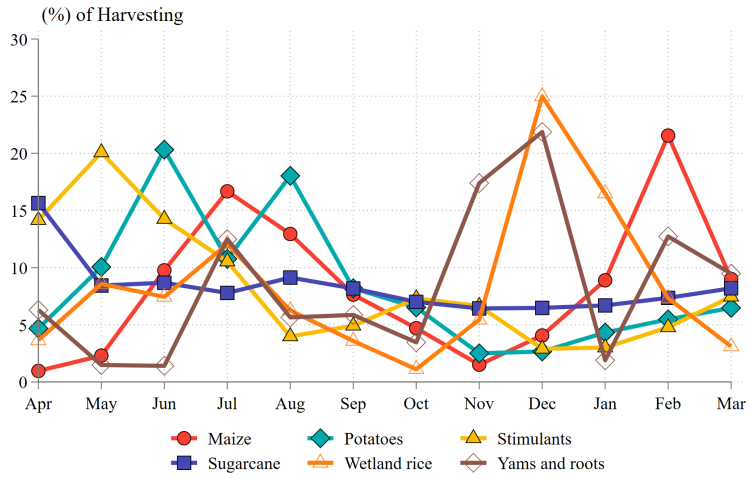
Notes. The figure shows the main harvested crop in each *vereda*. Stimulants include coffee, tea, and cocoa. *Veredas* shown in white indicate areas for which no information is available. Source: Own elaboration based on data from the Global Agro-Ecological Zones (GAEZ) v4 - FAO.

Colombia is located very close to the Equator, implying that temperature fluctuations do not follow a seasonal pattern. Instead, temperature varies primarily with altitude: lower-lying areas are warmer, while higher-altitude regions are colder. Despite the relative stability of temperatures throughout the year, climatic conditions do vary seasonally in terms of precipitation rather than temperature. As a result, some degree of climate seasonality is present (although to a much lesser extent than in countries with pronounced seasons) while temperature remains relatively constant over the year.

This climatic context, characteristic of equatorial countries, allows for the production of a wide range of agricultural goods depending on the altitude of cultivated areas. Consequently,

Colombia exhibits substantial heterogeneity both in the types of crops produced and in the timing of their production. This, in turn, leads to significant variation in agricultural calendars across regions. Figure 6 illustrates this heterogeneity by presenting the harvesting calendars of the three main crops in the affected departments. Specifically, we plot the share of each crop's total annual harvesting activity that occurs in each calendar month (see Appendix Figures A.4 and A.5 for detailed information on harvesting calendars in these two departments).

Figure 6: Harvesting Calendars for Main Crops in Affected Departments



Notes. This figure plots the proportion of days dedicated to harvesting activities in each month, relative to the total annual harvesting for each crop. Stimulants refer to coffee, tea, and cocoa. Data come from the Colombian Ministry of Agriculture.

Harvesting intensity varies substantially across crops and throughout the year. For example, maize harvesting is concentrated mainly in February and around the middle of the year, whereas stimulant crops—predominantly coffee—are harvested primarily between April and June. This heterogeneity is central to our analysis, as it allows us to identify areas within the affected departments that are more or less exposed to the reform.

4. Data

We combine four data sources to construct a school-level panel containing information on school progression, geographic location, and exposure to agricultural seasonality.

First, we use the school census from 2004 to 2018.[17] This census is compiled annually by the central government through surveys administered to school principals, who report detailed information on enrollment, infrastructure, and teaching staff. In particular, principals indicate the number of students enrolled in the previous year and classify them as currently enrolled on time, repeating a grade, having dropped out, or having transferred to another institution. We complement these data with georeferenced information on school locations.

Second, we compute harvested areas for different crops at the *vereda* level (geographic units smaller than municipalities) using data from the Global Agro-Ecological Zones (GAEZ)

[17]These data come from Form C-600 of the Colombian Ministry of Education, which is publicly available.

v4, produced by the Food and Agriculture Organization of the United Nations (FAO).[18][19] The GAEZ data are constructed on grids of approximately 9 × 9 kilometers at the equator and provide information on harvested areas for 25 crop groups.[20] We georeference these grids to the *vereda* level and match them to the school census. This procedure allows us to precisely identify the agricultural production in the areas surrounding each school in the data.

Third, we use information on harvesting calendars at the department–crop level provided by the Rural Agricultural Planning Unit (Unidad de Planificación Rural Agropecuaria, UPRA) of the Colombian Ministry of Agriculture.[21] These data report the timing and intensity of harvesting seasons for each crop in every department.

Fourth, we use administrative records from the Secretaries of Education of Nariño and Valle del Cauca detailing the academic calendars of public schools in these departments for the 2005–2008 period (pre-reform) and the 2011–2015 period (post-reform).

Combining these four data sets we build a school level panel that includes a total of 31,636 schools, representing all the schools in the country. Out of these, 59.57% correspond to rural and 88.36% to public, and 59.26% to rural, public schools (Appendix Figure A.6). Importantly, the panel includes information on crop harvesting in the *vereda* where the school is located. Table A.1 describes the school-level panel, which constitutes our estimating data set.

Overall, enrollment in rural schools declined over time across all departments in the sample. However, the reduction was substantially larger in the treated departments. Enrollment fell by 24% in Nariño and by 18% in Valle del Cauca, compared to a decline of only 9% in the rest of the country. Over the same period, dropout rates decreased and passing rates increased across all schools.

Similar patterns emerge when disaggregating by educational level, with one important difference. The decline in total enrollment is driven entirely by primary schools, whereas enrollment at the secondary level exhibits only a minimal decline or even a slight increase.

5. Empirical Strategy

This sharp and uniform calendar transition constitutes the core quasi-experimental variation exploited in our empirical strategy. By comparing schools in affected departments with appropriately selected schools in the rest of the country, we examine how changes in the timing of the school year—specifically, the redistribution of instructional and vacation days across months—affected school progression for rural children. We further analyze whether these effects are driven by increases in the overlap between academic calendars and local agricultural harvesting seasons in the most affected areas.

[18] A *vereda* is an administrative territorial division in the rural areas of municipalities, typically formed by a grouping of land parcels bounded by geographic features and major roadways.

[19] The data are available at: https://www.gaez.fao.org/.

[20] The crop groups include: wheat, rice, maize, sorghum, millet, barley, potato and sweet potato, cassava, yams and other roots, sugar beet, sugar cane, pulses, soybean, rapeseed, sunflower, groundnut, oil palm fruit, olives, cotton, banana, tobacco, vegetables, stimulants, fodder crops, and other crops.

[21] Available at: https://www.upra.gov.co/es-co/eva/eva-2019.

To estimate the effect of the change in the academic calendar, we compare schools in the two affected departments—Nariño and Valle del Cauca—with schools in the rest of Colombia. We focus specifically on rural and public schools, as these are the most directly influenced by agricultural calendars. This setup involves comparing a relatively small group of treated schools (1,668) with a much larger group of untreated schools across the rest of the country (16,885).

Given the large pool of untreated schools, identifying an appropriate counterfactual may be challenging and prone to researcher bias. To address this concern, we implement a Synthetic Difference-in-Differences (SDID) estimator, which provides a flexible and data-driven approach to constructing counterfactuals under weaker assumptions than the standard Difference-in-Differences (DID) framework (Arkhangelsky et al., 2021). The SDID method combines features of the DID design with the Synthetic Control approach (Abadie and Gardeazabal, 2003; Abadie et al., 2010, 2015; Abadie and L'hour, 2021), generating a weighted combination of untreated units that closely matches pre-treatment trends in the treated group. This framework enables causal inference under less restrictive assumptions than standard DID.

Formally, the SDID procedure assigns unit weights, $\hat{\omega}_i$, to schools in the untreated group so that the weighted average of their pre-treatment outcome trajectories closely matches that of the treated schools during the pre-exposure period (2004–2009). In addition, SDID assigns time weights, $\hat{\lambda}_t$, which balance pre- and post-treatment periods for the untreated units in the estimation. The estimator solves the following optimization problem:

$$\left(\hat{\tau}, \hat{\mu}, \hat{\alpha}, \hat{\beta}\right) = \underset{\tau,\mu,\alpha,\beta}{\operatorname{argmin}} \left\{ \sum_{i=1}^{N} \sum_{t=1}^{T} \left(y_{it} - \mu - \alpha_i - \beta_t - W_{it}\tau\right)^2 \hat{\omega}_i \hat{\lambda}_t \right\} \tag{2}$$

where y_{it} denotes the outcome for school i in year t, $W_{it} \in \{0, 1\}$ indicates treatment exposure, N is the number of schools, and T the number of years. The terms α_i and β_t represent school and year fixed effects, respectively. The parameter of interest, τ, measures the Average Treatment Effect on the Treated of the academic-calendar reform on schools in treated departments.

Our main outcomes of interest are total school enrollment (in logs), and the dropout rate, measured annually relative to the number of students enrolled in each school in the baseline year. We also present additional results for school promotion rates. While informative, this outcome is potentially subject to attrition bias, as it is defined conditional on students remaining enrolled in school.

Importantly, our SDID strategy is not affected by variation in treatment timing or by differential treatment intensity (de Chaisemartin and D'Haultfœuille, 2020). All affected schools experienced the calendar change simultaneously and to the same extent. Therefore, our identification strategy relies on three key milder assumptions: (1) the absence of differential pre-trends; (2) the absence of other policies specifically targeting the affected departments; and (3) the stable unit treatment value assumption (SUTVA). We provide evidence supporting the first assumption using event-study estimates. Regarding the second, we did not identify any other policy interventions affecting Nariño or Valle del Cauca during this period. Finally,

SUTVA could be violated if the treatment induced migration or population changes in the affected departments. We provide evidence against this in Section 6.4.

6. School-Level Effects of the Reform

6.1. Overlap Between School and Agricultural Calendars

The calendar reform modified the degree of overlap between academic and agricultural calendars in the affected departments. To quantify this change, we construct a school-level measure of overlap between the two calendars in three steps:

1. Using department-level school calendars, we compute the proportion of non-instructional days in month m for each affected department d and each academic calendar $c \in \{A, B\}$. We denote this proportion by V_{mdc}.

2. Using department- and crop-specific harvesting calendars, we identify harvesting-intensive months for each crop. We define an indicator variable, $\mathbb{1}_{\{m \in \mathcal{I}_j\}}$, equal to one if month m for crop j falls within the top quartile of the annual distribution of harvesting activity (i.e., the three most intensive months), denoted by $\mathcal{I}_j$, and zero otherwise.[22]

3. Combining these two measures, we define the overlap between academic and agricultural calendars for each school s under calendar c as:

$$O_{sc} = \sum_{j \in J} \omega_{sj} \left(\frac{1}{12} \sum_{m=1}^{12} \max \left\{ \mathbb{1}_{\{m \in \mathcal{I}_j\}} - V_{mdc}, 0 \right\} \right). \tag{3}$$

   The term inside the brackets captures the share of instructional days during harvesting-intensive months (i.e., $1 - V_{mdc}$) and is equal to zero during non-intensive months. Averaging this expression across months yields the mean share of instructional days a student would forgo if they participate in the labor market for a given crop j under calendar c. We then aggregate across crops using ω_{sj}, the share of crop j's harvested area in the *vereda* where school s is located. The resulting measure, O_{sc}, represents the weighted average share of potential school days lost due to agricultural labor participation. Larger values indicate greater overlap between instructional days and harvesting periods, and thus a higher opportunity cost of schooling during peak agricultural seasons.

4. Finally, we compute a school-level exposure measure, O_s, defined as the change in overlap induced by the calendar reform:

$$\Delta O_s = O_{sA} - O_{sB}. \tag{4}$$

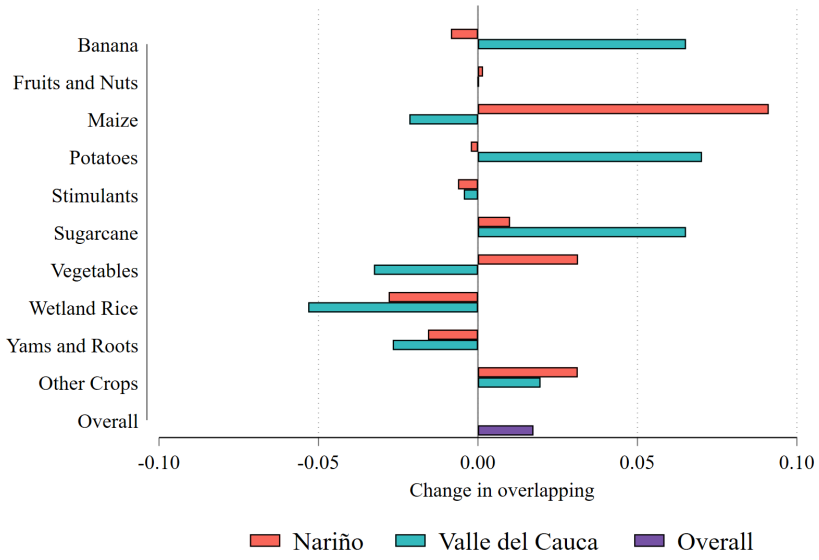
[22] The selection of the set $\mathcal{I}_j$ might vary depending on how many months we define as harvesting intensive. We provide robustness checks Section 6.4 varying the definition of $\mathcal{I}_j$ and show that our results do not depend on this.

A positive value of ΔO_s indicates that the post-reform January–November calendar (Calendar A) increases the overlap between academic activities and harvesting periods relative to the pre-reform September–June calendar (Calendar B) in school s.

Intuitively, the overlap measure captures changes in the opportunity cost of schooling faced by students in schools differentially exposed to the calendar reform. Consider a student living in a rural area where potatoes—primarily harvested in August—constitute the dominant crop. Under the pre-reform calendar, most days in August were school holidays, allowing children to participate in harvesting activities during a peak agricultural month. Under the post-reform calendar, August becomes a full instructional month. As a result, the student faces a sharper trade-off between attending school and working during the harvest season. With binding time constraints, this increased overlap raises the opportunity cost of schooling and may lead some students to reduce attendance or drop out altogether.

Figure 7 presents the average change in overlap for schools in both affected departments across the main crops in each region. We document substantial heterogeneity in overlap changes across crops and departments. For instance, while the overlap associated with maize harvesting increases markedly in Nariño, it decreases slightly in Valle del Cauca following the reform. This heterogeneity is central to our analysis, as it implies that exposure to the reform depends jointly on the dominant crops in each *vereda* and on department-specific harvesting calendars. Overall, the reform increased the calendar overlap as captured by the overall weighted average presented in the bottom of Figure 7.

Figure 7: Change in Calendar Overlap Induced by the Reform



Notes: The figure plots the average change in overlap between the academic and harvesting calendars before and after the reform, by crop, based on the most harvested crop in each *vereda* where schools are located.

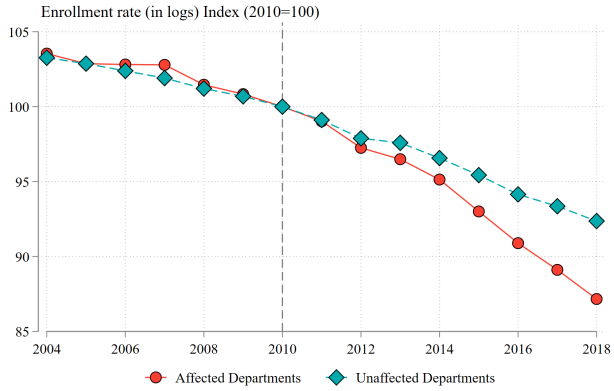
6.2. Effects of the Reform on School Attendance

The calendar reform decreased public school enrollment by inducing student dropout and decreasing school promotion. To see this, we begin by plotting the evolution of school

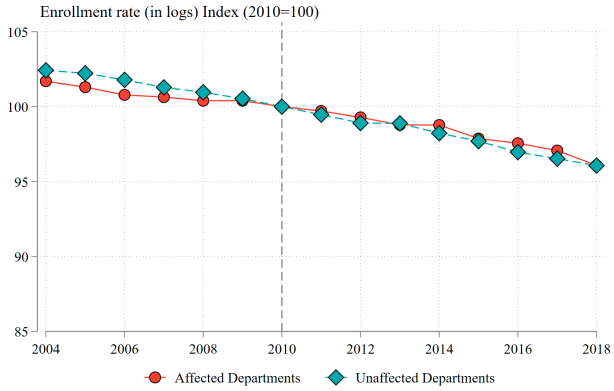
enrollment, normalized to the year prior to the reform, in Figure 8. We present estimates separately for rural (Panel 8a) and urban (Panel 8b) schools. Prior to the reform, school enrollment in affected and unaffected departments evolved in parallel indicating no differential pre-reform trends. However, after the reform we observe a sudden decline in school enrollment among rural schools in affected departments, with the gap widening over time through 2018. We do not see any change in enrollment among urban schools.

Figure 8: Public School Enrollment in Affected and Unaffected Departments

(a) Rural



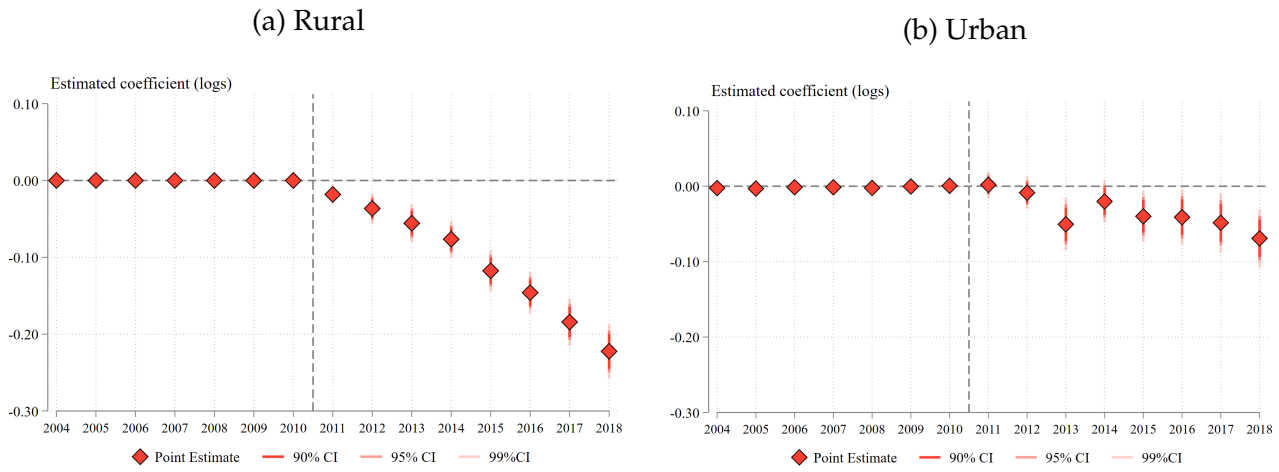
(b) Urban



Notes: The figure shows the average difference in the (log) number of enrolled students in schools in Nariño and Valle del Cauca relative to schools in the rest of Colombia, for each year compared to 2010 (the baseline year). Estimates come from a regression controlling for school and year fixed effects. Vertical lines indicate 95% and 90% confidence intervals. Standard errors are clustered at the school level. Source: Own elaboration based on data from DANE.

Although suggestive, this evidence suggests that the reform could have decreased rural school enrollment in the affected departments. More direct evidence comes from estimating the SDID specification in Equation 2 using enrollment as outcome. We present the results in Figure 9. The reform led to a persistent decline in enrollment in rural schools in affected departments. The negative effect emerges immediately after the reform and grows over time, remaining statistically significant through the end of the sample period. By 2018, average enrollment in treated schools had fallen by nearly 25% relative to the pre-reform baseline. Given an average baseline enrollment of approximately 78 students per school, this corresponds to a reduction of about 19 students per school.

Figure 9: Effect of the Calendar Reform on Rural School Enrollment



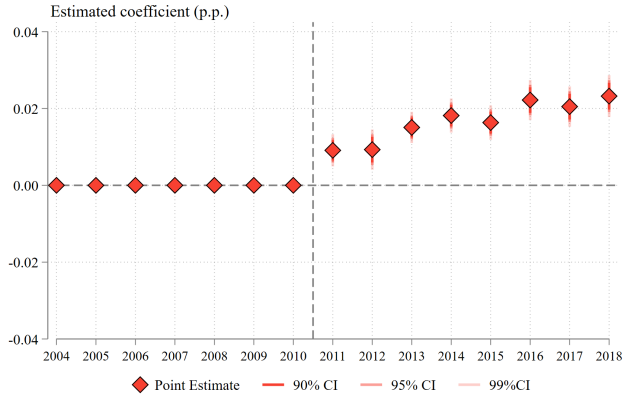
Notes: The figures show the estimated effect of the 2010 change in the academic calendar on the corresponding outcomes for public-rural, and public-urban schools in Nariño and Valle del Cauca, compared to the synthetic control constructed following the methodology described in Section 5. The vertical lines represent the 90%, 95%, and 99% confidence intervals, based on bootstrapped standard errors with 50 repetitions.

School enrollment, in levels, can just capture a scale effect and does not allow us to know if it is true dropout, grade retention, or overall changes in population. Therefore, to better understand the effects we again implement the SDID methodology using school dropout rates as outcome. We report the effects on Figure 10.[23] The calendar reform increased dropout rates among schools in the affected departments, whereas urban schools remained unaffected. We observe a substantial and persistent increase in dropout rates. By the end of the sample period, the dropout rate in treated schools had risen by approximately 2.5 percentage points (p.p.) relative to the baseline. This increase corresponds to roughly a 50% rise compared to the pre-reform dropout rate of about 5% in 2010.

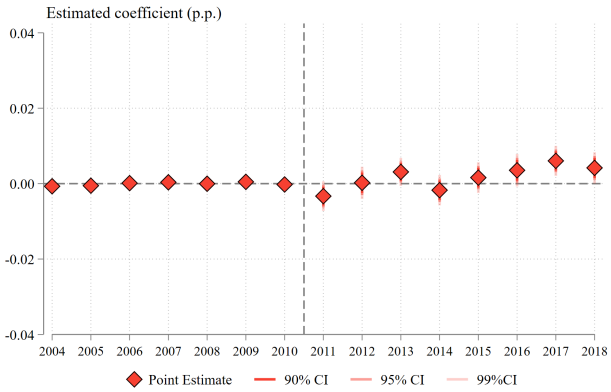
[23] Appendix Table A.3 reports the distribution of school-level weights ω_i estimated using the SDID methodology for the two main outcomes of interest. The first row shows the number of schools in the control group receiving a zero weight. We then grouped schools into deciles based on the magnitude of their weights and reported the average weight within each decile. For both outcomes, more than 10,000 schools received non-zero weights.

Figure 10: Effect of the Calendar Reform on School Dropout Rates

(a) Rural



(b) Urban

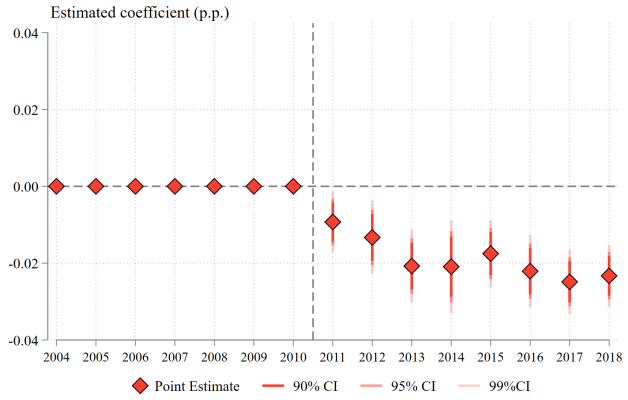


Notes: The figures show the estimated effect of the 2010 change in the academic calendar on the corresponding outcomes for public-rural, private-rural, public-urban, and private-urban schools in Nariño and Valle del Cauca, compared to the synthetic control constructed following the methodology described in Section 5. The vertical lines represent the 90%, 95%, and 99% confidence intervals, based on bootstrapped standard errors with 50 repetitions.

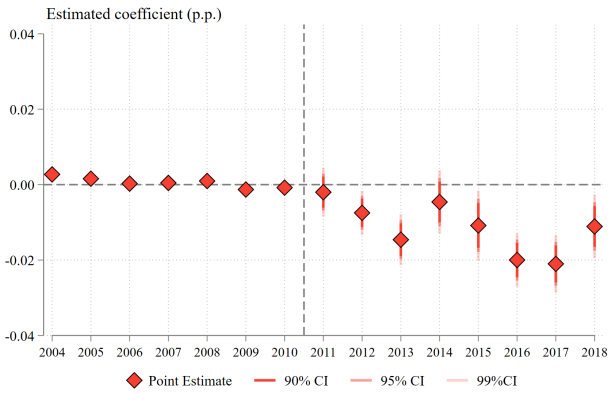
The reform induced rural students to drop out but also affected grade promotion. We analyze the effect of the reform using grade promotion rates as outcome in Figure 11. We again observe that rural students in affected departments were more likely to fail the grade after the reform relative to their unaffected counterparts. The reform increased grade retention by approximately 2.5 p.p. relative to baseline, corresponding to a decline of about 3% compared to the average passing rate in treated departments in 2010, prior to the reform.

Figure 11: Effect of the Calendar Reform on Grade Promotion

(a) Rural



(b) Urban



Notes: The figures show the estimated effect of the 2010 change in the academic calendar on the corresponding grade promotion defined as the share of students who approved a grade over the total enrollment in that grade. Panel 11a presents results for rural schools whereas 11b for urban schools. Treatement is defined as the schools in Nariño and Valle del Cauca, compared to the synthetic control constructed following the methodology described in Section 5. The vertical lines represent the 90%, 95%, and 99% confidence intervals, based on bootstrapped standard errors with 50 repetitions.

The effect on grade retention helps explain the persistent increase in dropout rates docu-

mented earlier in Figure 10. The calendar reform appears to operate along both an extensive and an intensive margin of school progression. On the extensive margin, some students responded to the higher opportunity cost of schooling by dropping out immediately after the reform. On the intensive margin, other students remained enrolled but faced greater difficulty balancing academic responsibilities with competing activities, such as agricultural work, leading to lower academic performance and, over time, an increased likelihood of eventual dropout.

Taken together, these results indicate that the transition from the September–June to the January–November academic calendar had significant adverse effects on educational progression in rural areas of the treated departments. The reform led to sizable and persistent reductions in school enrollment driven by increased dropout rates and grade retention rates.

Heterogeneity of the effect: The effects of the reform were concentrated on primary school students. Appendix Figure D.11 presents the results on school dropout separately for students in secondary and primary school. The effects are driven by primary-school students. By the end of the sample period, the reform reduced primary-school enrollment by approximately 35% on average, an effect largely attributable to a substantial increase in dropout rates. In contrast, we find no statistically significant effects on enrollment or dropout rates among secondary-school students.[24]

6.3. Effects of the Reform by Exposition to Calendar Overlap

The calendar reform affected academic progression among students in affected departments where the change in calendar overlaps more with the agricultural calendar. We exploit the calendar overlap measure introduced in Section 6.1 to analyze the effects of the reform among *veredas* that were exposed and not to the calendar overlap. We estimate heterogeneous effects across schools that experienced little or no increase in overlap (or even a reduction) and those that experienced a substantial increase.[25] The results are presented in Figure 12.

[24]We additionally examine heterogeneity by gender in Appendix Figure D.12, and do not find any substantial difference between male and female students.

[25]We classify schools as low-overlap if their change in overlap, ΔO_s, falls within the first quartile of its distribution, and as high-overlap if it falls within the top quartile.

Figure 12: Effects of the Reform by Levels of Exposure to Calendar Overlap

(a) Enrollment (in logs)



(b) Dropout rate



(c) Grade Promotion



Notes: The figures show the estimated effect of the 2010 change in the academic calendar on the corresponding outcomes for public and rural schools in Nariño and Valle del Cauca, compared to the synthetic control constructed following the methodology described in Section 5. The vertical lines represent the 90%, 95%, and 99% confidence intervals, based on bootstrapped standard errors with 50 repetitions. Source: Own elaboration based on data from DANE.

Schools located in areas where harvesting seasons overlap more closely with instructional days face larger increases in school dropout. The adverse effects of the calendar reform on enrollment are strongly driven by schools experiencing larger increases in overlap. By the end of the sample period, the decline in enrollment among high-overlap schools is approximately 50% larger than that observed among low-overlap schools. Consistent with this pattern, we find no meaningful effect on dropout rates for low-overlap schools, whereas the increase in dropout is concentrated among schools with substantial increases in overlap.

This evidence supports the interpretation that the calendar reform affected school progression primarily by increasing the overlap between academic schedules and local harvesting seasons. In schools where this overlap rose the most, students faced a higher opportunity cost of attending and remaining in school due to the outside option of agricultural work. Under binding time constraints, this increase in opportunity cost translated into higher dropout rates and lower enrollment. In the following section, we present suggestive evidence on changes

in child labor participation for treated departments in our analysis that further supports this mechanism.

6.4. Robustness of the School-Level Estimates

We provide additional evidence supporting our main results through three complementary robustness exercises. First, we show that our findings are not sensitive to alternative definitions of harvesting intensity months (i.e., the set defined in $\mathcal{I}_j$). Second, we assess whether our results are consistent with the stable unit treatment value assumption (SUTVA), which requires that schools in the control group are not affected by policy-induced changes in the composition of students. Third, we re-estimate the effects using a conventional difference-in-differences (DiD) design with a comparison group constructed independently of the SDID procedure.

Harvesting Intensity. Our baseline specification in Figure 12 defines harvesting intensity using the top quartile of the annual distribution of harvesting activity, corresponding to the three most intensive months of the year. Figure A.10 presents SDID point estimates obtained under alternative definitions of intensive harvesting months. For ease of comparison, we pool the dynamic effects into a single estimate and include the baseline specification. The results remain stable when defining harvesting intensity using either only the most intensive month or the two most intensive months of the year.

SUTVA. Our estimates could be biased if the reform affected outcomes in the untreated group of schools. The primary threat to SUTVA in this context is the possibility that the reform induced students to migrate from treated to untreated departments, thereby contaminating the counterfactual. We provide two pieces of evidence supporting the validity of the SUTVA assumption. First, we examine whether the reform affected school transfer rates and report the results in Figure A.9a.[26] We find no evidence of a reform-induced increase in transfer rates, suggesting that students in affected departments did not relocate to schools in unaffected departments. Second, we compare trends in the share of children who migrated within the last five years between treated and untreated departments. If the reform induced migration, we would expect to observe differential trends across these groups. As shown in Figure A.9b, no such divergence is apparent. Together, these findings provide strong support for the SUTVA assumption.

Difference-in-Differences. Finally, we assess whether our results are driven by the weights implicitly assigned by the SDID estimator. To do so, we implement a conventional DiD design using a set of untreated departments constructed to be comparable to the treated departments of Valle del Cauca and Nariño. This comparison group is built in two steps. First, we restrict the pool to untreated departments whose primary agricultural products overlap with those of the treated departments—namely stimulants (coffee) and rice.[27] Second, within this restricted

[26] The transfer rate in Figure A.9a is defined at the municipality level (rather than the school level), as our interest lies in movements across locations rather than across schools within the same location.

[27] This restriction excludes Bogotá, D.C., Bolívar, Boyacá, Caquetá, Cesar, Cundinamarca, Chocó, La Guajira, Norte de Santander, San Andrés y Providencia, and Amazonas.

pool, we select the three most similar departments based on a set of pre-treatment covariates.[28] Figure A.10 presents the DiD estimates using this comparison group. The resulting patterns closely mirror those obtained using SDID, providing additional support for the robustness of our main findings.

7. Labor Market Consequences

7.1. Child Labor Responses to School Dropout

To validate our prior results, we explore whether child labor could have been affected by the reform. By increasing the calendar overlap, the reform raised the relative cost of school attendance compared to the outside option of working, thereby inducing some students to drop out.

Due to data limitations, we do not observe individual-level labor supply with sufficient granularity to causally estimate the effect of the calendar reform on children's participation in rural work relative to a control group. Nevertheless, we find suggestive descriptive consistent evidence about the reform increasing child labor in affected departments. This evidence is summarized in Figure 13.

Using nationally representative household survey data from Colombia, Figure 13 presents patterns of child labor in rural areas for treated departments and the rest of the country. Panel (a) shows the time-series evolution of the share of children working in rural activities. Panel (b) reports average child labor rates for primary-school-age children before and after the calendar reform in treated and untreated areas, in the spirit of a raw difference-in-differences comparison. Panel (c) disaggregates the analysis for treated departments by educational attainment.

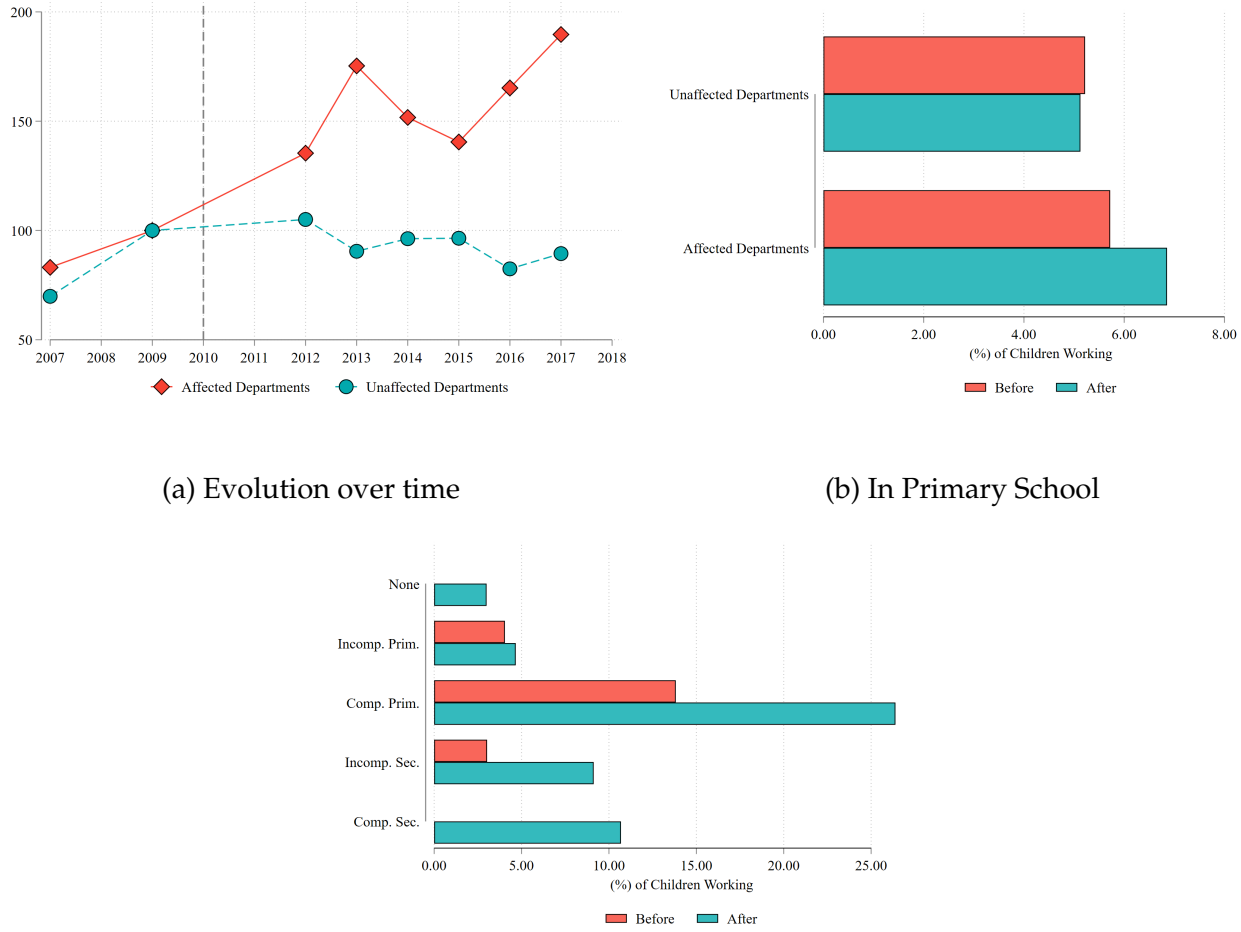
First, Panel (a) shows that following the calendar reform, the share of children working in rural activities increased markedly in treated departments relative to the rest of the country, with the divergence widening over time. By 2017, the share of children working in rural areas in treated departments had approximately doubled relative to the pre-reform period, whereas the corresponding share in untreated areas remained largely flat.

Second, Panel (b) provides a more compact summary of this pattern. In departments not affected by the reform, the share of primary-school-age children working in rural activities did not increase and, if anything, declined slightly after 2010. In contrast, in treated departments the share of children working rose by approximately 1 p.p. on average, corresponding to a 20% increase relative to pre-reform levels.

Finally, Panel (c) shows that this increase is concentrated among children with completed primary education and those with incomplete secondary education. The share of children

[28] Specifically, we compute a standardized index based on: (i) the share of agriculture in departmental GDP; (ii) the log of the rural population; (iii) the log of public expenditure; and (iv) the log of public revenues (as a proxy for state capacity). We then calculate Euclidean distances in the standardized covariate space and select the three closest untreated departments. This procedure identifies Risaralda, Sucre, and Arauca as the most comparable departments.

Figure 13: Share of Children Working in Agriculture



(a) Evolution over time

(b) In Primary School

(c) By Educational Level

Panel (a) shows the evolution of the share of children working in agriculture and silviculture over time, normalized to 100 in 2009, for Nariño and Valle del Cauca compared to the rest of Colombia. Panel (b) shows the share of children with incomplete or complete primary education working in agriculture and silviculture before and after the academic calendar change, for Nariño and Valle del Cauca compared to the rest of Colombia. Panel (c) shows the share of children working in agriculture and silviculture before and after the academic calendar change, by educational level, for Nariño and Valle del Cauca. Source: Own elaboration based on data from DANE.

working among those with completed primary schooling increased from approximately 12% to nearly 25%, while for those with incomplete secondary education it rose from about 3% to roughly 10%. This pattern closely mirrors the heterogeneous treatment effects documented earlier in the paper, where the increase in school dropout was driven primarily by students at the primary level.

Taken together, this evidence, while descriptive in nature, is consistent with the main mechanism proposed in this paper. In rural areas of treated departments, the calendar reform not only increased dropout rates and reduced enrollment, but was also accompanied by an increase in child labor participation. These patterns align with the interpretation that greater overlap between academic calendars and agricultural harvesting seasons raised the opportunity cost of schooling, leading some students to substitute school attendance with labor supply in order to support household income.

8. Conclusions

This paper analyzes the impact of an academic calendar reform in Colombia on the school progression of rural students in two treated departments, Nariño and Valle del Cauca. We exploit a quasi-experimental setting in which public schools in these departments shifted from a September–June academic calendar to a January–November calendar, aligning them with the rest of the country.

Our results show that this calendar change had adverse effects on school progression in rural areas. Enrollment declined substantially following the reform, an effect driven primarily by a significant increase in dropout rates. These impacts are concentrated among primary-school students, while we find no differential effects by gender.

We provide evidence that these effects operate through a mechanism related to increased overlap between instructional schedules and local agricultural calendars. In areas where the reform generated greater overlap between school days and peak harvesting periods, the opportunity cost of attending school rose sharply under binding time constraints. Consistent with this mechanism, suggestive evidence indicates an increase in child labor participation in rural areas of treated departments relative to the rest of the country.

Our findings highlight the role of academic calendar design as a relevant—and often overlooked—policy instrument for improving school attendance in developing countries, particularly in rural regions where agricultural activity plays a central role. While much of the existing policy response has focused on alleviating household financial constraints through interventions such as conditional cash transfers, our results suggest that adjusting the timing of the school year to better align with local economic conditions may offer a complementary and cost-effective approach. By reducing the opportunity cost of schooling, such reforms have the potential to improve educational progression, strengthen human capital accumulation, and support long-run economic development.

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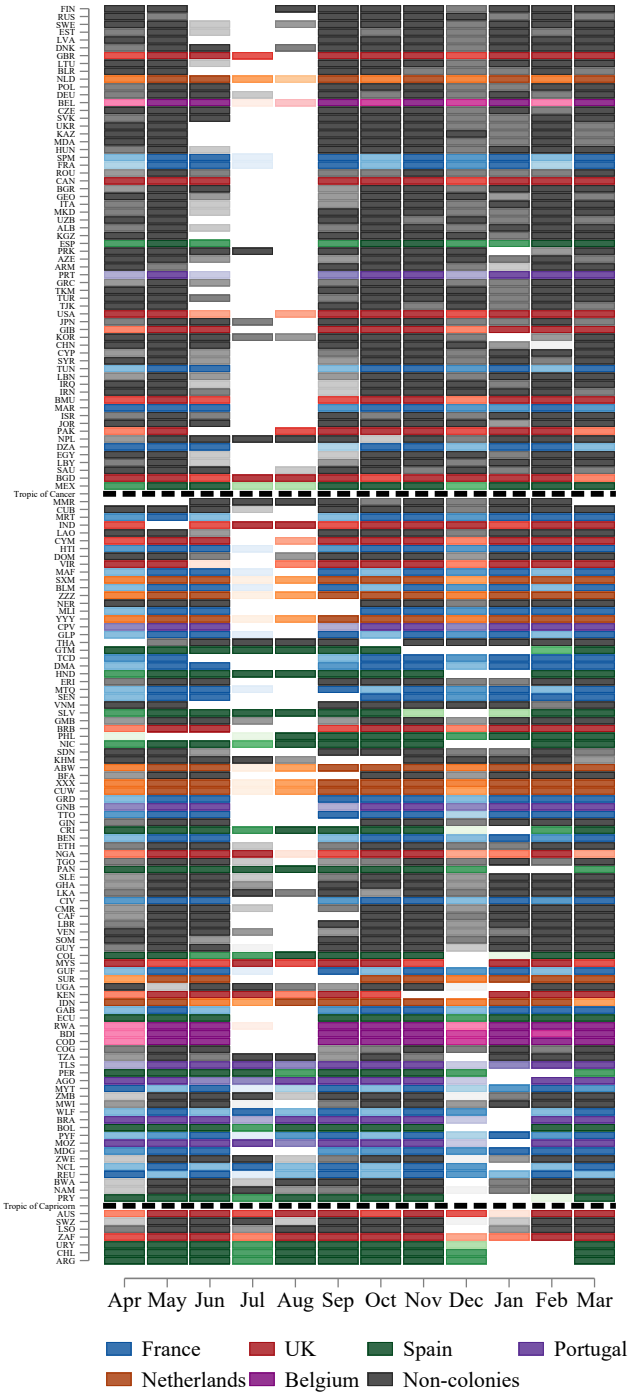
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A. Additional Figures and Tables

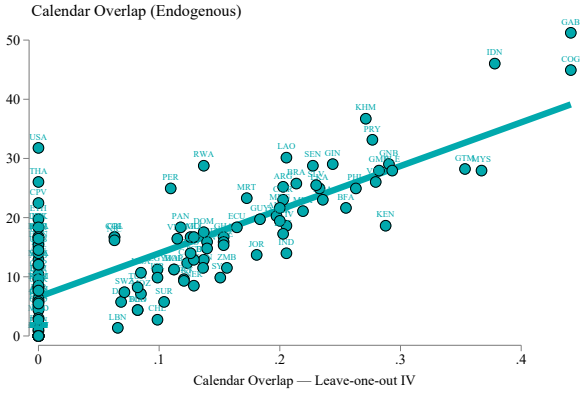
Appendix Figure A.1: Worldwide Academic Calendars by Latitude and Colonizer



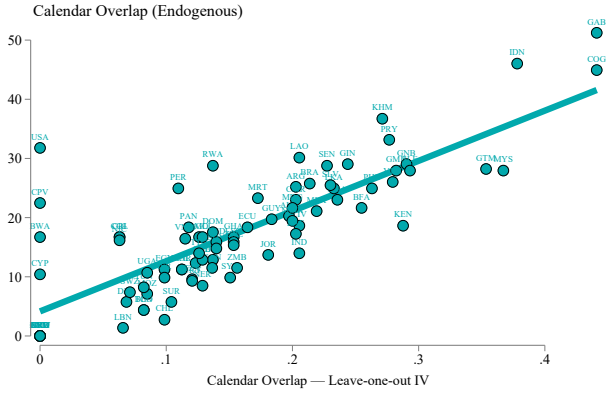
Notes: The figure shows the share of school days in each month. For each country, the information corresponds to the most recent school calendar data available. Source: Own elaboration based on official sources.

Appendix Figure A.2: First-stage relationship

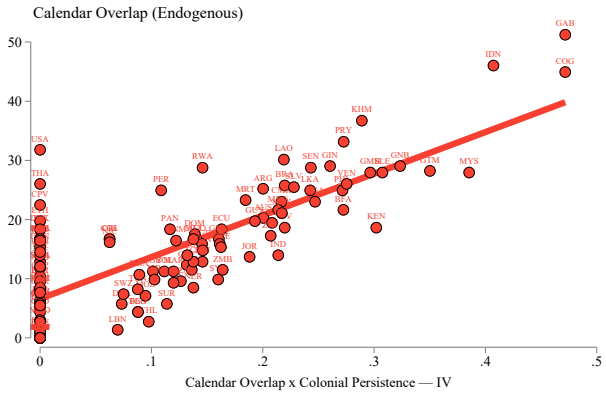
(a) Leave-one-out overlap, Full sample



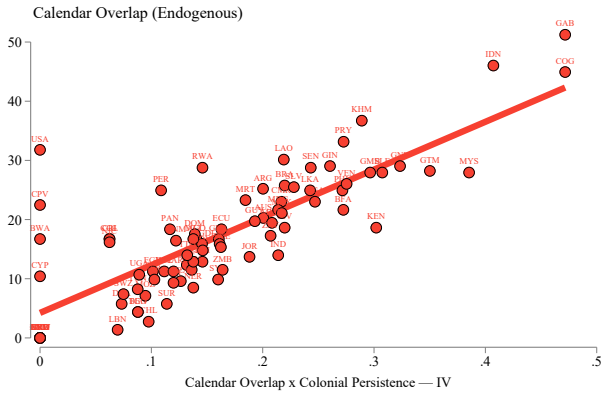
(b) Leave-one-out overlap, Colonies



(c) Overlap × colonial persistence, Full sample

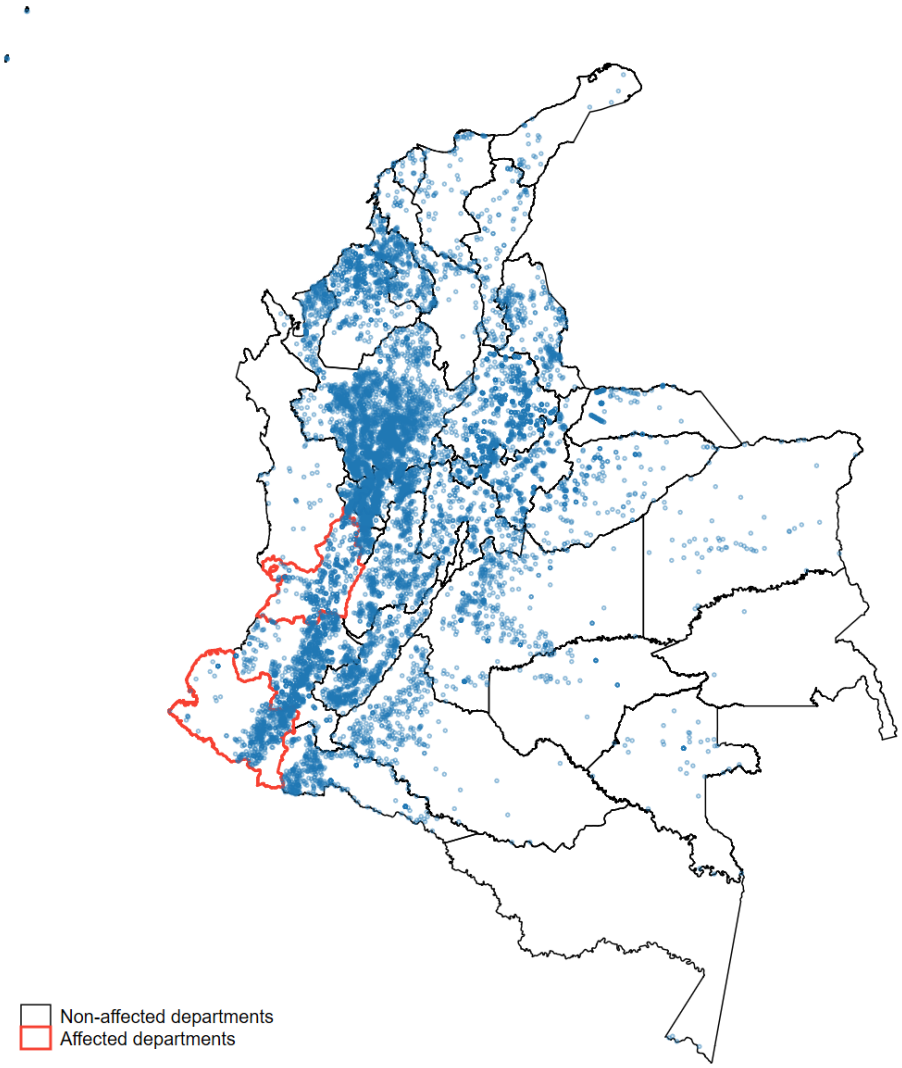


(d) Overlap × colonial persistence, Colonies



Notes: The figures shows a scatterplot between the measured overlapping between harvesting and school calendars according to equation 2.3, and the IVs Z_i^{LOO} and Z_i^{CP}.

Appendix Figure A.3: Schools Distribution



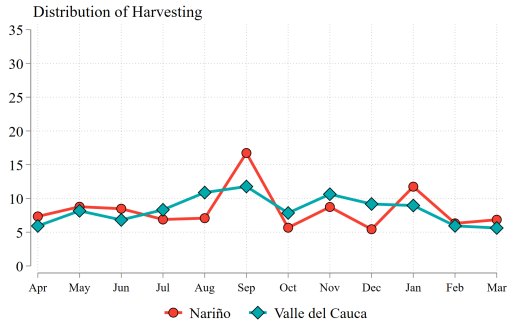
Notes. Each dot represents a school in the estimation sample. Source: Own elaboration based on data from DANE.

Appendix Table A.1: Descriptive Statistics

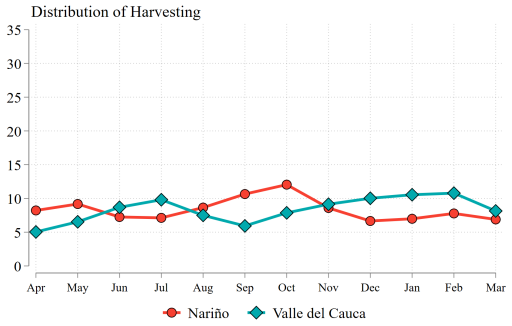
	Before				After			
	Affected	Unaffected	DID	SDID	Affected	Unaffected	DID	SDID
Panel A: Overall								
No. Students Enrolled	78.57	77.07	87.75	91.41	70.68	75.42	80.56	88.34
Dropout rate	0.074	0.085	0.106	0.086	0.034	0.043	0.054	0.043
Passing rate	0.840	0.808	0.782	0.808	0.874	0.847	0.835	0.847
Observations	1,668	16,885	1,112	10,008	1,668	16,885	1,112	10,008
Panel B: Primary level								
No. Students Enrolled	56.28	56.08	66.62	64.92	42.67	56.08	66.62	53.72
Dropout rate	0.073	0.084	0.107	0.085	0.032	0.041	0.053	0.041
Passing rate	0.840	0.807	0.781	0.807	0.879	0.850	0.836	0.850
Observations	1,668	16,885	1,112	10,008	1,668	16,885	1,112	10,008
Panel C: Secondary level								
No. Students Enrolled	22.28	20.99	21.12	26.49	28.02	28.25	25.48	34.62
Dropout rate	0.081	0.091	0.097	0.091	0.046	0.060	0.059	0.060
Passing rate	0.851	0.837	0.825	0.835	0.848	0.830	0.824	0.827
Observations	1,668	16,885	1,112	10,008	1,668	16,885	1,112	10,008
Panel D: Teachers								
No. Teachers	3.84	3.25	3.63	3.85	3.68	3.55	3.87	4.12
Share Male Teachers	0.32	0.31	0.40	0.31	0.34	0.33	0.40	0.33
Share Teachers with Postsecondary	0.70	0.64	0.72	0.65	0.83	0.75	0.81	0.76
Observations	1,668	16,679	1,111	9,890	1,668	16,679	1,111	9,890
Panel E: Crop Harvesting								
Harvested area (ha)	158.3	110.2	90.7					
No. of products	9.8	11.1	10.4					
Main crops: harvested area (ha)								
Stimulants	28.2	24.6	19.2					
Wetland Rice	26.0	13.0	18.7					
Maize	25.8	16.6	12.0					
Observations	2,400	29,905	6,777					

Notes. Panels A-C report the average of each variable listed in the first column across schools. Panel D reports the average harvested area and the average number of distinct crops across all *veredas* in affected and unaffected departments. Source: Own elaboration based on data from DANE and the Global Agro-Ecological Zones (GAEZ) v4, FAO.

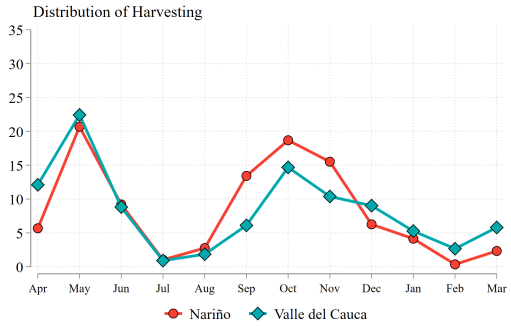
Appendix Figure A.4: Harvesting Calendars - Nariño and Valle del Cauca



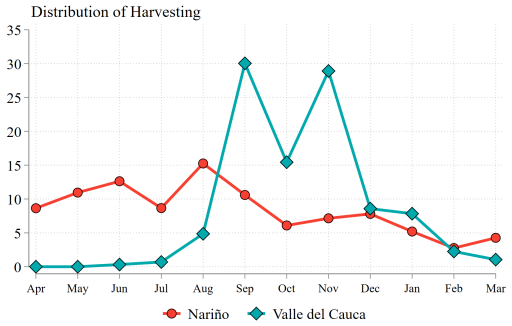
(a) Banana



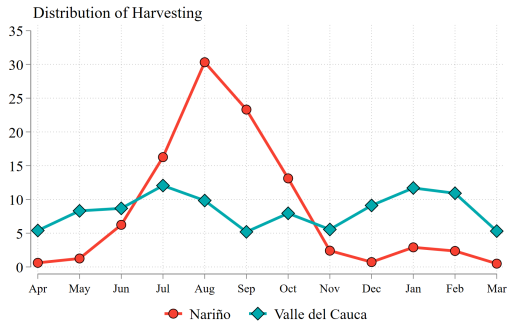
(b) Fruits and Nuts



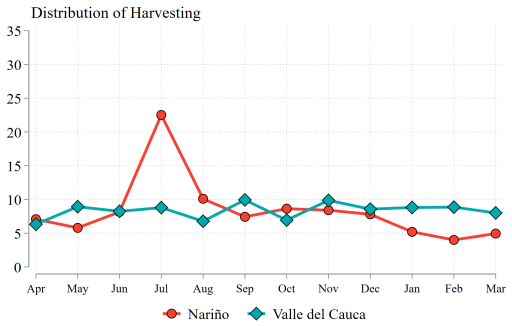
(c) Maize



(d) Potato and Sweet Potato



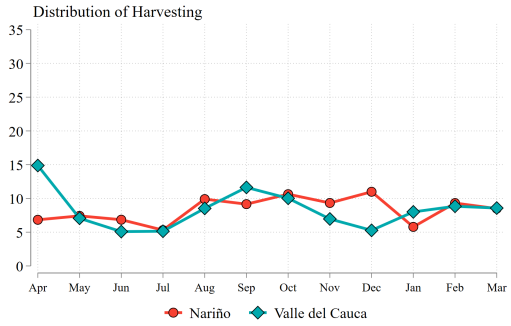
(e) Stimulants



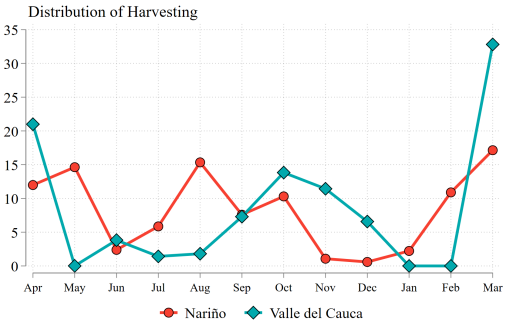
(f) Sugarcane

Notes. The figures show the proportion of days dedicated to harvesting activities in each month, relative to the total annual harvesting for each crop. Source: Own elaboration based on data from the Colombian Ministry of Agriculture.

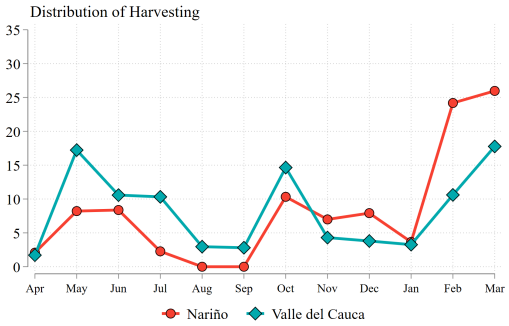
Appendix Figure A.5: Harvesting Calendars - Nariño and Valle del Cauca



(a) Vegetables



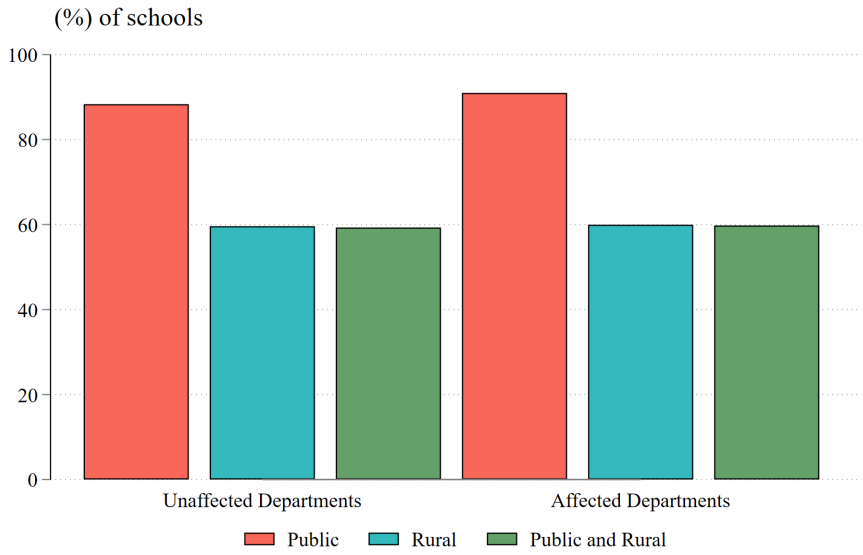
(b) Wetland Rice



(c) Yams and Other Roots

Notes. The figures show the proportion of days dedicated to harvesting activities in each month, relative to the total annual harvesting for each crop. Source: Own elaboration based on data from the Colombian Ministry of Agriculture.

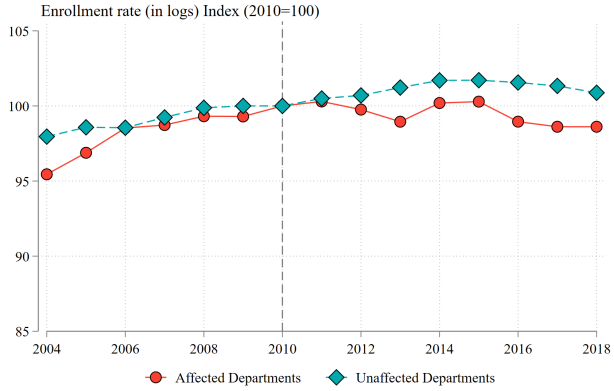
Appendix Figure A.6: Proportion of Public and Rural Schools



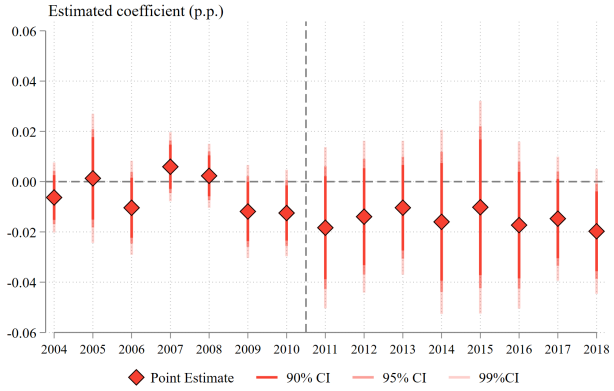
Notes: The figure shows the percentage of schools that are public, rural, or both in 2010, in affected departments (i.e., Nariño and Valle del Cauca), and in the rest of the country. Data come from the Colombian census of schools (Form C-600).

Appendix Figure A.7: Effects of the Reform on Private Schools

(a) Enrollment



(b) Dropout Rates



Appendix Table A.2: Calendar Overlap and School Dropout Rates by Colonies and Non-Colonies

	Dependent variable: Dropout rate				
	(1)	(2)	(3)	(4)	(5)
Panel A: Main effects					
Calendar Overlap	0.237***	0.167*	0.222***	0.211***	0.211***
	(0.077)	(0.088)	(0.083)	(0.068)	(0.071)
Observations	126	126	126	126	126
Panel B: Colonies					
Calendar Overlap	0.114	0.126	0.214**	0.167*	0.163*
	(0.107)	(0.107)	(0.103)	(0.085)	(0.091)
Observations	84	84	84	84	84
Panel C: Non-colonies					
Calendar Overlap	0.069	0.038	0.056	0.044	-0.014
	(0.114)	(0.090)	(0.089)	(0.081)	(0.098)
Observations	42	42	42	42	42
Geographic controls	No	Yes	Yes	Yes	Yes
Macroeconomic controls	No	No	Yes	Yes	Yes
Demographic controls	No	No	No	Yes	Yes
Trade controls	No	No	No	No	Yes

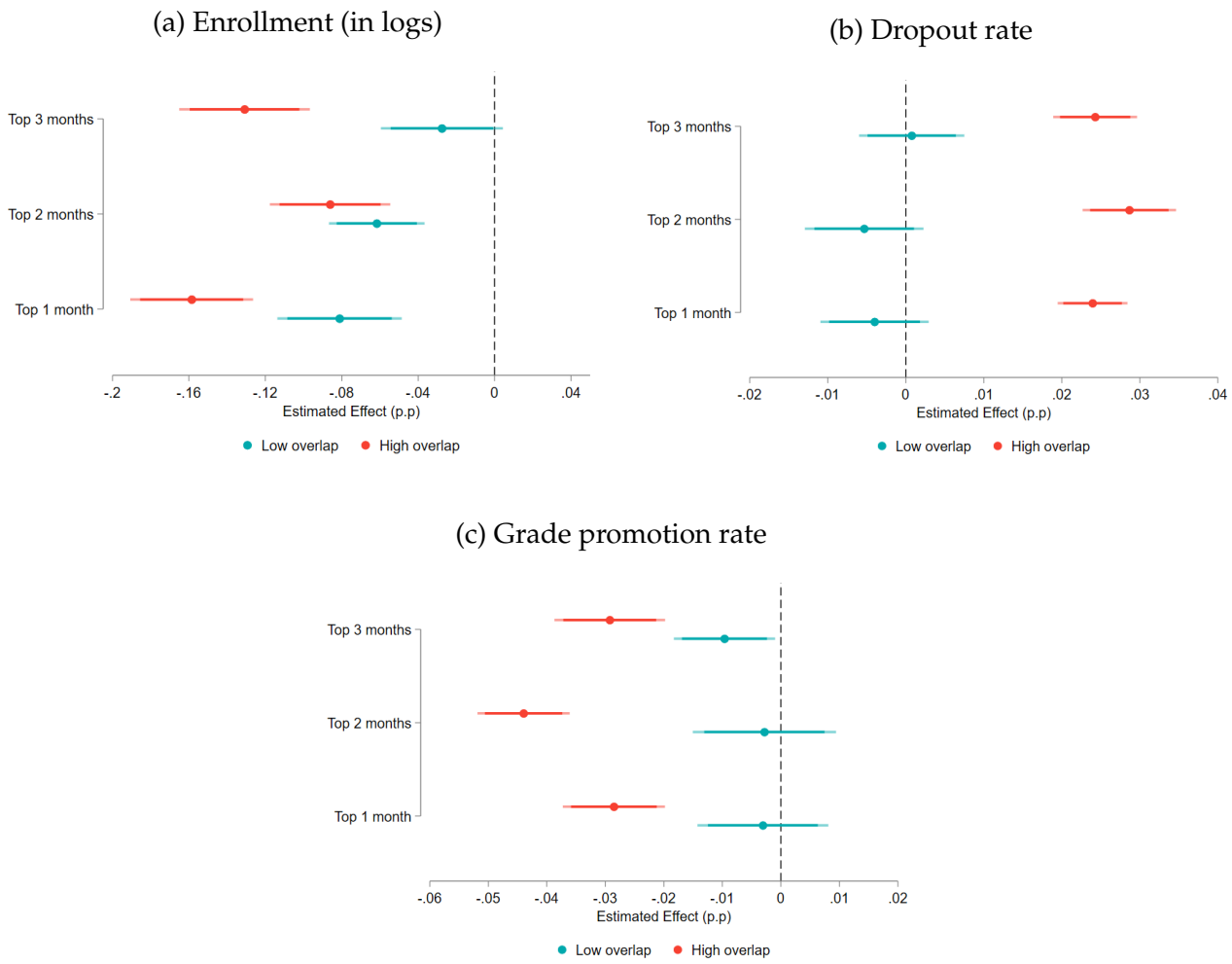
Notes. The dropout rate is defined as the share of primary school-age children out of school. For each country, we use the latest available value during the 2010–2019 period. Geographic controls: country latitude. Macroeconomic controls: GDP (in logs) and consumption share of GDP. Demographic controls: population and employment-to-population ratio. Trade controls: share of trade in GDP and the total trade volume between each country and the set of colonizers, comprising Belgium, France, Portugal, Spain, the Netherlands, and the UK. Source: own elaboration based on administrative records, World Bank Indicators, Penn World Table version 11.0, and Sacks et al. (2010).

Appendix Table A.3: Synthetic Difference-in-Differences Weights

Group	Enrollment		Dropout	
	No Schools	Weight	No Schools	Weight
No weight	6807		6791	
Decile				
1	1008	.000095904	1010	.000094891
2	1008	.000099163	1009	.000099050
3	1008	.000099235	1010	.000099162
4	1008	.000099289	1009	.000099239
5	1007	.000099334	1009	.000099295
6	1008	.000099375	1010	.000099339
7	1009	.000099419	1009	.000099375
8	1007	.000099477	1010	.000099418
9	1008	.000099608	1009	.000099512
10	1007	.000101455	1009	.000101405

Notes. The first row reports the number of schools in the control group that receive a zero weight, ω_i, when implementing the SDID methodology for each outcome variable. The subsequent rows report the average weight within each decile of the weight distribution among schools that receive a non-zero weight.

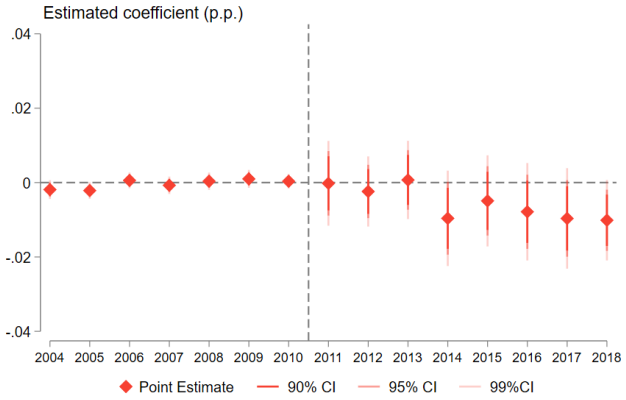
Appendix Figure A.8: Effects Varying the Definition of Harvesting Intensive Months ($\mathcal{I}_j$)



Notes: The figure shows the estimated effect of the 2010 change in the academic calendar on the corresponding outcomes for public and rural schools in Nariño and Valle del Cauca, compared to the synthetic control constructed following the methodology described in Section 5. The vertical lines represent the 90%, 95%, and 99% confidence intervals, based on bootstrapped standard errors with 50 repetitions. Source: Own elaboration based on data from DANE.

Appendix Figure A.9: Evidence Against the Violation of *SUTVA*

(a) Effects on School Transfer Rate



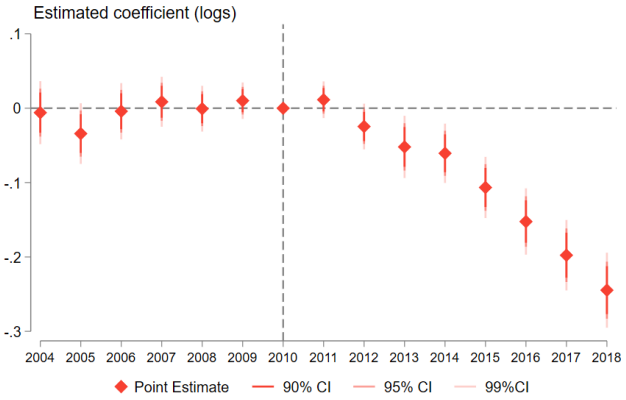
(b) Share of Migrant Children in Time



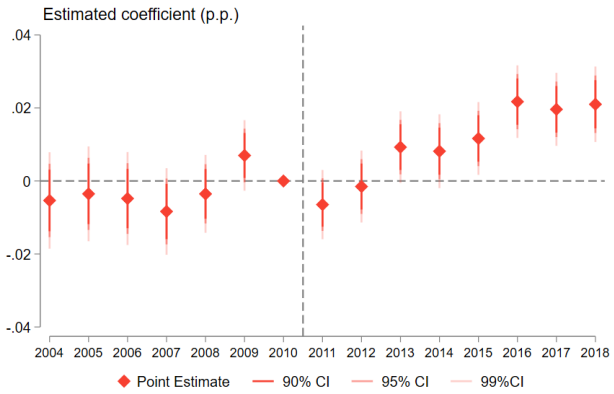
Notes: Panel A.9a plots the estimated effect of the 2010 change in the academic calendar on the average transfer rate at the municipality level for public and rural schools in Nariño and Valle del Cauca, compared to the synthetic control constructed following the methodology described in Section 5. The vertical lines represent the 90%, 95%, and 99% confidence intervals, based on bootstrapped standard errors with 50 repetitions. Source: Own elaboration based on data from DANE. Panel A.9b presents the percentage of children aged 5 to 15 who report living in the mentioned departments five years ago and migrated. Data from "Gran Encuesta Integrada de Hogares".

Appendix Figure A.10: Results using Difference-in-Differences

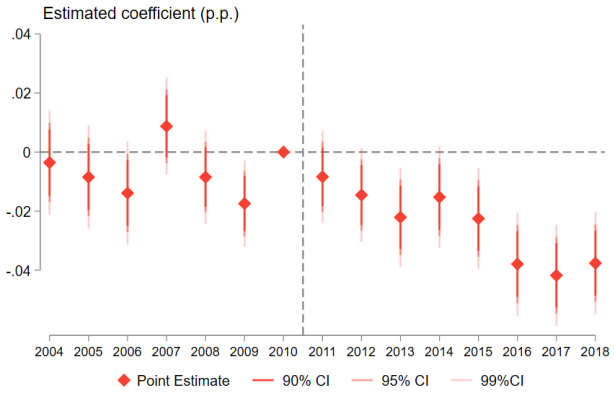
(a) Enrollment (in logs)



(b) Dropout rate



(c) Grade Promotion



Notes: The figure shows the estimated effect of the 2010 change in the academic calendar on the corresponding outcomes for public and rural schools in Nariño and Valle del Cauca compared to similar departments (Arauca, Risaralda, and Sucre). The vertical lines represent the 90%, 95%, and 99% confidence intervals, based on school-level clustered standard errors. Source: Own elaboration based on data from DANE.

B. Worldwide School and Agricultural Calendars

B.1. Data Construction

In this appendix, we describe the construction of the school and agricultural calendars for each country in our sample, as well as the measure of overlap between them.

School Calendar. We hand-collected academic calendar information from the official websites of ministries of education or equivalent government bodies in each country, using the most recently available calendar at the time of data collection. For each country, we recovered the start and end dates of the academic year, as well as the dates of all main school breaks. We then constructed a day-level indicator variable equal to one if school is in session on a given day of the year and zero otherwise.

For countries with multiple regional calendars, we selected the calendar of the most populous region or capital. Specifically, we used England for the United Kingdom, Berlin for Germany, the Central Region for the Netherlands, the French Community for Belgium, Washington D.C. for the United States, and Ontario for Canada. For Nigeria, India, and Indonesia, however, we deliberately deviated from this convention. Rather than selecting the capital region, we selected the calendar of the region that is the primary producer of the country's main crop as identified in the harvesting data: Kano state for Nigeria (sorghum), West Bengal for India (rice), and Central Java for Indonesia (rice). This choice ensures that the school calendar used in the overlap calculation reflects the institutional environment actually faced by farming households in the main crop-producing areas.

Harvesting Calendar. To construct harvesting calendars, we rely on data from Sacks et al. (2010), which reports the start and end dates of harvesting seasons for the main crops in each country, along with the corresponding harvested area at the national level. We define the main crop as the one with the largest harvested area, or as the crop flagged as primary in the database when such a designation is available. For Nigeria, India, and Indonesia, we use the harvesting calendars for sorghum, rice (Aman and Boro seasons), and rice (both seasons), respectively.

Overlap Measure. Based on the school and harvesting calendars described above, we compute for each country the share of the year in which both school is in session and the main crop harvest is underway. Formally, this is the number of days on which both activities overlap, divided by 365. This measure captures the extent to which the institutional school calendar conflicts with the peak labor demand period in agriculture.

Educational Laws. To measure the number of years elapsed between the institutionalization of each colonizer's education system and the independence of each colony, we identify for each colonizer the foundational law that established public primary schooling as a state responsibility. These laws share a common logic: they replaced church-dominated or locally fragmented schooling with a centralized, state-regulated system of primary education, thereby creating the institutional template—including the academic calendar—that was subsequently transmitted to colonial territories.

For France, we use the Loi Guizot of 28 June 1833 (Loi sur l'instruction primaire), which was the first law to create a durable national primary school system, requiring every municipality to maintain at least one school, establishing a mandatory curriculum, and creating a national teacher certification system and a network of teacher-training colleges. For Belgium, we use the Loi Nothomb of 23 September 1842 (Loi organique de l'instruction primaire), which was the founding act of Belgium's education system as an independent state, obliging every municipality to maintain at least one primary school and embedding religious instruction within the academic calendar. For the Netherlands, we use the Schoolwet van 1806 (Wet voor het Lager Schoolwezen en de Onderwijzers), which, despite being preceded by two

short-lived school acts in 1801 and 1803, was the first durable organic law of Dutch primary education, remaining in force for over fifty years and establishing classroom-based instruction, teacher examinations, and national school inspections as the pillars of a secular public school system. For Spain, we use the Ley de Instrucción Primaria of 21 July 1838 (Ley Someruelos) together with its Reglamento of 26 November 1838, which collectively established the first functioning liberal primary school system in Spain, requiring municipalities to maintain public schools, introducing teacher certification, and creating provincial supervision of education.[29] For Portugal, we use the Carta de Lei de 6 de Novembro de 1772, enacted under the Marquis of Pombal, which abolished Jesuit-controlled schooling, created a state-funded network of royal primary schools across Portugal and its empire, and introduced the subsídio literário—a dedicated national tax to fund teachers' salaries—marking the first systematic intervention of the Portuguese state in public primary education.[30] For the United Kingdom, we use the Elementary Education Act of 1870 (the Forster Act), which was the first law to establish a national framework for public primary schooling in England and Wales, filling the gaps left by the existing patchwork of voluntary and church schools by creating elected local school boards empowered to build and maintain publicly funded schools, levy local taxes for education, and—for the first time—work toward universal provision of elementary schooling across the country.

Independence Years. For each country in our sample, we use the year of independence from its corresponding colonizer. In most cases, this corresponds to the year in which the country formally declared or was granted independence. For a small number of cases, the year we use requires clarification. For Bangladesh, we use 1947—the year of the partition of British India and the creation of Pakistan, of which Bangladesh (then East Pakistan) was a part—rather than 1971, the year of Bangladesh's independence from Pakistan, since our interest is in the duration of exposure to the British institutional framework. For the Philippines, we use 1898—the year Spain ceded the territory following the Spanish-American War—rather than 1946, the year of formal independence from the United States, since our colonizer of interest is Spain and 1898 marks the effective end of Spanish institutional influence over the country. For the Dominican Republic, we use 1865—the year of its final independence from Spain following the War of Restoration—rather than 1844, the year of its independence from Haiti, since our colonizer of interest is Spain. In all three cases, the years we use correspond to the moment at which the country ceased to be under the direct institutional influence of the colonizer whose education system we are studying, which is the relevant date for our analysis.

B.2. Robustness to the Instrumental Variable Strategy

We provide robustness checks to our results in Section 2.3 by introducing a second instrument that exploits the interaction between the school calendar of the colonizing country, the agricultural calendar predicted by their latitude, and the degree of exposition to colonial education institutions. Let $c(i)$ denote the country that colonized country i and let $\mathbb{L}_i$ denote the set of countries located at latitudes similar to that of country i. We construct the following

[29] The institutional framework established by the *Ley Someruelos* was later consolidated and extended by the *Ley de Instrucción Pública* of 9 September 1857 (*Ley Moyano*), which introduced compulsory and free elementary schooling and integrated primary, secondary, and higher education into a single national system. While the *Ley Moyano* is often cited as the more comprehensive foundational law of Spanish education, we use the 1838 law as our reference date as it marks the first effective state intervention in primary schooling.

[30] Subsequent nineteenth-century reforms, notably those of 1822, 1835, and 1844, sought to reorganize and expand primary schooling in Portugal under liberal constitutional governments, but were largely left incomplete due to the country's severe economic difficulties and political instability during this period. We nonetheless retain the 1772 Pombaline reform as our reference date, as it constitutes the original act by which the Portuguese state assumed direct responsibility for public education, displacing the Jesuit institutional model that had governed schooling in Portugal and its overseas territories since the sixteenth century.

instrument:

$$Z_i = \frac{|\mathbb{S}_{c(i)} \cap \mathbb{A}_{\mathbb{L}_i}|}{|\mathbb{D}|} \times (Y_{c(i)}^{educ} - Y_i^{indep}),$$

where $\mathbb{S}_{c(i)}$ denotes the set of school days in the colonizing country $c(i)$, $\mathbb{A}_{\mathbb{L}_i}$ corresponds to the set of days of high agricultural activity predicted by the latitude of country i, and the term in parentheses captures the difference in years between the institutionalization of the colonizer's school calendar ($Y_{c(i)}^{educ}$) and the year in which country i gained independence (Y_i^{indep}). Using this instrument, we estimate the Equations 1.

This alternative instrument combines two sources of variation in a manner similar to a shift-share design. Its validity therefore relies on either the *share* component (Goldsmith-Pinkham et al., 2020) or the *shift* component (Borusyak et al., 2021) being uncorrelated with current school dropout in country i. In our setting, both components are plausibly orthogonal to contemporary educational outcomes.

The *share* component corresponds to the same used in Section 2.3, and quantifies the overlap that would arise if former colonies adopted the school calendar of their colonizer while facing agricultural conditions determined by their latitude. This term isolates variation in school calendars inherited from the colonizer while accounting for local agricultural cycles. Its exogeneity is plausible because colonial powers originally designed their domestic school calendars to reflect their own climatic and agricultural conditions rather than those of the territories they later administered. Moreover, by using agricultural calendars derived from countries located at similar latitudes, the instrument captures agricultural conditions predicted by geography rather than country-specific institutional choices.

The *shift* component captures the extent to which colonial institutions influenced the determination of school calendars in country i. Specifically, it weights the inherited calendar variation by the time elapsed between the educational reform in the colonizing country and the independence of the colony. Countries that gained independence later were more likely to inherit the colonizer's calendar, while those that became independent earlier had greater scope to adopt calendars adapted to local conditions. This timing is plausibly exogenous to current educational outcomes because the date of colonial independence relative to the timing of educational reforms in the colonizing country was largely determined by geopolitical and historical forces unrelated to contemporary school dropout.

Taken together, this second instrument captures the overlap that country i would have experienced if it had adopted the colonizer's calendar while facing agricultural conditions determined by its latitude, with greater weight placed on countries whose institutional choices were more strongly shaped by colonial rule. Even if one of the components is not exogenous, it suffices that the other component is orthogonal to guarantee the consistency of the estimator (Goldsmith-Pinkham et al., 2020; Borusyak et al., 2021). This provides additional evidence to our strategy detailed in Section 2.3.

Table B.4 presents the results of the estimations using this version of the instrument. We observe precisely estimated positive coefficients in both cases, proving that our results are robust to additional instruments with additional sources of exogeneity.

Appendix Table B.4: Effect of Calendar Overlap on Dropout

	Dependent variable: Dropout rate				
	(1)	(2)	(3)	(4)	(5)
Panel A: Full sample					
Calendar Overlap	0.529***	0.399***	0.416***	0.416***	0.402***
	(0.104)	(0.098)	(0.096)	(0.096)	(0.096)
First-stage F	159.65	114.12	113.41	121.05	122.92
Observations	126	126	126	126	126
Panel B: Former colonies					
Calendar Overlap	0.343***	0.262***	0.330***	0.329***	0.317***
	(0.115)	(0.094)	(0.101)	(0.103)	(0.102)
First-stage F	92.52	91.31	78.44	80.18	82.48
Observations	84	84	84	84	84
Geographic controls	No	Yes	Yes	Yes	Yes
Macroeconomic controls	No	No	Yes	Yes	Yes
Demographic controls	No	No	No	Yes	Yes
Trade controls	No	No	No	No	Yes

Notes. The dropout rate is defined as the share of primary school-age children out of school. For each country, we use the latest available value during the 2010–2019 period. Geographic controls: country latitude. Macroeconomic controls: GDP (in logs) and consumption share of GDP. Demographic controls: population and employment-to-population ratio. Trade controls: share of trade in GDP and the total trade volume between each country and the set of colonizers, comprising Belgium, France, Portugal, Spain, the Netherlands, and the UK. Source: own elaboration based on administrative records, World Bank Indicators, Penn World Table version 11.0, and Sacks et al. (2010).

C. Historical Evolution of the Academic Calendar in Colombia

The academic calendar in Colombia has undergone substantial transformations since the early nineteenth century. These changes reflect shifting priorities in educational administration, evolving degrees of centralization, regional heterogeneity, and growing recognition of climatic and institutional differences across the country. From an initially centralized system that tightly regulated vacations and examinations nationwide, Colombia progressively moved toward differentiated academic calendars across regions—later formalized as Calendar A and Calendar B—before adopting a decentralized framework that allows territorial entities to define calendars within national guidelines.

C.1. Colonial Period (Before 1820s)

During the colonial period, particularly before the eighteenth century, education in Spain and its colonies was primarily provided by the Church in a decentralized manner. Since the sixteenth century, instruction was largely delivered by Catholic religious orders—such as Jesuits, Franciscans, and Dominicans—who focused mainly on teaching Christian doctrine and basic literacy in Indigenous languages, while learning Spanish was often optional. Education was typically delivered in *escuelas de primeras letras*, institutions that provided basic instruction by introducing children to Christian principles and values, teaching them to read, familiarizing them with the four basic arithmetic operations, and developing writing skills through exemplars and guided practice (Anguita Osuna, 2019). Over time, however, strong pressure (especially from archbishops, the Council of the Indies, and Crown officials) emerged to promote instruction in Spanish, as Indigenous languages were increasingly viewed as obstacles to the diffusion of Christianity.

During the eighteenth century, the Spanish Crown introduced the Bourbon reforms to modernize state capacity in the colonies (Chiovelli et al., 2023). As part of these reforms, and influenced by Enlightenment ideas, Carlos III promoted an education reform aimed at reducing the Church's influence over schooling and expanding educational access among local and Indigenous populations (Herrera, 2004; Anguita Osuna, 2019; García, 2005). This process gained momentum after the suppression of the Society of Jesus, which entailed the expulsion of Jesuit members from Spain and its colonies in 1767. Nevertheless, education remained accessible only to a small elite, with broad segments of society excluded (García, 2005). Instructional institutions were scarce in the Kingdom of New Granada (which encompassed present-day Colombia), as evidenced by the presence of only one free *escuela de primeras letras* in Santa Fe, the capital of the kingdom and the site of present-day Bogotá (García, 2005). Importantly, school calendars during this period played little role in shaping educational access.

C.2. Early Republican Regulation and Centralization (1820s–1870)

The landscape of Colombian society in the early years of national consolidation highlighted the need for a new and more structured educational system. Independence leaders promoted the creation of civic educational institutions, such as *colegios* and public schools, framed within republican ideals of citizenship and Enlightenment thought, although resources and administrative capacity were limited. Efforts were made to implement laws and establish institutions that expanded access and provided practical instruction, but their reach remained uneven, and religious actors continued to exert significant influence (Báez Osorio, 2006).

Historical overviews suggest that school calendars were not a major policy concern in the early republic (Báez Osorio, 2006). Educational provision was still being organized, and formal structures such as fixed academic calendars were not yet nationally institutionalized.

Nonetheless, the earliest national regulation potentially affecting the academic calendar dates to 1824, when Vice President Francisco de Paula Santander issued a decree establishing that school vacations should coincide with the recesses observed by courts and tribunals, as defined in the Law of October 12, 1821. Under Articles 70 and 71 of that law, judicial activity was suspended only during major religious feast days, Holy Week, and December. Consequently, school vacations were institutionally anchored to these same periods.

This framework was reinforced by the General Law of 1826, which explicitly defined the structure of the academic year. Article 112 stipulated that annual vacations would run from the conclusion of examinations in November until January 1, and that no additional recesses would be permitted beyond religious feast days and Easter. Contemporary correspondence illustrates that this reform curtailed earlier local practices. In December 1826, students from the *Colegio de Boyacá* protested the elimination of a traditional vacation period running from late July to mid-October, which was replaced by a single end-of-year recess in December following the enactment of Santander's legislation. The governor of Boyacá responded that the matter fell under central authority, and the reform was ultimately reaffirmed.

This episode suggests that, prior to the reforms promoted under Santander's administration, academic calendars in at least some institutions followed a timing that differed substantially from the post-1826 national standard and appears to have been closer to the patterns inherited from the Spanish period. In particular, the existence of a long mid-year interruption, with instruction extending across the calendar year. From 1826 onward, this earlier arrangement—rooted in pre-republican institutional practice—was explicitly displaced by a centrally imposed calendar more closely resembling the January-November calendar.

The emphasis on standardization continued with the Organic Decree of Public Instruction of 1870, which formalized a system of two academic terms per year, each lasting five months. Schools were to open on January 10 and July 10 and close on May 31 and November 30, with vacations in June and December. This decree established a nationally uniform structure that would remain influential for decades.

C.3. Consolidation and Incremental Adjustments (1880s–1890s)

Late nineteenth-century sources indicate both continuity and incremental adjustments within this centralized framework. Institutional correspondence from 1888 shows that intermediate examinations were held in late July, followed by short vacations, while final examinations took place in November. National decrees in 1892 and subsequent regulations consistently defined the academic year as running from February (or January) to November, with vacations concentrated in December–January.

However, some institutional and regional variation emerged. For example, the *Colegio Público de Barranquilla*, established in 1892, followed an academic year running from August to June. Regulations for normal schools and primary schools in 1893 retained the February–November or January–November structure but clarified enrollment periods, examination timing, and paid vacation months. These variations, however, remained exceptions within an otherwise standardized national system.

C.4. Departmental Differentiation in the Early Twentieth Century (1900s–1940s)

By the early twentieth century, departmental regulations increasingly reflected differentiated academic timing. Resolutions from 1906 illustrate this divergence clearly. In the Department of Cauca, which at the time included territories that later became the departments of Nariño and Valle del Cauca, secondary and professional institutions were required to operate on an academic year running from October 1 to July 20. By contrast, in the Department of

Huila the school period was fixed from January 10 to November 30, with additional vacations during Holy Week and in late July.

A significant event occurred in 1913, when the Governor of Antioquia decreed that the academic year should begin in mid-September and end in June. The decree explicitly justified this structure by reference to pedagogical considerations, climatic conditions, and the convenience of students pursuing studies abroad.

Regional differentiation became increasingly pronounced in the southwest. Decree 1457 of 1939 required the Rural Normal School of Popayán to suspend classes at the end of July and resume them in October. Decree 3087 of 1945 further confirmed that institutions in the southwest operated under a calendar distinct from that followed in other regions. By this period, Colombia effectively maintained multiple regional academic calendars, though they had not yet been formally labeled.

C.5. Formal Recognition of Dual Calendars (1950s–early 1960s)

The regional division of academic calendars became explicit and institutionalized in the mid-twentieth century. Decree 0075 of 1951 clearly differentiated academic timing across regions: colleges in Valle del Cauca and Nariño were to implement the new curriculum beginning in October, while institutions in the rest of the country would do so beginning in February. This marked the first nationwide decree to formally recognize a dual calendar structure aligned with regional geography.

An attempt to unify the system followed with Decree 3109 of 1956, which mandated the unification of calendars beginning in September 1958. However, subsequent amendments—particularly Decree 1254 of 1957—introduced transitional adjustments, reflecting practical difficulties in implementing uniformity.

Rather than eliminating differentiation, reforms in the early 1960s codified it more precisely. Decree 45 of 1962 and Decree 1710 of 1963 established detailed academic periods, vacations, and examination schedules separately for the central-eastern and south-western regions, covering both secondary and primary education. These distinctions were further reinforced by Decree 2720 of 1963, which formally distinguished Calendar A (central-eastern region) and Calendar B (south-western region) and explicitly allowed schools to choose which calendar to follow.

C.6. Attempts at Unification and Reinstatement of the Dual System (Late 1960s–1980s)

A renewed effort to impose national uniformity came with Decree 1816 of 1967, which standardized instructional days and vacation lengths nationwide while allowing calendars to differ only in start dates. This reform was implemented gradually between 1968 and 1969.

However, the reform proved unsustainable. Decree 1902 of 1969 reversed course, citing reduced end-of-year vacations, administrative constraints in educational planning, the need for mid-year teacher training, climatic conditions in the southwest, and requests from school communities. The decree reinstated a clear territorial division: Calendar B for Nariño, Cauca, Valle del Cauca, and Putumayo, and Calendar A for the rest of the country.

This dual structure persisted through the 1970s and was reaffirmed in subsequent regulations. Decree 691 of 1972 established a provisional calendar following a nationwide suspension of activities, while Decree 174 of 1982 maintained Calendars A and B for both public and private institutions at the preschool and primary levels.

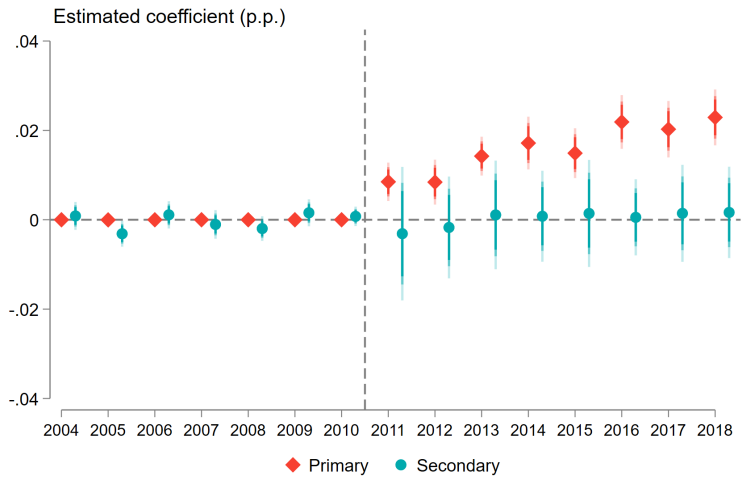
C.7. Decentralization and Contemporary Framework (2000s–Present)

A major institutional shift occurred with the decentralization reforms of the early 2000s. Law 715 of 2001 assigned departments responsibility for organizing education provision in non-certified municipalities, including defining the academic calendar, while granting certified municipalities autonomy over education provision. Decree 1850 of 2002 required certified territorial entities to issue annual academic calendars for all public institutions within their jurisdiction, explicitly allowing calendars to account for regional economic conditions and institutional traditions.

While this framework preserved the historical distinction between Calendars A and B, it also enabled greater coordination and gradual convergence in academic timing, particularly in certified and urban jurisdictions. As a result, contemporary academic calendars reflect both long-standing regional differentiation and increased institutional coordination within a decentralized governance structure.

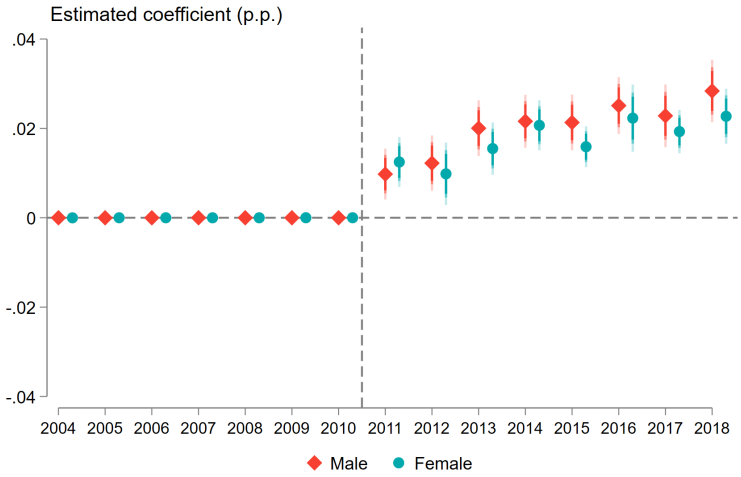
D. Heterogeneous Effects

Appendix Figure D.11: Effect of the Reform on Dropout Rates by Educational Level



Notes: The figures show the estimated effect of the 2010 change in the academic calendar on the corresponding outcomes for public and rural schools in Nariño and Valle del Cauca, compared to the synthetic control constructed following the methodology described in Section 5. The estimates are presented separately for students in primary and secondary education. The vertical lines represent the 90%, 95%, and 99% confidence intervals, based on bootstrapped standard errors with 50 repetitions. Source: Own elaboration based on data from DANE.

Appendix Figure D.12: Effects of Reform on Dropout Rates by Gender



Notes: The figures show the estimated effect of the 2010 change in the academic calendar on the corresponding outcomes for public and rural schools in Nariño and Valle del Cauca, compared to the synthetic control constructed following the methodology described in Section 5. The estimates are presented separately for girls and boys. The vertical lines represent the 90%, 95%, and 99% confidence intervals, based on bootstrapped standard errors with 50 repetitions. Source: Own elaboration based on data from DANE.