Highlights

THE LONG-TERM EFFECT OF RESOURCE BOOMS ON HUMAN CAPITAL

Roberto Mosquera

- Resource booms can have negative long-term effects on human capital accumulation
- Exposure to the 1973 oil boom decreased college completion by 2.9 percentage points
- Exposure to the boom did not affect home and vehicle ownership in the long run

THE LONG-TERM EFFECT OF RESOURCE BOOMS ON HUMAN CAPITAL

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Abstract

Resource booms may reduce human capital accumulation. They can increase the opportunity costs of education by favoring low-skilled jobs, thus making it optimal for individuals to interrupt their education. This study uses proprietary individual-level data to study the long-term effects of an oil boom on human capital in a developing country. Exploiting variation in the timing of the shock and geographic differences in the effect of exposure to the boom, I find that exposure to the boom decreased college completion, increased low-skill employment, and had limited long-term effects on wealth accumulation.

Keywords: Resource booms, Development, Long-term effects, Completed education

JEL codes: O12, O13, J24, H30, H75

1. Introduction

Are resource booms a blessing or a curse for a country? A priori, we would expect that natural resources should boost economic development; however, since the work of Sachs and Warner (1999, 2001), there is ample evidence to suggest that resource-rich countries underperform in several dimensions.[2] One concern in this area is the possibility that resource booms reduce human capital accumulation. These booms are shocks that affect labor-market

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[2]See Sachs and Warner (1999, 2001); Gylfason (2001); Torvik (2002); Papyrakis and Gerlagh (2004, 2007); Stijns (2006); James and Aadland (2011); Van der Ploeg (2011); Smith (2015).

conditions, making low-skilled occupations more attractive and increasing the opportunity cost of education. Thus, some individuals find it optimal to drop out of high school/college and enter the workforce.[3]

It is not clear whether these decisions to leave school are temporary or permanent. If individuals anticipate that the resource boom is temporary, they may plan to return to school at a later date. However, as time passes, life events may impose further costs on returning to school, and the time horizon for realizing the return to education decreases. Also, if agents expect that the natural resource boom will be a permanent shock, then the likelihood of returning to school decreases. These factors make it less likely for individuals to resume their education; hence, the decrease of human capital could be permanent, affecting both individuals' living conditions and a country's growth potential.

This paper uses proprietary individual-level data from a financial services company in Ecuador to document the long-term effects of the 1970s oil boom on educational attainment levels. I estimate the reduced form effects of exposure to this shock on college completion rates as measured 40 years after the boom. I use an intensity difference-in-differences design that compares changes in college completion rates across cohorts who turned 18 before and after 1973 (the year of the boom) to changes in college completion across different regions.[4]

In 1972, Ecuador started oil production, and in 1974 the price of oil skyrocketed due to the Arab embargo. In Ecuador, as in many countries, the state owns all mineral rights, so the government received a massive influx of funds that it directed toward highway spending, infrastructure, and subsidies (World Bank, 1979a; Acosta, 2006). These expenditures lowered the cost of starting new commerce and construction businesses, which increased the productivity of low-skilled jobs by 93 percent (World Bank, 1979a). Low-skilled workers' real earnings increased by 18 percent following the boom, while high-skilled real earnings

[3]Human capital accumulation models predict that, because resource booms increase earnings for low-skilled workers, some individuals may stop their education, at least in the short run (Becker, 1964; Black et al., 2005b; Charles et al., 2015). There is evidence that labor demand shocks from fracking favor less educated workers (Bartik et al., 2017; Kearney and Wilson, 2017). In cases where the state owns mineral rights, government policies can facilitate the development of low-skilled, labor-intensive occupations (De La Torre et al., 2015).

[4]Jäger et al. (2019) use a similar design to estimate the effect of unemployment insurance on job separations.

decreased by 8.8 percent (Palma, 1986). Consequently, employment rates in non-agricultural low-skilled jobs increased by 14.1 percentage points, compared with only 7.5 percentage points in high-skilled jobs. These shifts suggest that the opportunity cost of college increased, making college less appealing.

Ecuador's geographic features created three sources of regional variation in terms of the effect of exposure to the oil boom. First, the oil industry is located in the Amazon jungle, an isolated region in the 1970s. For this region, the oil industry's presence could have plausibly increased or decreased the costs of college attendance after the oil boom, thus making the effect on college completion rates uncertain. On the one hand, the new low-skill jobs created by the oil industry are concentrated in this region, increasing the opportunity cost of college. On the other hand, the oil boom led to improved connectivity with the rest of the country and spillovers from the oil industry. These factors plausibly increased the returns of education.

Second, while the oil boom was a national-level shock, the cities of Quito and Guayaquil benefited the most from the infrastructure boost driven by the boom, implying a more considerable increase in education's opportunity cost.

The third source of regional variation relies on the fact that during the 1970s, there were only universities in five cities, and college supply was concentrated in Quito and Guayaquil.[5] This situation, together with drastic altitude differences across the country that increase transportation costs, implies that people born in regions without universities faced higher costs of college attendance than people born in cities with universities. Theoretically, lower costs allow more students with lower ability levels and income to attend college. Hence, the marginal student from regions with low costs who attend college would be expected to have lower ability and income levels than the marginal student from regions with high costs. This difference makes regions with low costs more sensitive to shocks that increase low-skilled workers' earnings. As the cities with universities also benefited the most from the infrastructure boost triggered by the boom, the total effect of exposure to the oil boom should be more noticeable in these cities than in the rest of the country.

The intensity difference-in-differences design compares cohorts who had already decided

[5] No new universities opened after the oil boom, and most universities were public and free.

whether to go to college by 1973 with cohorts who were still in high school and thinking about whether to attend college across regions. This design obtains the change in college completion rates in regions with universities and the Amazon region against that in regions without universities, which should be the least affected by the boom.[6]

The results show that exposure to the resource boom decreased education completion rates. College completion decreased the most in the cities where the majority of universities were concentrated. Exposure to the boom decreased college completion by 2.9 percentage points, which represents 12.2 percent of the college completion rate for those who turned 18 just before the oil boom. Robustness tests show that, if there were any confounding shock, it would attenuate the estimates.

The long-term reduction of college completion rates is consistent with a model of rational individuals who stopped their educational attainment because the increase in low-skilled workers' earnings was large enough to compensate for the loss of human capital accumulation. Unfortunately, there is no data on earnings to test this channel directly, but I provide three pieces of evidence consistent with this dynamic. First, if the oil boom increased the returns of education in a region, then completed educational attainment should have increased there. As mentioned above, the boom had a positive effect on connectivity and local income in the Amazon region, plausibly increasing the returns of education there, and countering the effect of the availability of low-skilled jobs in the oil industry documented by Chuan (2020). Exposure to the oil boom increased college completion in the Amazon region by 4.5 percentage points (58.5 percent of the baseline).

Second, the structure of the labor market shifted toward low-skilled occupations, and this shift lasted over the long term. This shift is consistent with the dynamics documented by Gollin et al. (2016), who find that natural resource shocks drive higher employment in non-tradable services such as commerce. I find that, in the cities with full universities, exposure to the oil boom before turning 18 increased the likelihood of working informally in 2012 by 0.8 percentage points (1.9 percent of the baseline), while it decreased this probability by 1.7 percentage points (3 percent of the baseline) in the Amazon region.

[6] I assign individuals to their region of birth to account for migration caused by the boom.

Third, I find that exposure to the oil boom before turning 18 did not affect two relevant measures of wealth: homeownership (in 2010) and vehicle ownership (in 2013). The point estimates for homeownership in the cities with universities are smaller than 0.6 percentage points (1 percent of the baseline), and the confidence interval rules out effects larger than two percentage points. In addition, I find that exposure to the oil boom before turning 18 decreased vehicle ownership in these cities by 0.5 percentage points (2.8 percent of the baseline).

This study's findings contribute to our understanding of the effects of resource booms on outcomes related to growth and living conditions. One branch of this research area documents the effects of resource shocks on educational attainment, finding that exposure to resource booms decreases high school enrolment in resource-rich areas in the short term (Black et al., 2005b; Cascio and Narayan, 2020) but have mixed results on self-reported completed educational attainment (Emery et al., 2012; Kumar, 2017; Chuan, 2020). Other studies consider the effects of natural resource shocks on: (i) non-resource economic activity (Black et al., 2005a; Michaels, 2011; Marchand, 2012; Allcott and Keniston, 2017); (ii) participation in disability programs (Black et al., 2002); (iii) family income and children's education (Løken, 2010; Løken et al., 2012); (iv) income levels and health spending (Acemoglu et al., 2013); (v) public expenditure, corruption, and crime (Caselli and Michaels, 2013; Street, 2018); and (vi) intergenerational mobility (Bütikofer et al., 2020).

My study contributes to this literature in three ways. First, this paper addresses data limitations that usually prevent studying long-term effects in developed and developing countries. By using administrative measures of educational attainment collected in the proprietary data, this paper controls for recall bias, social desirability bias, and other issues that affect self-reported measures of completed education. Such biases can limit our ability to detect negative effects. By addressing these issues, this paper documents that exposure to a resource boom can permanently reduce completed education, which is a new result in the literature.

Second, this paper's results suggest that the effect of resource booms on human capital accumulation can be different between developed and developing countries. Emery at al.'s (2012) results refer to a context where 40 percent of the affected population has postsecondary education. In Ecuador, only 13 percent of the cohorts who turned 18 around 1973 have some postsecondary education. These differences translate into different labor markets, which can lead to different responses to resource booms. The Ecuadorian context shows that resource booms can have adverse effects on human capital in settings where educational attainment is low, and labor markets are oriented towards low-skilled occupations.

Third, the Amazon region's case suggests that policy has a role in the propagation of natural resource shocks and that increasing the returns of education can counter the negative effect on educational attainment. Policymakers can encourage this policy effect by investing part of the windfall from the boom in policies that increase high-skill productivity to reduce the opportunity costs of attending college. A caveat is that these booms are large enough to drive progress in many sectors and policies in a country. Particularly in developing countries, these policies would not have existed in the absence of a boom because they depend on the windfall received by the government. Thus, the identified effect corresponds to the reduced-form effect of exposure to the boom, and the estimation strategy considers the different channels through which the boom affected the country.

Finally, in assessing the long-term effects of resource booms on educational attainment and wealth, this study joins a broader literature examining the impacts of changes in short-term opportunity costs on educational attainment levels and labor markets. Previous studies have analyzed, for example, the effects of housing booms (Charles et al., 2015), manufacturing export processing zones (Atkin, 2016), large infrastructure projects (Carrington, 1996), technological changes (Fetzer, 2014; Bartik et al., 2017; Feyrer et al., 2017), and manufacturing booms, busts, and recessions (Goldin and Katz, 2007; Kahn, 2010; Oreopoulos et al., 2012). This paper complements this literature by documenting that exposure to a short-term resource boom can lead to a reduction of human capital in the long run by decreasing the incentives to return to school.

2. Selected Facts about the Ecuadorian Oil Boom

In the early 1970s, oil was found in Ecuador's Amazon region, and extraction operations began on June 26, 1972. At the same time, oil's price increased exponentially due to the Arab embargo in 1973–1974. Figure 1 shows the macro effects of this boom. Annual oil output increased from 0 to 28.6 million barrels in 1972 and further to 76.2 million barrels in

1973, stabilizing at around this level through the rest of the decade. In 1974, oil prices rose from $4.20 to $13.00 per barrel, and it remained at high levels until 1982.

These two shocks had profound implications for Ecuador's economy. GDP per capita increased from $503 in 1972 to $983 in 1974 (Figure 1, Panel f); the highest growth in the country's history. Oil became a major source of fiscal revenue because the state owns all mineral rights (Figure 1 Panels c and d). From 1973 to 1980, oil represented 34 percent of Ecuador's total fiscal revenue (4.5 percent of GDP). The non-oil tax revenue share decreased from 93.7 percent of total revenue in 1971 to 64.6 percent in 1980.

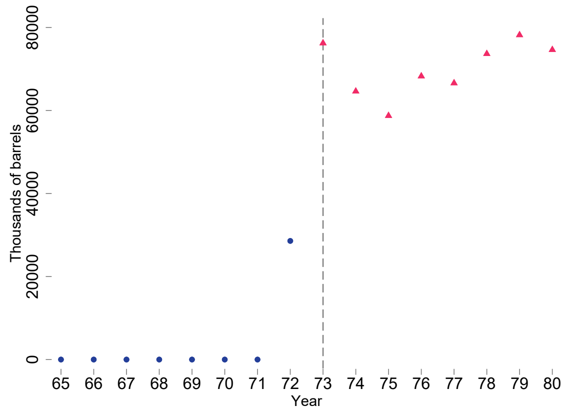
The government channeled these funds to new forms of expenditure. According to the Central Bank of Ecuador, government expenditures, mainly personnel expenses, increased by 659 percent from 1972 to 1980, while capital expenditures grew by 603 percent. Government capital spending increased from 2 percent of GDP before the boom to an average of 8 percent after the boom (Figure 1, Panel e). The government focused its investments on expanding the country's existing highway network and developing new infrastructure for the oil, electricity, agriculture (irrigation and storage), and health sectors (World Bank, 1979c).[7] The government also financed interest-rate subsidies for specific sectors, price controls on agricultural products, and subsidies on gasoline and other fuels (World Bank, 1979a; Cisneros et al., 1988; Acosta, 2006).

The cities of Quito and Guayaquil benefited the most from the infrastructure boost (Larrea, 1989; Velasco, 1988). The 1979 budget shows that these cities concentrated 69 percent of the budget allocated to urban development (World Bank, 1979b). The budget allocated to these cities represented 8.9 percent of Ecuador's 1979 GDP, while the budget for the rest of the country represented 4 percent of GDP. The government allocated $1,267 million to these cities in four years, 92 percent of what was allocated to the oil sector.

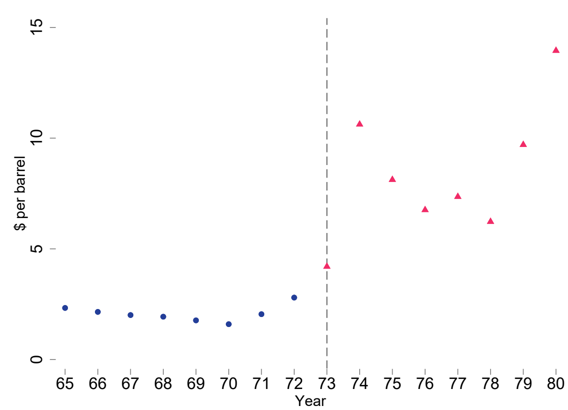
The oil boom did not lead to an increase in the industrial sector's share in the economy. The manufacturing sector's share of real GDP barely increased from 17 percent in 1970 to just 18 percent in 1977 (World Bank, 1979c). At the same time, the share of people working in manufacturing activities fell from 13.6 percent in 1962 to 12.6 percent by 1982 (Figure 2).

[7] In contrast to the Indonesian case (Duflo, 2001), spending on education infrastructure was minimal.

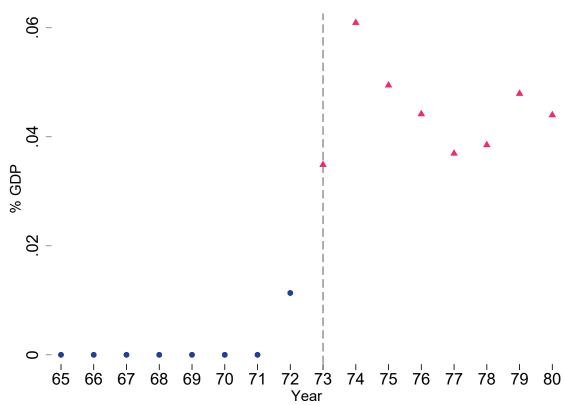
Figure 1: Oil Output and Price



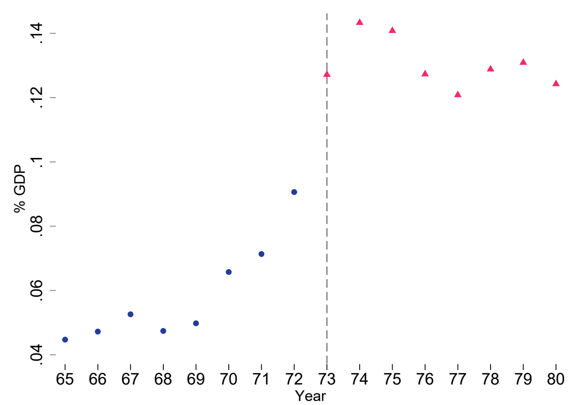
(a) Oil output



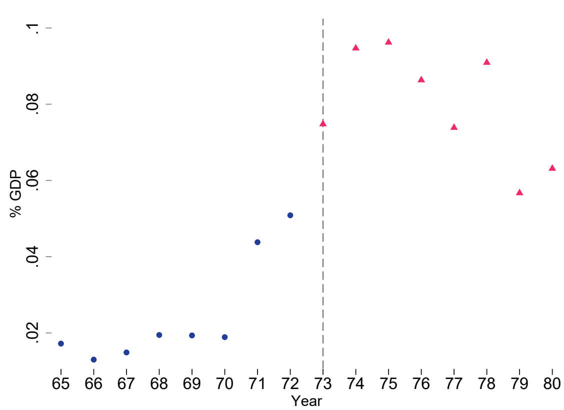
(b) Price ($ per barrel)



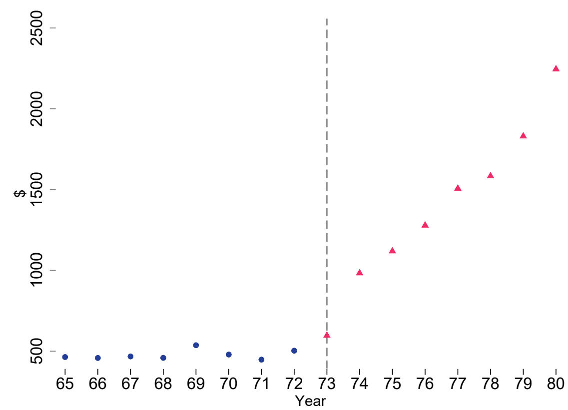
(c) Government's Oil Revenue (% GDP)



(d) Government's Total Revenue (% GDP)



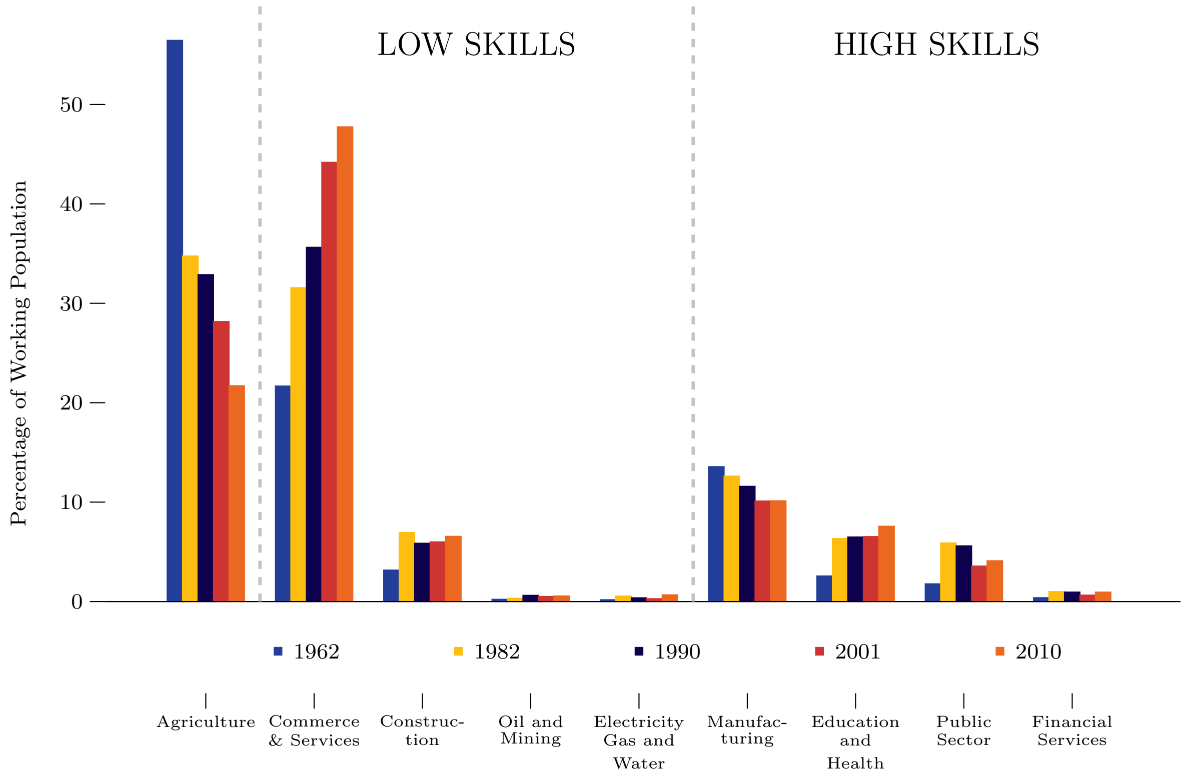
(e) Government's Capital Spending (% GDP)



(f) GDP per Capita

Notes: This figure presents the evolution of Ecuador's crude oil output, its price, government's revenue from oil exports, government's capital spending and GDP per capita from 1965 to 1980. Oil output data, government's oil revenue, capital spending, and GDP per capita is reported by Ecuador's Central Bank. Oil's price is inflation-adjusted (1973 dollars). From 1965 to 1971, it is the average price of OPEC, from 1972 onward it corresponds to the average price of Ecuador's oil exports as reported by its Central Bank.

Figure 2: Employment by Sector Before and After the Oil Boom



Notes: This figure presents the proportion of the working population employed in each sector of the economy in 1962–2010. Data comes from Ecuador's 1962, 1982, 1990, 2001 and 2010 population censuses.

We may think that employment in the manufacturing sector fell due to the adoption of capital-intensive technologies that that require fewer but more productive employees. However, the World Bank (1979a) estimates that value added per worker remained practically constant for the industrial sector between 1972 to 1975. At the same time, the value added per worker in low-skilled non-agricultural sectors increased by 93 percent, from \$806 to \$1,556. Labor productivity of low-skilled jobs increased after the oil boom because infrastructure spending, subsidies, and price controls lowered the relative cost of capital in these occupations. For instance, it was cheaper to purchase small machinery (cooking appliances, drinks dispensers, sewing machines) and vehicles than before the oil boom.

Higher productivity translated into higher earnings for people who worked in commerce, construction, and low-skilled services. Table 1 shows that earnings for people working in low-skilled occupations increased by 18 percent after the oil boom, while earnings in high-skilled

Table 1: Real Annual Earnings by Occupation 1968–1975

	1968	1975	% Change
High-Skill Occupations			
Managers, administrators and directors	4566	3913	-0.143
Licensed professionals, technicians and related workers	2378	2320	-0.024
Office employees and related workers	1682	1520	-0.096
Low-Skill Occupations			
Professional drivers	1394	2051	0.471
Commerce	1292	1387	0.074
Farmers, fishermen, forestry workers, mining	1168	1332	0.140
Craftsmen and related workers	860	1008	0.172
Other craftsmen and operators	860	1044	0.214
Household services	704	709	0.007

Notes: Source Palma (1986). This table present real mean annual earnings by occupation type in Ecuador in 1968 and 1975. Earning are measured in 1968 sucres, Ecuador's currency at that time.

jobs decreased by 8.8 percent (Palma, 1986). Thus, individuals had an incentive to work in occupations with lower skill requirements, which increased the opportunity cost of education.

Consequently, after the boom, employment shifted from agriculture to other low-skilled sectors (food preparation, repairs, transportation, housekeeping). Employment in agriculture decreased by 21.7 percentage points between 1962 and 1982, while employment in low-skilled occupations increased by 14.1 percentage points and employment in high-skilled jobs increased by only 7.5 percentage points (Figure 2).[8] These dynamics suggest that, at least in the short term, some individuals exposed to the boom when they were in high school might have chosen to forgo college to take advantage of higher earnings in low-skilled jobs.[9]

The oil industry is located in the Amazon jungle at the eastern end of the Andes, which was an isolated region before the boom (Appendix Figure B.11). Unfortunately, there is no regional income data for the 1970s to look for a change in low-skilled workers' earnings directly.[10] To address this limitation, I use a revealed preference approach and explore the employment choices of individuals born in different regions. If the opportunity cost of

[8]Employment increased in governmental "high-skilled" jobs (e.g., administration, education, health). At that time, teaching did not require a college degree, and there were specialized high schools for training teachers. Also, the oil industry is not a significant employer in Ecuador. Employment in the oil and mining sector (basically the oil industry) fluctuated between 0.22 percent in 1962 to 0.56 percent in 2010.

[9]There was no compulsory school age at the time.

[10]Employment surveys form the 1970s covered only the cities of Quito and Guayaquil

education shifted differently across regions, then distinct employment patterns would have appeared across them. After the oil boom, employment in high-skilled jobs (not in the oil industry) increased to a greater extent than employment in low-skilled jobs in the Amazon region, in contrast to the rest of the country. Between 1962 and 1982, employment in agriculture decreased by 16.1 percentage points, while employment in low-skilled occupations increased by 6.8 percentage points and employment in high-skilled jobs increased by 9.2 percentage points. In the rest of the country, employment in agriculture decreased by 21.9 percentage points, while employment in low-skilled occupations increased by 14.4 percentage points and employment in high-skilled jobs increased by only 7.6 percentage points.

The employment patterns outlined above suggest that the opportunity cost of education decreased in the Amazon region, while it increased in the rest of the country. Before the oil boom, 1.6 percent of the population lived in this region, and it only had one highway that connected it to the rest of the country. After the oil boom began, government investment and spillovers from the oil industry changed this situation dramatically. The government built a new highway from Quito to the Amazon region to access the oil fields. It also established that municipalities in the Amazon region should receive 10 percent of the fiscal revenue from oil (Acosta, 2006). Thus, it is plausible that exposure to the oil boom increased the returns of education in the Amazon region, countering a growing demand for low-skilled individuals from the oil industry, while the rest of the country was only exposed to the shock that made low-skilled jobs more appealing. Moreover, the fact that these changes in employment composition lasted until 2010 would be consistent with a long-term reduction in educational attainment. I study this issue in the rest of the paper.[11]

3. Data

For this study, I obtained access to proprietary data from a financial services company in Ecuador. This company collects comprehensive demographic data of the country's entire

[11]Ideally, we would estimate the effect of the oil bust to see whether the effects are symmetric. Unfortunately, the cohorts born after 1961 were affected by a series of additional shocks that act as confounding variables: a war in 1981; the oil bust and a declaration of default in 1982; and a major earthquake in 1987 that destroyed the only oil pipeline in the country. Thus, I focus only on the effect of the 1973 boom.

adult population.[12] Data include gender, year of birth, marital status, number of children, canton of birth,[13] canton of residence, highest completed education level, type of occupation, employees' income rates, and car ownership. Also, I use homeownership data from Ecuador's 2010 Population Census.[14] I focus on the cohorts born in Ecuador between 1948 and 1961 (1,711,538 individuals) to estimate the long-term effects of exposure to the oil boom on those who had not yet turned 18 when it occurred.

A limitation of these data is that we are not able to observe these cohorts at different points in time (i.e., to compare the different cohorts at certain ages) to control for life-cycle fluctuations adequately. The demographic information corresponds to 2014, car ownership to 2013, labor market to 2012, and homeownership to 2010. This concern is not likely to alter the results because the observed outcomes should be mostly determined for these cohorts. To attenuate this concern, cohort trends are included in the estimation.

Table 2 presents descriptive statistics for the full sample.[15] Women constituted 51 percent of the cohorts, and on average, the individuals were 57 years old in 2014. Table 2 also splits the cohorts into two groups: those individuals who turned 18 years old before the oil boom in 1973 (born in 1948–1954) and those who turned 18 after the oil boom (born in 1955–1961). There is no difference in the proportion of women between the two groups.

Table 2 also presents labor participation indicators as of 2012. The data are divided into three categories: (i) employees – people who work for a firm and receive a monthly wage; (ii) professional workers – people who are self-employed and registered with the Ecuadorian tax office; and (iii) informal workers. The data classify an individual as an "informal" worker in 2012 if at least one of the three following conditions holds: (i) they work in food preparation, repairs, transportation, or housekeeping (as an employee or on a self-employed basis); (ii)

[12] Sources include banks, other financial institutions and web scraping to fill gaps. Credit applications collect demographic information from Ecuador's national identification cards. It is not possible to link these data to the census.

[13] A canton is an administrative division similar to a U.S. county.

[14] The census database is publicly available from Ecuador's national statistics agency; see Rivadeneira and Zumarraga (2011) for a complete description of the census data. I also use 10 percent random samples reported by the Minnesota Population Center from Ecuador's population censuses of 1962, 1974, and 1982 to construct the labor participation statistics reported in Section 2.

[15] Appendix Tables A.4, A.5, A.6, and A.7 present these statistics separately for the four regions considered in the empirical analysis. See Section 4.2 for details.

Table 2: Sample Means

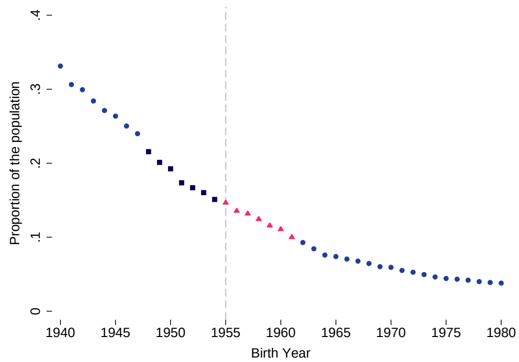
	Full Sample	1948-1954	1955-1961
Proportion Women	0.51	0.51	0.51
Age	56.73	60.78	53.84
Proportion Informal Workers in 2012	0.53	0.56	0.51
Proportion Employees in 2012	0.15	0.13	0.17
Proportion Professional Workers in 2012	0.32	0.31	0.33
Monthly Wage for Employees in 2012	974.90	1039.17	939.50
Proportion Vehicle Owners in 2013	0.17	0.16	0.17
Average age of vehicle in 2013	16.09	16.92	15.54
Proportion Home Owners in 2010	0.78	0.81	0.76
Proportion Home Owners with More than 2 Rooms in 2010	0.57	0.59	0.56
Proportion Home Owners with Home above Median Quality in 2010	0.33	0.34	0.32

Notes: The data corresponds to 2014 unless otherwise noted. Column 1 presents means for the full sample, that is individuals who were born in Ecuador between 1948 and 1961. Column 2 considers individuals born between 1948 and 1954, that is the cohorts who turned 18 before the oil boom in 1973. Column 3 considers individuals born between 1955 and 1961, that is the cohorts who turned 18 after the oil boom.

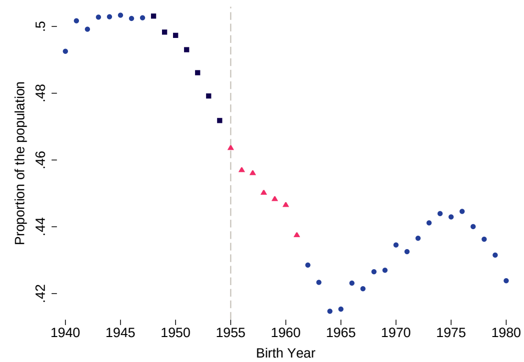
they are retired; or (iii) they are of working age but are not registered with the Ecuadorian tax office. More than 50 percent of the members of these cohorts were informal workers in 2012, with a slight drop for those who turned 18 after the oil boom.

I use home and vehicle ownership as proxies of wealth. We can observe that only 17 percent of the individuals born between 1948 and 1961 own at least one vehicle. In developing countries, housing quality is a relevant measure for assessing wealth. Poor households tend to split their land to give their children a place to build a small house when they marry. Thus, the homeownership rate is close to 80 percent, but this does not necessarily reflect wealth. Homeownership decreases to 57 percent if we consider only those who own a house with more than two rooms. I also combined data from the census on the type of construction, materials used, water source, type of sewage, and garbage disposal into a housing quality index. In Ecuador, brick-and-mortar houses are of higher quality than wood houses, and the type of water source (tap/well/creek) and the type of waste disposal (sewage/septic tank/open) also signal degrees of wealth. Homeownership of houses above the median of this index is 33 percent. There are no substantial differences between individuals who turned 18 before and after the boom.

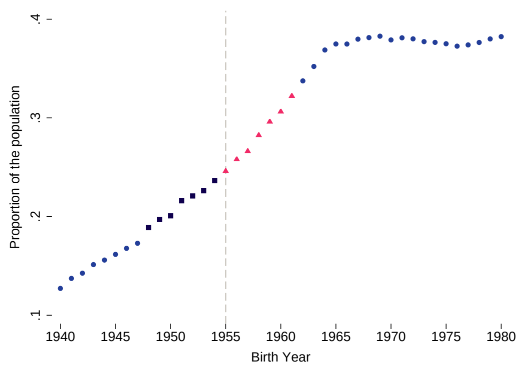
Figure 3: Highest Level of Education Attainment by Birth Cohort



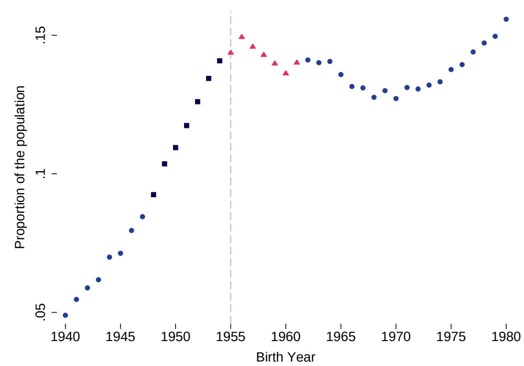
(a) No education



(b) Completed Elementary Education



(c) Completed Secondary Education



(d) Completed College or More

Notes: This figure presents the proportion of the cohorts born in Ecuador between 1940 and 1980 by their highest completed schooling level. For example, if a person dropped out of high school, their highest completed education level is primary school. The cohorts born between 1955 and 1961 (red triangles) turned 18 during the oil boom in the 1970s.

4. The Long-Term Effects of the Oil Boom on Human Capital Accumulation

4.1. Descriptive analysis

Figure 3 presents the evolution of the highest completed schooling level, measured in 2014, for individuals born between 1940 and 1961. For example, if a person dropped out of high school, then their highest completed education level is primary school. The proportion of those born in years up to and including 1954 who have no education or primary education shows a smooth decrease, while the proportion of individuals with secondary education or college shows a smooth increase.[16]

[16]Primary school includes grades 1–6, and secondary school includes grades 7–12.

There is a major kink in educational attainment for cohorts who turned 18 after the oil boom. College completion flattens and decreases for the cohorts born between 1955 and 1961 (red triangles in Figure 3). Naively, if we extend the pre-1955 cohort trend, Figure 3 suggests that exposure to the oil boom at the end of high school decreased college completion by around two percentage points.

This abrupt change in college completion is consistent with low-skilled jobs becoming more appealing as a result of the oil boom. As discussed in Section 2, higher earnings in low-skilled jobs increased the opportunity cost of education, which led some individuals to interrupt their high school/college education. The drop in college completion rates could be explained by lower returns of education in the long run, increasing costs of returning to school with increased age, or agents believing that the shock was going to last for a long period. Any of these reasons could imply that some people chose not to complete their education.

Figure 3 also shows that there is no change in the trend of people with no education for the 1948–1961 cohorts, suggesting that there were no other shocks that affected early educational attainment that could explain the reduction in college completion. Hence, the only difference for cohorts who turned 18 years old around 1973 is that for some people the boom occurred when they were already attending college, while for others it occurred when they were completing high school and still considering whether to attend college.[17] In the next section, I develop an empirical strategy to rigorously estimate how exposure to the oil boom before turning 18 affected college completion rates.

4.2. Empirical strategy

This section presents a strategy to estimate the reduced-form effect of exposure to the oil boom on college completion. It presents the conditions under which the oil boom, a country-level shock, affected the opportunity cost of education differently across different regions. This discussion leads to an estimation strategy as well as further analysis of the identification assumption and of threats to the identification of the effect.

[17] Oil extraction began in 1972. Figure 3 shows no effect for the cohort who turned 18 in that year. The estimates in Section 4.3 show that the effects get larger for the younger cohorts, who were exposed to the price shock in 1974 that was exogenous to Ecuador.

4.2.1. Regional heterogeneity in the effects of a country-level shock

There are three channels through which exposure to the oil boom before turning 18 displayed regional heterogeneity in Ecuador in the 1970s. First, the location of the oil industry. Second, regional differences in government expenditures funded by the windfall from the boom. Finally, preexisting differences across regions in the cost of college attendance.

As mentioned in Section 2, the oil industry is located in the Amazon region. This was an isolated region at the time of the boom. For the Amazon region, the oil industry's presence could have plausibly increased or decreased the costs of college attendance after the oil boom, thus making the effect on college completion rates uncertain. On the one hand, the new low-skill jobs created by the oil industry are concentrated in this region. This could increase the opportunity cost of college. On the other hand, the oil boom led to improved connectivity with the rest of the country and spillovers from the oil industry. These factors plausibly increased the returns of education, suggesting increased completed education rates in the long run.

Regarding the second channel, while the oil boom was a national-level shock, the cities of Quito and Guayaquil saw the greatest benefit from the infrastructure boost driven by the boom. As shown in Section 2, Quito and Guayaquil concentrated a large share of the new government expenditures. Thus, the increase in infrastructure spending triggered by the oil boom likely generated an immediate increase in the opportunity cost of education in these cities, suggesting the likelihood of a more substantial decrease in college completion rates compared to the rest of the country.

The third channel can reinforce the second one and determine the least affected group for an intensity difference in differences design. Regional differences in the costs of college attendance in Ecuador in the 1970s stemmed from the fact that there were universities in only five of the country's cities, with no new universities opening during that period (Appendix Figure D.13). Four universities were located in Quito, three in Guayaquil, three in Cuenca, and one each in Loja and Ibarra. Moreover, only universities in Quito and Guayaquil offered majors in every field of study. The other cities only had access to majors related to law and the humanities (liberal arts).[18]

Attending college was cheaper for individuals who lived in the cities with universities due to lower living, travel, and information costs (most universities were free at that time). In Ecuador, it is common for young adults to live with their parents until they reach their early 30s, especially while they are still studying.[19] Ecuadorian universities do not offer dorms, but people born in a city with universities did not have to rent their own accommodation; they could live with their parents while they studied, thus significantly lowering the costs of education. In addition, dramatic altitude differences across the country increased transportation costs within relatively short distances (Appendix Figure B.11), which further lowered the costs of attending college for people who lived in cities with universities. For instance, travel between the two largest cities in the country (260 miles) took ten hours by car, and there were limited air travel options available.

Regional variation in the costs of attending college can create differences in the abilities of the marginal students who attended college from each region. These differences in ability can imply that a shock that increases the opportunity cost of education in a country can have varying effects in different regions. This result is derived from the human capital accumulation model of Charles et al. (2015), who define a model for young adults who differ in ability θ_i that follows some distribution Φ_θ. In this setup, the lifetime payoff of going to college in year t is

$$R_{it}(\theta_i) = \sum_{k=1}^{L} E_t[\Pi_{t+k}|\Lambda_t] - (1+b)F - \kappa(1-\theta_i) - Y_t^0 \tag{1}$$

where $E_t[\Pi_{t+k}|\Lambda_t]$ captures the expected returns of college attendance conditional on all information available Λ_t, $(1+b)F$ is the present value of the direct cost of college attendance (tuition, fees, living costs), $\kappa(1-\theta_i)$ is the psychological cost of education, and Y_t^0 is the

[18]The rest of the country only had agricultural technical schools. Only one new technical school opened in 1973. These schools are coded as secondary in Figure 3. Appendix Table D.9 lists all universities and technical school that functioned until 1989.

[19]In 1974, 36.5 percent of all adults between 18 and 30 years old lived with their parents. This share increases to 46.5 percent if we consider just those aged 18–24 (Appendix Table D.8). For comparison, Vespa (2017) reports that, in 1975, 26 percent of adults in the U. S. aged 18–34 lived with their parents or in college dorms.

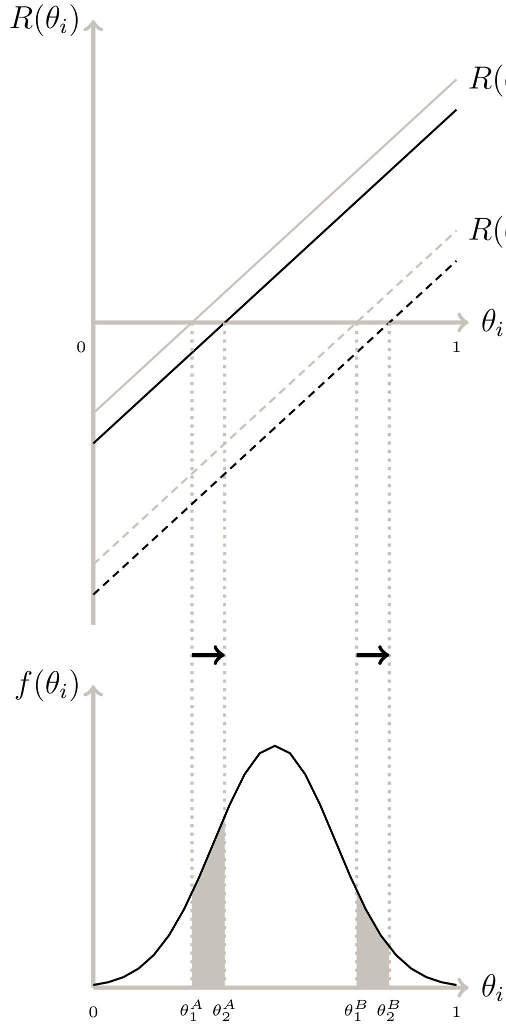
opportunity cost of college attendance in the form of lost wages. The authors assume that the lifetime value of attending college increases with ability. This implies that there is an indifferent individual with ability θ^* such that all individuals with ability $\theta_i \geq \theta^*$ choose to go to college.

With this model, I show that a country-level shock that increases the opportunity cost of education or reduces its returns can have different effects across different regions. Let us suppose that there are two regions in a country, A and B with different direct costs of college attendance, $F^A < F^B$. This difference implies that, for any underlying distribution of ability, college attendance is higher in region A than in region B. Region A corresponds to the regions with universities and region B to the regions without universities. Now, suppose that both regions are affected by a shock that increases the costs of college attendance ($(1+b)F$ or Y_t^0) across regions. College attendance will decrease in both regions but, unless the distribution of ability in the country is uniform, which region is the most strongly affected depends on the magnitude of the difference in costs and the shape of Φ_θ. The shaded areas in the second panel in Figure 4 shows that, given the shape of the distribution, the larger the difference in costs, the more likely it is that the cheaper region will be affected to the greatest extent.

This result requires that the increase in the costs of college attendance in the regions with universities should be no smaller than that in the regions without universities. As mentioned above, Quito and Guayaquil concentrated a large share of the new infrastructure expenditures funded by the boom. This suggests that the opportunity costs of college attendance increased more in these regions than in the regions without universities.

The theoretical result also depends on the shape of the ability distribution across regions. Low college completion rates across the country before the boom suggest that only the right tail of the ability distribution attended college in those years. Moreover, Figure 5 shows substantial differences between regions. Seven percent of the 1948 cohort in regions without universities completed college, compared to 16 percent of those born in major cities. This gap of nine percentage points increased to 12 percentage points for the 1954 cohort, who turned 18 just before the boom. While there are no data on ability measures available to test this hypothesis directly, these regional differences in college completion suggest that only individuals with very high ability levels from regions without universities went to college.

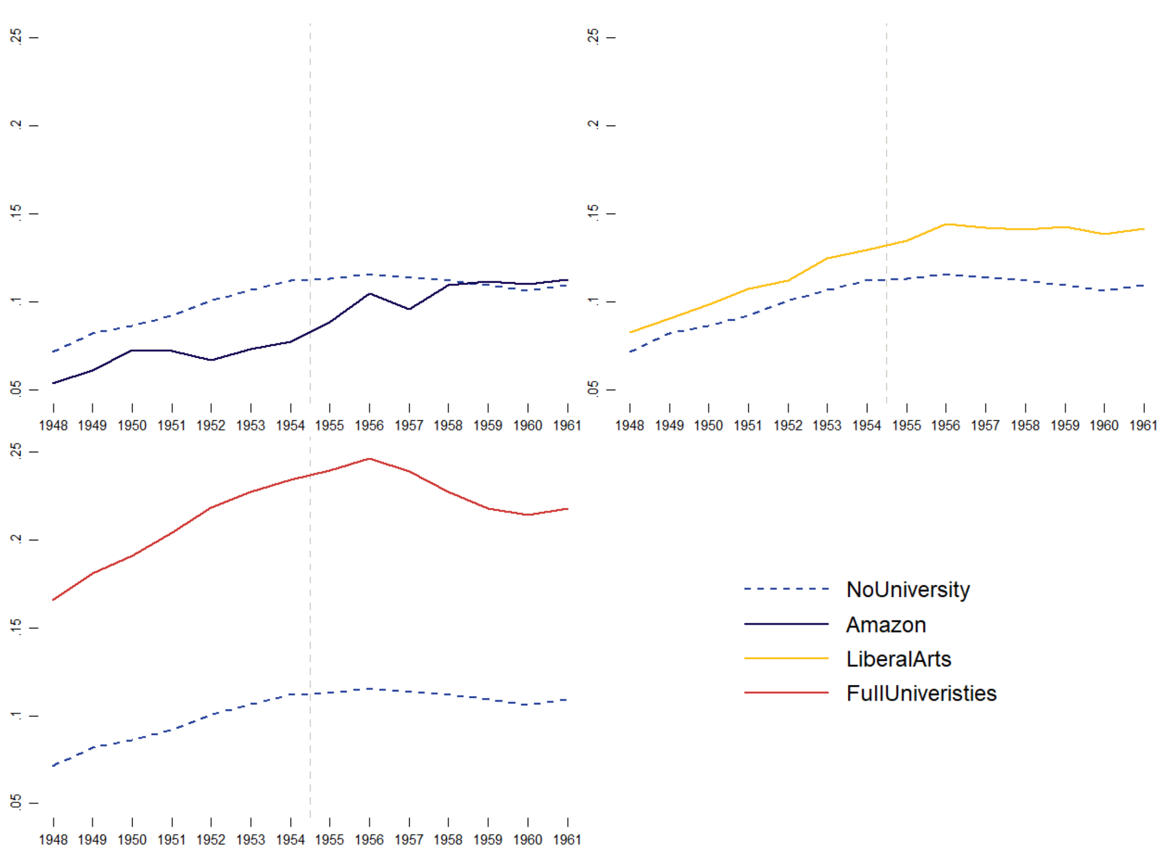
Figure 4: Effects of a Decrease in the Return of Education across Regions with Different Costs of College Attendance



Notes: This figure exemplifies how differences in costs of attending college between regions can lead to differences in the proportion of the population that discontinue their education in the presence of a shock that increases the opportunity cost of college attendance. The first panel presents the present value of education returns as a function of an individual's ability. Region A has lower costs than Region B, which results in higher returns. The second panel presents ability distribution. I assume the same distribution for both regions in this example, but this is not needed for the general result. The shock shifts education returns to the right in both regions. Since the marginal student in Region A had lower ability than the marginal student in Region B, and the marginal student in region B was in the distribution's right tail, more students drop out of college in Region A. The shaded areas in the second panel represent the proportion of people that drop out of college.

Moreover, these differences suggest that the marginal student in the cheaper region had lower ability than the marginal student in the more expensive region. Unless ability's distribution in regions without universities had a substantially fatter right tail than in regions

Figure 5: College Completion by Birth Cohort and Region



Notes: This figure presents the evolution of the proportion of the population who graduated from college in Ecuador for the cohorts born between 1948 and 1961. The horizontal axis plots the year of birth. The country is divided into four regions depending on the geographic location and type of universities before the oil boom. The cohorts born in 1955–1961 were exposed to the oil boom before turning 18.

with universities, regions with universities should experience a larger decline in college completion.[20]

I combine the three channels discussed above to define four areas (Appendix Figure D.14).[21] The first region is the Amazon jungle, which hosts the oil industry ($n = 28,922$). The second region corresponds to the cities of Quito and Guayaquil, which had the lowest costs of college attendance and benefited the most from government spending after the boom ($n = 372,023$). The third region corresponds to the areas of influence of the cities of Cuenca,

[20] A smaller gap exists between regions with liberal arts colleges and those without universities, suggesting smaller differences between the marginal students in these regions.

[21] I explicitly exploit distance to a full university in Section 4.4.1.

Loja, and Ibarra, which had access to liberal arts colleges ($n = 302,702$). The fourth area corresponds to regions without universities that had the highest college attendance costs as serve as the comparison group ($n = 1,007,891$). It is important to note that the changes caused by infrastructure spending and the changes based on differences in how individuals responded to the shock given their ability levels would not have existed without the oil boom; thus, it is not possible to identify their individual effects. We can only identify the total effect of exposure to the oil boom before turning 18.

4.2.2. Estimation and identification

To estimate the effects of exposure to the oil boom before turning 18 on college completion rates, I use an intensity difference-in-differences design that compares changes in outcomes across cohorts of individuals who turned 18 before and after 1973 with changes in outcomes across the regions identified in the previous section.[22,23]

I estimate the change in college completion since 1948 in each region over the change observed in the regions without universities. As long as the oil boom decreased college completion in the baseline region (suggested by Figure 5), we can recover a lower bound of the real effect. For individual i, born in region r in year t we have the following specification:

$$college\ completion_{irt} = \alpha_r + \alpha_t + \lambda_r t + \sum_{r \neq NoU} \sum_{t>1948}^{1961} \theta_{rt} region_r \cdot BirthYear_t + u_{irt} \qquad (2)$$

with region and year of birth fixed effects, α_r and α_t, respectively.[24] The coefficients θ_{rt} capture the effect of exposure to the oil boom for each cohort.

Figure 5 shows that regions with universities and liberal arts colleges not only had higher college completion rates than regions without universities but also a steeper trend across birth cohorts. These differences in trends are consistent with the differences in college at-

[22] Jäger et al. (2019) use a similar design in comparing affected and unaffected cohorts across different regions to estimate the effect of unemployment insurance on job separations in Austria. For other applications of this type of design, see Acemoglu et al. (2004), Finkelstein (2007), Baez (2011), and Felfe et al. (2015).

[23] Oil production began on June 26, 1972. The government launched a massive advertising information campaign to raise awareness that oil production started on that precise date (Cuesta, 1972). By that time, the 1954 cohort had already finished high school, which attenuates concerns of anticipatory effects.

[24] Neighboring cantons share labor markets and can be affected by the same shocks. Region fixed effects account for these potential confounders.

tendance costs across regions and capture regional differences in labor markets, wealth and political power, among other factors. Particularly, large cities concentrated a larger share of high-skilled jobs before the boom than the rest of the country (22 percent vs. 14 percent), suggesting higher returns to education. Thus, I control for differential cohort trends in outcomes, $\lambda_r t$. These trends also capture any remaining variation based on age differences and the life cycle across cohorts. I check the robustness of the results to different trend specifications.

Given the need to control for trends, the identification assumption is that, in the absence of the oil boom, differences in college completion rates across regions would have continued on the same trends seen before the boom. Any change in their relative trajectories caused by the boom is part of the reduced-form effect. Given this assumption, there are two main concerns regarding interpreting θ_{rt} as the causal effect of exposure to the oil boom before turning 18: migration across regions, and other shocks that may have affected younger or older cohorts differently across regions.

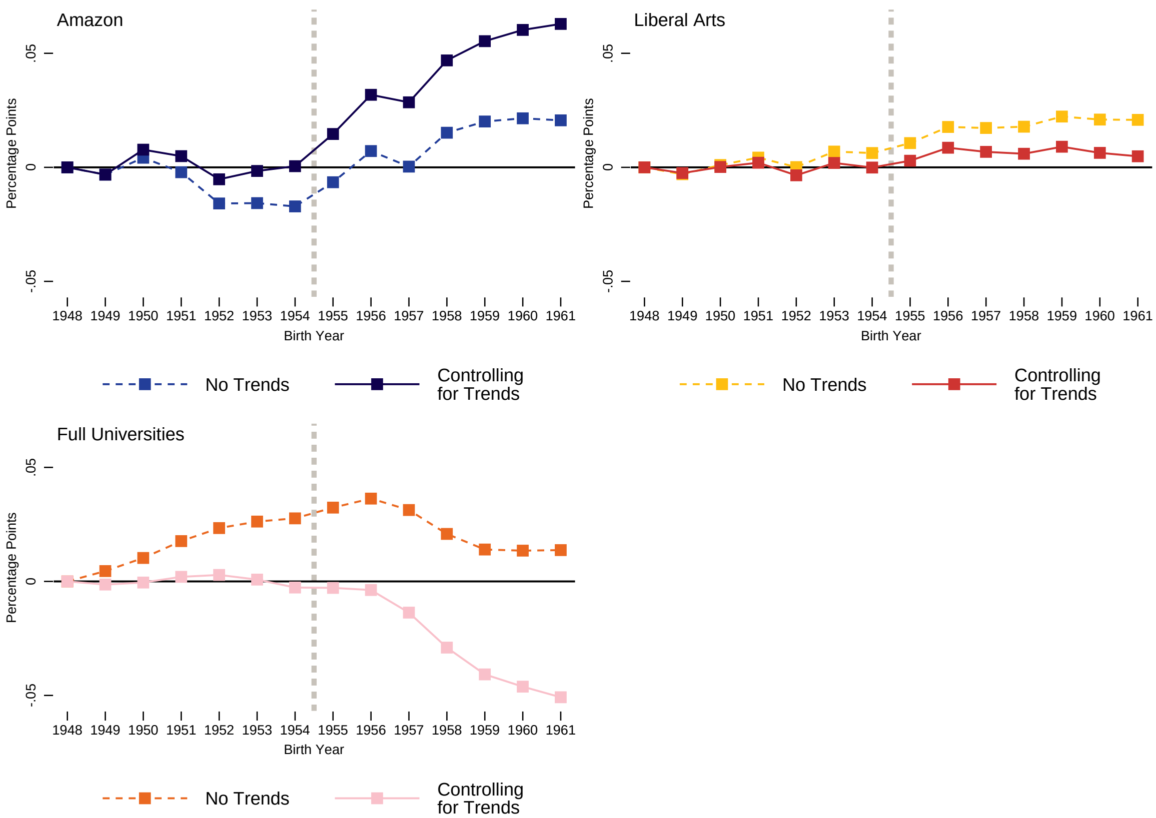
Migration across regions due to the oil boom is the first threat to identifying its effect. Using data from the 1962, 1974, and 1982 population censuses, Velasco (1988) shows that Quito and Guayaquil received an influx of low-skill immigrants from the rest of the country during the oil boom. Thus, in 2014, the cities with full universities had a larger proportion of people who did not go to college, so using the current place of residence would overestimate the effect. To address this concern, individuals are assigned to their region of birth.

The second identification challenge is other shocks that could have affected cohorts who turned 18 before and after the boom differently across regions. Ecuador was under a dictatorship from June 1970 to August 1979. Repression could have affected college attendance, particularly in Quito, where the dictator closed the largest university in the country for a year in 1970. However, Figures 3 and 5 show no dips or kinks in college completion rates for the cohorts who turned 18 in 1970, 1971, and 1972, which would have been consistent with repression. In contrast to other Latin American countries, the 1970s were relatively peaceful in Ecuador.

Shocks that affect population composition differentially in different regions are another concern. For example, an earlier shock that increased fertility after 1955 in areas without universities could have increased the proportion of people with no education in this region, which would have mechanically decreased the proportion of people who completed college. This shock would bias the estimates downward. Conversely, the estimates would be biased upward if college-educated individuals born in cities with full universities after 1955 were more likely to migrate to other countries than older cohorts. Finally, since mortality is negatively correlated with educational attainment, different mortality rates across regions are another potential threat. To assess if any population composition change is a concern, I apply a version of McCrary's (2008) population density test. This type of shock would create discontinuities or kinks in the distribution of the population who turned 18 years old around the oil boom, but Appendix Figure C.12 shows that these issues are not present in the data. The trends have no discontinuities or kinks and are almost identical across regions. These results suggest that population composition changes are not driving the results.

I follow Abadie et al. (2017) to determine the proper way to calculate standard errors in a cross section, where the outcomes for the different cohorts are measured at the same point in time. Abadie et al. (2017) found that, in models that include fixed effects, we should use clustered robust standard errors if there are heterogeneous treatment effects, and either (i) there is clustering in the sample or (ii) there is clustering in treatment assignment. We can rule out (i) because this study's sample consists of the entire population born between 1948 and 1961. Concerning (ii), Abadie et al. (2017) define that there is clustering in treatment assignment when the probability that individual i is assigned to treatment is correlated with the treatment assignment of other individuals in the same region. The extreme case would be that all individuals in a region have the same treatment. In this case, the treatment is turning 18 after 1973. Thus, in the absence of past regional shocks that affect fertility, the probability that one individual in any given region turned 18 after the oil boom should not be correlated with other individuals in the region turning 18 before or after the boom. Hence, neither (i) nor (ii) hold and heteroskedastic robust standard errors should be sufficient. For robustness, I also report standard errors clustered at the canton level (215 clusters) that would account for unobserved, local shocks to fertility.

Figure 6: Effects of Exposure to the Oil Boom Before Turning 18 on College Completion-Impact of Trends



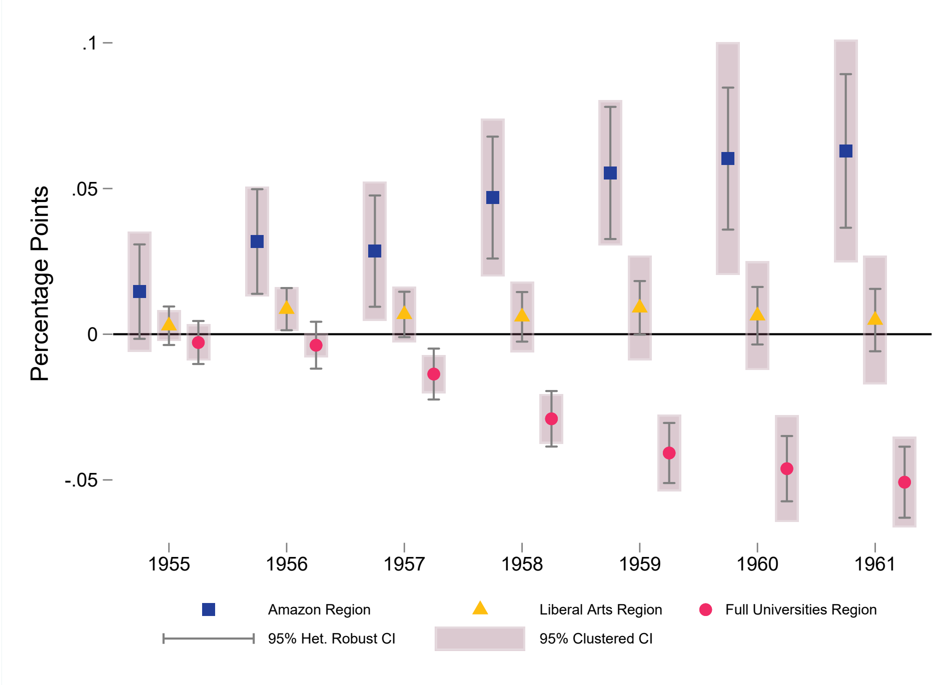
Notes: This figure presents dynamic difference-in-difference estimates of the effect of exposure to the oil boom before turning 18 on the probability of completing college. The region without universities is the control, and the estimates omit the 1948 cohort. Confidence intervals are reported in Figure 7.

4.3. Results

Figure 6, Figure 7, and Table 3 present the estimates of the effect of exposure to the oil boom before turning 18 on college completion. Figure 6 confirms that college completion had different trends across regions for the cohorts who turned 18 before 1973. Compared to regions with no universities, regions with full universities and liberal arts colleges had steeper trends, and the Amazon region had a lower trend. These differences are consistent with the different college attendance costs across regions discussed in Section 4.2.1, and they disappear after controlling for linear trends. From this point onward, I control for trends in all estimates.

Figure 7 presents the estimates of the effect of exposure to the oil boom before turning 18 for the treated cohorts (born between 1955 and 1961), and the first column in Table 3

Figure 7: Effects of Exposure to the Oil Boom Before Turning 18 on College Completion



Notes: This figure presents the effect of exposure to the oil boom before turning 18 on the probability of completing college for the treated cohorts. For the clustered confidence interval, the standard errors are clustered at the canton level (215 clusters). The sample includes 1,711,538 individuals.

averages these effects across cohorts, weighting the estimates by population. In all regions, the estimates are larger for the youngest cohorts in the sample. This pattern is consistent with increasing oil prices after 1973 and with more prolonged exposure to the oil boom, which gave younger individuals more time to see the shift in the labor market toward low-skilled jobs and to perceive the decreasing returns of education. Longer exposure may also have biased their perceptions regarding the expected duration of the boom, and they may have been more likely to believe that the boom was a permanent change in the economy.

The regions with full universities were the most strongly affected by the oil boom, which is consistent with the theoretical prediction in Section 4.2.1. Exposure to the oil boom decreased college completion rates by 2.9 percentage points for the treated cohorts in these cities, relative to regions without universities (first column in Table 3). This change represents 12.2 percent of the college completion rate of individuals who turned 18 in 1954.[25] Controlling

[25]Throughout the paper, I will refer to the 1954 cohort as the baseline for all comparisons.

Table 3: Average Effects of Exposure to the Oil Boom Before Turning 18

	College Completion	Informal Employment	Owning a house with more than two rooms	Owning a house of quality above the median of the quality index	Vehicle Ownership
Full Universities	-0.029	0.008	-0.005	-0.004	-0.005
	(0.004)	(0.006)	(0.006)	(0.006)	(0.004)
	(0.005)	(0.009)	(0.004)	(0.004)	(0.003)
Liberal Arts	0.006	-0.001	-0.004	-0.004	0.005
	(0.004)	(0.006)	(0.007)	(0.006)	(0.005)
	(0.006)	(0.008)	(0.006)	(0.006)	(0.005)
Amazon Region	0.045	-0.017	0.010	0.033	0.021
	(0.009)	(0.017)	(0.019)	(0.015)	(0.011)
	(0.013)	(0.024)	(0.016)	(0.020)	(0.016)

Notes: This table presents the average effect of exposure to the oil boom before turning 18 on different outcomes indicated in the column headers. Each column averages the estimated effect for the treated cohorts using population as weights. Standard errors are in parentheses. The first row of standard errors corresponds to heteroskedastic robust standard errors. The second row of standard errors are clustered at the canton level (215 clusters). The sample includes 1,711,538 individuals.

for quadratic trends yields almost identical results (Appendix Table E.10). Conversely, college completion did not change for the regions with liberal arts colleges that only offered majors related to the humanities.

Exposure to the oil boom increased college completion rates in the Amazon region by 4.5 percentage points for the treated cohorts (58.5 percent of the baseline, first column in Table 3). As mentioned above, this region benefited from improved connectivity infrastructure and spillovers from the oil industry after the boom, counteracting a growing demand for low-skilled labor created by the oil industry.

It is assumed that people who did not attend college either dropped out of high school or finished high school but did not enroll in college. The estimates in Appendix Table E.11 confirm that the reduction in college completion rates in the cities with full universities translated into increased completion rates of primary and secondary education. In the Amazon region, where the college completion rate increased, primary education completion decreased, while there was no significant effect on completion of secondary education. In the regions with liberal arts colleges, no change in primary or secondary education is observed.

Appendix Table E.12 presents the effects of exposure to the oil boom broken down by gender. The point estimates for both the regions with full universities and the Amazon region are larger for men than for women, although most of the differences are not statistically significant. For the treated cohorts in cities with universities, exposure to the oil boom decreased college completion by 1.8 percentage points (9.9 percent of the baseline) for women and by 3.9 percentage points for men (13.7 percent of the baseline). Exposure to the boom seems to have affected younger women (born in 1958 and after), while it affected almost all the men who turned 18 after the boom. This difference suggests that men were affected first by the increase in infrastructure spending and construction that came after 1973, while women were more affected by the increase in low-skilled productivity that followed. In the Amazon region, exposure to the oil boom increased college completion rates by 3.6 percentage points for women (56.3 percent of the baseline) and by 5.4 percentage points for men (59.9 percent of the baseline). There is no significant effect for either gender in the regions with liberal arts colleges.

The identifying assumption behind this design is that differences in college completion rates across regions would have continued on the same trends seen before the boom in the absence of the oil boom. To further test this assumption's robustness, I follow the inference methods proposed by Rambachan and Roth (2020) to check if the results are robust to further deviations in trends. These methods estimate robust confidence sets that check if the estimated treatment effect is robust to non-linearities in the underlying trends.[26] In Ecuador, the difference in trends captures regional differences in labor markets, wealth, and political power that would have continued in the absence of the boom. Given this setting, I follow Rambachan and Roth's (2020) suggestion and impose monotonicity restrictions on the differential trends in the same direction as the trend differences observed for the untreated cohorts. I perform a sensitivity analysis for multiple deviations from the current linearity assumption up to the largest slope change observed for the untreated cohorts.

Appendix Figures E.17, E.18, and E.19 present these results. The sensitivity analysis suggests that the results for the regions with full universities are robust to further non-linearities. The robust confidence sets are consistent with the effects reported in Figure 7.

[26]In this case, we no longer have point-identification but set-identification.

For each treated cohort, the upper bound of the confidence sets is at the same level of the confidence intervals of the main results, while the lower bound suggests negative effects more than twice the magnitude of the point estimates in Figure 7. Only for the 1960 and 1961 at the most significant deviation, we cannot reject the null hypothesis of no treatment effect. For the regions with liberal arts colleges, the robust confidence sets cannot reject the null hypothesis of no effect, consistent with the main results. For the Amazon region, the robust confidence sets suggest even larger positive effects. However, due to the smaller sample in this region, the sets are less precise and cannot reject the null of no effect.

4.4. Further evidence for the validity of the research design

This section reports the results from additional tests on the research design.

4.4.1. Distance to college

In Section 4.2.1, I argued that differences in travel costs to universities have significant effects on people's decision to attend college in Ecuador. To test the theoretical importance of distance to a university, I calculate the distance in miles from the center of each canton to the closest full university. Then, I substitute inverse distance to the closest full university for the regional dummies in Equation 2. The estimates indicate that living close to universities increases the probability of completing college and that exposure to the oil boom before turning 18 decreased this premium (Appendix Table E.13). For the cohorts born after 1958, not living in a city with full universities increased college completion by around 1.7 percentage points, which is consistent with the main results.

4.4.2. Finance-like event study

The evolution of college completion across birth cohorts presented in Figure 3 suggests a second strategy to estimate the effect of exposure to the boom. In the absence of the boom, we should expect that college completion across cohorts follows a constant time process. In other words, we would expect college completion to increase smoothly across birth cohorts. This setting is similar to event studies in the finance literature (MacKinlay, 1997). Following the setup in finance, to estimate the effect of exposure to the boom, we can estimate the constant time process using the older cohorts who were not exposed to the boom before turning 18.

Then, I use the estimated time process to predict college completion for the cohorts born since 1995. The effect of exposure to the boom is the difference between observed college completion and predicted college completion.[27] If the regions without universities are a comparison group in the primary estimation strategy, the aggregate effect estimated by the finance-like event study should be an average of the effects I estimate across regions using the difference in differences design. This suggests that the aggregate effects should be slightly smaller than the effect on the region with full universities.

Appendix Table J.19 presents the event study estimates for college completion. The average effect for the exposed cohorts is 2.6 percentage points, slightly smaller than the average effect for the cities with full universities presented in Figure 7 and follows the same pattern across cohorts.

4.4.3. Placebo check

Given the magnitude of the oil boom, it is not easy to find an outcome that should not have been affected by it for a placebo check. In the available data, gender is the only variable that satisfies this requirement. This placebo check is an additional test against composition changes in the sample. In Ecuador, international migration is driven by less-educated males from regions without universities. I re-estimate Equation 2 using a dummy for women as the outcome. All the point estimates are small compared to a 51 percent baseline and statistically insignificant (Appendix Table E.14). These results further validate that migration-driven composition changes are not a concern.

4.4.4. Robustness to region definition

To check if the results are robust to the definition of the regions, I conduct a permutation test. Individuals are reassigned to regions randomly, and we then re-estimate the effects of exposure to the boom on 10,000 random samples. Appendix Figure E.15 presents these results. The effects of the boom in the regions with full universities and in the Amazon region are clear outliers in the distribution of effects. In contrast, the effects in the regions with liberal arts colleges do not differ from the random estimates. Randomization inference

[27] See Online Appendix J for details on this estimation strategy.

p-values confirm that the effects in the regions with full universities and the Amazon region are significant, while there is no significant effect on the regions with liberal arts colleges (Appendix Table E.15). The same results hold if the permutation considers t-values as suggested by MacKinnon and Webb (2020) (Appendix Figure E.16).

Also, I estimate the effect on college completion with a sample restricted to individuals who still live in their canton of birth. Compared to the main results, Appendix Table E.16 shows a slightly larger effect in the cities with full universities, a slightly smaller effect in the Amazon region, and no effect in the regions with liberal arts colleges.

4.4.5. Additional robustness checks

Section 4.2 discussed shocks associated with composition changes across regions and ruled out this concern. However, shocks that affect early educational attainment differently across regions could still present an issue. Online Appendix F explores this potential concern. These results suggests shocks that affect early educational attainment would be attenuating the negative effect of exposure to the boom in the cities with full universities.

Finally, the results in Section 4.3 capture the change in college completion rates in the different regions over the change of college completion in the regions with no universities. If exposure to the oil boom before turning 18 had a small, negative effect on educational attainment in the latter regions, as suggested by Figure 5, then the estimates are a lower bound of the real effect. However, if exposure to the oil boom had a positive effect in the regions without universities, then the estimates in Section 4.3 would overstate the effect. To address this concern, in Online Appendix G, I re-estimate Equation 2 using people who became Ecuadorian by naturalization as the control group. The estimates follow the same pattern but are between two and four times larger than the estimates in Figure 7. The cities with full universities are still the most strongly affected region. These results confirm that we can take the main estimates in Figure 7 as a conservative measure of the true effect.

5. Long-term Effects on Employment and Wealth

The results presented in Section 4 provide quasi-experimental evidence that a natural resource boom can cause a permanent decrease in completed educational attainment. There could be more than one explanation behind this effect. The first hypothesis would be that lower completed educational attainment could have been the result of a rational decision; if the increase in low-skilled workers' earnings was large enough, it could compensate for the loss of human capital accumulation over a person's lifetime. Additionally, the temporary resource boom could have created a permanent shift in the structure of the economy toward low-skilled jobs, lowering the long-term returns of education. In these cases, rational individuals would not return to school, and there would be no long-term effect on wealth accumulation.

The second hypothesis would be that lack of information, or present-biased preferences, could have led individuals to overestimate the expected duration of the boom. When myopic agents realized that the boom had ended, age-related costs may have prevented them from resuming their education (Castillo et al., 2011; Sutter et al., 2013; Cadena and Keys, 2015). In this case, we would observe a long-term reduction of educational attainment, and potentially a decrease in lifetime wealth, creating a "lost generation."

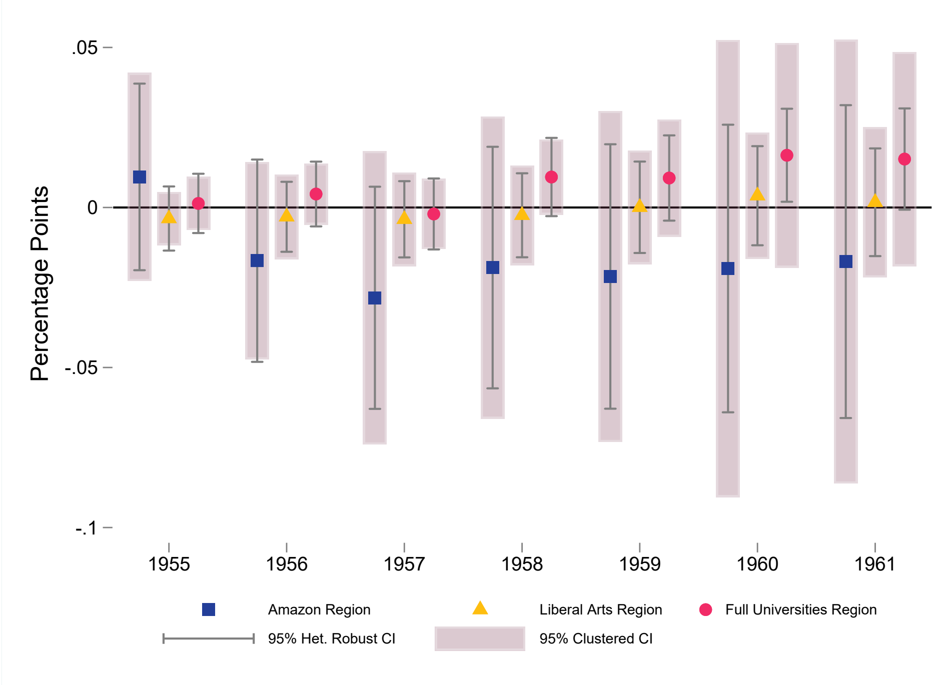
Unfortunately, no high-quality data are available for the 1970s to study how incentives to attend college were differentially affected, or how the types of individuals attending college changed. Hence, I evaluate whether the long-term effects of exposure to the boom on employment and wealth are consistent with the first or second hypotheses.

5.1. The labor market shifted to low-skilled occupations

After the oil boom, the change in employment composition discussed in Section 2 neither reverted nor switched toward high-skilled occupations. The importance of low-skilled jobs in the economy continued to grow until 2010. In 1982 the share of non-agricultural low-skilled jobs was 39.4 percent, and this had increased to 55.5 percent by 2010, while the share of high-skilled occupations decreased from 25.8 percent to 22.8 percent over the same period (Figure 2). These changes suggest that the oil boom changed the structure of the labor market by enhancing the importance of low-skilled jobs. This change should result in a higher likelihood of employment in low-skilled jobs for the treated cohorts.

Ideally, I would estimate the effect of exposure to the oil boom on the probability of working in low-skilled jobs in the long term. However, the available data do not report specific occupations and only report an aggregate measure of informality as explained in

Figure 8: Effects of Exposure to the Oil Boom Before Turning 18 on Informal Employment



Notes: This figure presents the effect of exposure to the oil boom before turning 18 on the probability of working informally informally in 2012 for the treated cohorts. For the clustered confidence interval, the standard errors are clustered at the canton level (215 clusters). The sample includes 1,711,538 individuals.

Section 3. I estimate the effect of exposure to the oil boom on this measure of informality.[28]

Exposure to the oil boom before turning 18 increased the probability of working informally by 0.8 percentage points (1.9 percent of the baseline, second column in Table 3) in the cities with full universities relative to the regions without universities, while it decreased this probability by 1.7 percentage points (3 percent of the baseline, second column in Table 3) in the Amazon region (second column in Table 3, Figure 8, Appendix Figures H.23 and H.24). While the magnitudes are meaningful, the estimates are imprecise. There is no statistically or economically significant change in the probability of working informally in the regions with liberal arts colleges, where there is no effect on college completion. Overall, these results are consistent with the changes in educational attainment in these regions and with a labor

[28]Given this definition of informality, retired individuals would bias the estimates towards zero because they are classified as informal workers. However, in 2012, the majority of the sample was below the legal threshold for retirement.

market oriented toward low-skilled jobs.[29,30]

5.2. Long-term effects of exposure to the oil boom on wealth

The literature on the returns of education implies that a reduction in educational attainment should translate into lower levels of wealth, absent a change in the returns of education. However, if wealth is not affected in the long run, this would be consistent with rational individuals optimally choosing to stop their education because the level of low-skilled earnings would compensate for the lower human capital accumulation. Here, wealth is proxied through three measures: owning a house with two or more rooms; owning a house of quality above the median of a quality index; and vehicle ownership.

Exposure to the oil boom did not affect homeownership in the regions with full universities relative to the regions without universities (third and fourth columns in Table 3, Figure 9 and Appendix Figures I.25, I.26, I.27, and I.28). For the treated cohorts, exposure to the oil boom decreased the probability of owning a home with more than two rooms by 0.4 percentage points (0.7 percent of the baseline, third column in Table 3), which is not significant at conventional levels. The standard errors rule out effects larger than three percent of the baseline in any direction. There is no significant effect on the regions with liberal arts colleges. There are similar results in terms of the effect on the probability of owning a house of quality above the median of the quality index (fourth column in Table 3).

The previous estimates would be biased if fluctuations from the life cycle were different across regions. If people in the cities with full universities wait longer to own a house than people in regions without universities, then Equation 2 would yield a negative effect on homeownership.[31] This bias would imply that the results in Figure 9 are a lower bound of the actual effect on homeownership.[32]

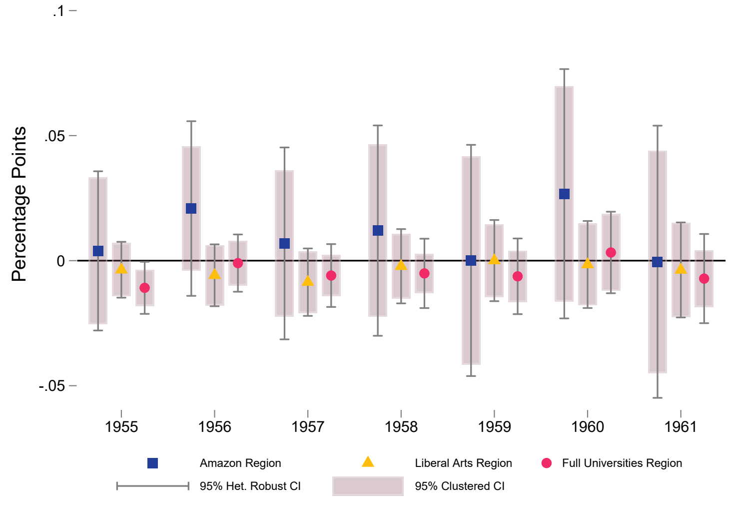
[29]According to Ecuador's Labor Survey of December 2012, informal workers earn on average \$195 per month, while formal workers earn on average \$470 per month. I am not able to estimate the reduced form effect of exposure to the oil boom on income because the labor survey does not report place of birth and the data I use only reports earnings for salaried employees.

[30]Appendix Table J.20 presents the finance-like event study estimates for informal employment. These estimates are very similar in magnitude to the estimates for the full university regions in Figure 8.

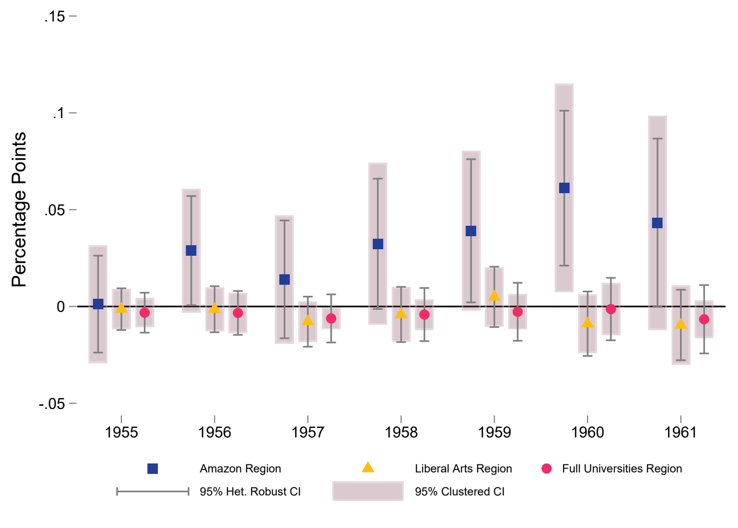
[31]In Ecuador, the home purchase mean age across the whole country is 39.7 years, with regional means of 38.3 years in the cities with full universities, 41.4 years in the cities with liberal arts colleges, 36.9 years in the Amazon region, and 40.8 years in the regions without universities.

[32]In addition, home quality could increase with age. Regarding this potential concern, the two indicators

Figure 9: Effects of Exposure to the Oil Boom Before Turning 18 on Home Ownership



(a) Owning a house with more than two rooms



(b) Owning a house of quality above the median of the quality index

Notes: This figure presents the effect of exposure to the oil boom before turning 18 on the probability of owning a home with more than two rooms (Panel a) and on the probability of owning a home of quality above the median of the quality index (Panel b) for the treated cohorts. Home ownership is measured in the 2010 census. For the clustered confidence interval, the standard errors are clustered at the canton level (215 clusters). The sample includes 1,287,721 individuals.

capture simple measures of quality that are plausibly less likely to change with age. The first indicator captures owning a house with at least a kitchen and another room. When individuals downsize as they age, it is not likely that they would choose to decrease their living standards drastically to owning only one room. The second indicator captures quality based on construction type and access to basic services, which are also not likely to change much with age.

In the Amazon region, changes in homeownership rates are consistent with increased college completion. The treated cohorts have a higher likelihood of owning a house with more than two rooms (1 percentage point; 1.8 percent of the baseline; third column in Table 3). In this region, the point estimates are imprecise and fluctuate across cohorts. Exposure to the oil boom before turning 18 increased the probability of owning a house of above-median quality by 3.3 percentage points (17 percent of the baseline, fourth column in Table 3).[33]

Exposure to the oil boom before turning 18 did not affect the probability of owning at least one vehicle in the cities with full universities (fifth column in Table 3, Figure 10, Appendix Figures I.29 and I.30). The point estimates are small and statistically indistinguishable from zero. For the Amazon region, the point estimates are imprecise, but they indicate that exposure to the oil boom before turning 18 increased the likelihood of owning a car by 2.1 percentage points (17.8 percent of the baseline, fifth column in Table 3), which is again in line with the effects on educational attainment.[34]

6. Discussion

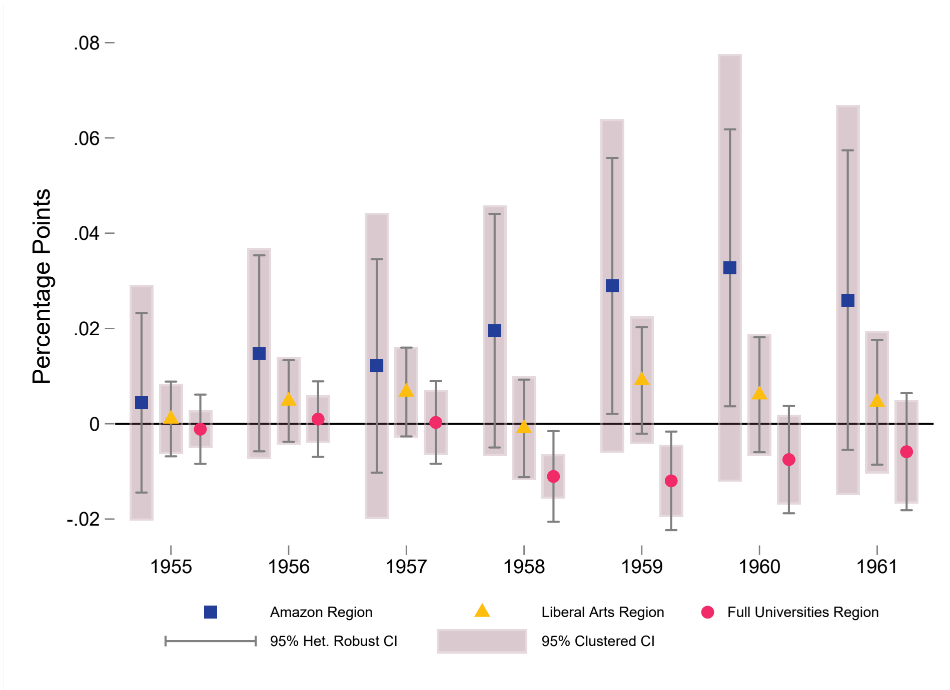
By analyzing the Ecuadorian oil boom of the 1970s, this paper provides some groundwork for understanding how a natural resource boom can affect human capital accumulation in the long term. The results indicate that educational attainment decreased without affecting home or vehicle ownership. This finding suggests that for low-ability individuals most likely affected by exposure to the boom, the increase in low-skilled workers' earnings was large enough to compensate for the loss of human capital accumulation. However, it is important to note that the absence of effects on home and vehicle ownership does not rule out adverse effects on other measures of wealth.

One potential concern for interpreting the results is the evolution of oil's price and the presence of other booms and busts. Since I determine more and less affected regions using universities' location and public spending in the 1970s, the time path of oil prices would

[33] Appendix Table J.21 presents the finance-like event study estimates for homeownership. For owning a house with more than two rooms, the estimates are similar to the main results reported in Figure 9. For owning a house of quality above the median of the quality index, the event study estimates are negative and significant, in contrast to the main results in Figure 9 that suggested negligible effects.

[34] Appendix Table J.22 presents the finance-like event study estimates for vehicle ownership. The point estimates are small and statistically insignificant.

Figure 10: Effects of Exposure to the Oil Boom Before Turning 18 on Vehicle Ownership



Notes: This figure presents the effect of exposure to the oil boom before turning 18 on the probability of owning at least one vehicle in 2013 for the treated cohorts. For the clustered confidence interval, the standard errors are clustered at the canton level (215 clusters). The sample includes 1,711,538 individuals.

be a concern if it affected the cohorts born in 1955–1961 differently from the cohorts born in 1948–1954. For these cohorts, the effects are driven by the confluence of the oil boom (output and prices) and the fact that some cohorts were still in high school while slightly older individuals already made their decision to go to college or not. Future oil price booms and busts are unpredictable. Thus, they should not affect a decision that takes place at a particular moment in a person's life.

The results further suggest that policy has a role in the propagation of natural resource shocks, particularly in cases where the state owns the resource rights. The long-term reduction in educational attainment levels in Ecuador is consistent with policies that increased low-skilled productivity and earnings at the time, which were applied again in Latin America during the resource boom in the 2000s. De La Torre et al. (2015) presented descriptive evidence that low-skilled earnings increased in resource-rich Latin American countries during the commodity price boom, driven by policies similar to those implemented in Ecuador in the

1970s.[35] Thus, the latest resource boom might have decreased education completion rates in Latin America.

Furthermore, it is plausible that policies that increase productivity and earnings in high-skilled occupations would produce a different effect. The Amazon region's case suggests that increasing the returns of education can counter the negative effect on educational attainment. As a suggestive example, Indonesia, another oil-producing developing country, actively promoted industrialization to increase exports of manufactured goods and invested in education infrastructure during the 1970s (Duflo, 2001; Elias and Noone, 2011). Appendix Figure K.31 shows that there is no drop in college completion for the exposed cohorts who turned 18 after the oil boom. Further studies are needed to fully understand how fiscal spending can modulate the effects of natural resource booms.

Also, while the estimates suggest that those who turned 18 after the oil boom did not fare worse than their older peers regarding home and vehicle ownership, we should also consider other outcomes that may be affected by education. These include social capital and civic engagement (Dee, 2004; Milligan et al., 2004; Huang et al., 2009; McMahon, 2010), health (Silles, 2009; Brunello et al., 2016), safety in the country (Lochner and Moretti, 2004; Buonanno and Leonida, 2009), and future generations (Behrman and Rosenzweig, 2002; Currie and Moretti, 2003; Mine Güneş, 2015). These are exciting areas for future work on the effects of resource booms.

From a macroeconomic perspective, the results indicate that the oil boom decreased Ecuador's human capital accumulation. On the other hand, the boom expanded Ecuador's infrastructure. It is not obvious how lower human capital but better infrastructure balance out in terms of growth potential. Gollin et al. (2016) find that income boosts from natural resources make cities (and countries) richer, but the quality of life does not improve as much as industrialization would. Lower completed educational attainment could be a potential mechanism for this effect. Also, there is evidence that a drop in educational attainment can constrain the development of high-skilled industries (Becker et al., 2011; Becker and Woessmann, 2010)). Hence, lowering human capital accumulation may attenuate the impact

[35] Additionally, Caselli and Michaels (2013) find that oil revenue increases budgeted spending for public services in Brazil, but it does not affect living conditions, suggesting that corruption might be a problem.

of other forms of capital accumulation, affecting total growth potential.

References

Abadie, A., Athey, S., Imbens, G.W., Wooldridge, J., 2017. When Should You Adjust Standard Errors for Clustering? Working Paper 24003. National Bureau of Economic Research.

Acemoglu, D., Autor, D.H., Lyle, D., 2004. Women, war, and wages: The effect of female labor supply on the wage structure at midcentury. Journal of Political Economy 112, 497–551.

Acemoglu, D., Finkelstein, A., Notowidigdo, M.J., 2013. Income and health spending: Evidence from oil price shocks. Review of Economics and Statistics 95, 1079–1095.

Acosta, A., 2006. Breve Historia Economica del Ecuador. Corporacion Editora Nacional, Quito, Ecuador.

Allcott, H., Keniston, D., 2017. Dutch disease or agglomeration? The local economic effects of natural resource booms in modern America. The Review of Economic Studies 85, 695–731.

Atkin, D., 2016. Endogenous skill acquisition and export manufacturing in Mexico. American Economic Review 106, 2046–85.

Baez, J.E., 2011. Civil wars beyond their borders: The human capital and health consequences of hosting refugees. Journal of Development Economics 96, 391–408.

Bartik, A.W., Currie, J., Greenstone, M., Knittel, C.R., 2017. The Local Economic and Welfare Consequences of Hydraulic Fracturing. Working Paper 23060. National Bureau of Economic Research.

Becker, G., 1964. Human capital: A theoretical and empirical analysis with special reference to education. Third ed., Columbia University Press, New York.

Becker, S.O., Hornung, E., Woessmann, L., 2011. Education and catch-up in the Industrial Revolution. American Economic Journal: Macroeconomics 3, 92–126.

Becker, S.O., Woessmann, L., 2010. The Effect of Protestantism on education before the Industrialization: Evidence from 1816 Prussia. Economics Letters 107, 224–228.

Behrman, J.R., Rosenzweig, M.R., 2002. Does increasing women's schooling raise the schooling of the next generation? American Economic Review 92, 323–334.

Black, D., Daniel, K., Sanders, S., 2002. The impact of economic conditions on participation in disability programs: Evidence from the coal boom and bust. American Economic Review 92, 27–50.

Black, D., McKinnish, T., Sanders, S., 2005a. The economic impact of the coal boom and bust. The Economic Journal 115, 449–476.

Black, D.A., McKinnish, T.G., Sanders, S.G., 2005b. Tight labor markets and the demand for education: Evidence from the coal boom and bust. ILR Review 59, 3–16.

Brunello, G., Fort, M., Schneeweis, N., Winter-Ebmer, R., 2016. The causal effect of education on health: What is the role of health behaviors? Health Economics 25, 314–336.

Buonanno, P., Leonida, L., 2009. Non-market effects of education on crime: Evidence from Italian regions. Economics of Education Review 28, 11–17.

Bütikofer, A., Dalla-Zuanna, A., Salvanes, K.G., 2020. Breaking the Links: Natural Resource Booms and Intergenerational Mobility. Technical Report. Norwegian School of Economics, Department of Economics, Working Paper.

Cadena, B.C., Keys, B.J., 2015. Human capital and the lifetime costs of impatience. American Economic Journal: Economic Policy 7, 126–53.

Carrington, W.J., 1996. The Alaskan labor market during the pipeline era. Journal of Political Economy 104, 186–218.

Cascio, E.U., Narayan, A., 2020. Who needs a fracking education? The educational response to low-skill biased technological change. ILR Review Forthcoming.

Caselli, F., Michaels, G., 2013. Do oil windfalls improve living standards? Evidence from Brazil. American Economic Journal: Applied Economics 5, 208–38.

Castillo, M., Ferraro, P.J., Jordan, J.L., Petrie, R., 2011. The today and tomorrow of kids: Time preferences and educational outcomes of children. Journal of Public Economics 95, 1377–1385.

Charles, K.K., Hurst, E., Notowidigdo, M.J., 2015. Housing Booms and Busts, Labor Market Opportunities, and College Attendance. Working Paper 21587. National Bureau of Economic Research.

Chuan, A., 2020. The impact of oil and gas job opportunities on long term human capital. Available at SSRN 3597176 .

Cisneros, C., Preston, D., Ibarra, H., Martinez, L., Lentz, C., Pachano, S., Chiriboga, M., Velasco, J.L., Montalvo, J.G., Farrell, G., Placencia, M.M., Mauro, A., Unda, M., 1988. Poblacion, Migracion y Empleo en el Ecuador. ILDIS, Quito, Ecuador.

Cuesta, A., 1972. Primer barril de petroleo. http://cinematecanacionalcce.com/Peliculas/Detalle/3073.

Currie, J., Moretti, E., 2003. Mother's education and the intergenerational transmission of human capital: Evidence from college openings. The Quarterly Journal of Economics 118, 1495–1532.

De La Torre, A., Ize, A., Beylis, G., Lederman, D., 2015. Jobs, Wages and the Latin American Slowdown. World Bank Publications, Washington D.C.

Dee, T.S., 2004. Are there civic returns to education? Journal of Public Economics 88, 1697–1720.

Duflo, E., 2001. Schooling and labor market consequences of school construction in Indonesia: Evidence from an unusual policy experiment. American Economic Review 91, 795–813.

Elias, S., Noone, C., 2011. The growth and development of the Indonesian economy. RBA Bulletin , 33–43.

Emery, J.H., Ferrer, A., Green, D., 2012. Long-term consequences of natural resource booms for human capital accumulation. ILR Review 65, 708–734.

Felfe, C., Nollenberger, N., Rodriguez-Planas, N., 2015. Can't buy mommy's love? Universal childcare and children's long-term cognitive development. Journal of Population Economics 28, 393–422.

Fetzer, T., 2014. Fracking growth. CEP Discussion Papers , 2–47.

Feyrer, J., Mansur, E.T., Sacerdote, B., 2017. Geographic dispersion of economic shocks: Evidence from the fracking revolution. American Economic Review 107, 1313–34.

Finkelstein, A., 2007. The aggregate effects of health insurance: Evidence from the introduction of Medicare. The Quarterly Journal of Economics 122, 1–37.

Goldin, C., Katz, L.F., 2007. Long-Run Changes in the U.S. Wage Structure: Narrowing, Widening, Polarizing. Working Paper 13568. National Bureau of Economic Research.

Gollin, D., Jedwab, R., Vollrath, D., 2016. Urbanization with and without industrialization. Journal of Economic Growth 21, 35–70.

Gylfason, T., 2001. Natural resources, education, and economic development. European Economic Review 45, 847–859.

Huang, J., Van den Brink, H.M., Groot, W., 2009. A meta-analysis of the effect of education on social capital. Economics of Education Review 28, 454–464.

James, A., Aadland, D., 2011. The curse of natural resources: An empirical investigation of us counties. Resource and Energy Economics 33, 440–453.

Jäger, S., Schoefer, B., Zweimüller, J., 2019. Marginal Jobs and Job Surplus: A Test of the Efficiency of Separations. Working Paper 25492. National Bureau of Economic Research.

Kahn, L.B., 2010. The long-term labor market consequences of graduating from college in a bad economy. Labour Economics 17, 303–316.

Kearney, M.S., Wilson, R., 2017. Male Earnings, Marriageable Men, and Nonmarital Fertility: Evidence from the Fracking Boom. Working Paper 23408. National Bureau of Economic Research.

Kumar, A., 2017. Impact of oil booms and busts on human capital investment in the usa. Empirical Economics 52, 1089–1114.

Larrea, C., 1989. Industria, estructura agraria y migraciones internas en el Ecuador: 1950-1982. Documentos de trabajo (FLACSO): Economia Volumen 8.

Lochner, L., Moretti, E., 2004. The effect of education on crime: Evidence from prison inmates, arrests, and self-reports. American Economic Review 94, 155–189.

Løken, K.V., 2010. Family income and children's education: Using the Norwegian oil boom as a natural experiment. Labour Economics 17, 118–129.

Løken, K.V., Mogstad, M., Wiswall, M., 2012. What linear estimators miss: The effects of family income on child outcomes. American Economic Journal: Applied Economics 4, 1–35.

MacKinlay, A.C., 1997. Event studies in Economics and Finance. Journal of Economic Literature 35, 13–39.

MacKinnon, J.G., Webb, M.D., 2020. Randomization inference for difference-in-differences with few treated clusters. Journal of Econometrics .

Marchand, J., 2012. Local labor market impacts of energy boom-bust-boom in Western Canada. Journal of Urban Economics 71, 165–174.

McCrary, J., 2008. Manipulation of the running variable in the regression discontinuity design: A density test. Journal of Econometrics 142, 698–714.

McMahon, W.W., 2010. The external benefits of education. Economics of Education , 68–79.

Michaels, G., 2011. The long term consequences of resource-based specialisation. The Economic Journal 121, 31–57.

Milligan, K., Moretti, E., Oreopoulos, P., 2004. Does education improve citizenship? Evidence from the United States and the United Kingdom. Journal of Public Economics 88, 1667–1695.

Mine Güneş, P., 2015. The role of maternal education in child health: Evidence from a compulsory schooling law. Economics of Education Review 47, 1–16.

Minnesota Population Center, 2017. Integrated Public Use Microdata Series, International: Version 6.5 [dataset]. https://doi.org/10.18128/D020.V6.5. Minneapolis, MN: University of Minnesota.

Oreopoulos, P., Von Wachter, T., Heisz, A., 2012. The short-and long-term career effects of graduating in a recession. American Economic Journal: Applied Economics 4, 1–29.

Palma, J., 1986. Distribucion del Ingreso en el Ecuador (1970–1984). Master's thesis. Pontificia Universidad Catolica del Ecuador.

Papyrakis, E., Gerlagh, R., 2004. The resource curse hypothesis and its transmission channels. Journal of Comparative Economics 32, 181–193.

Papyrakis, E., Gerlagh, R., 2007. Resource abundance and economic growth in the United States. European Economic Review 51, 1011–1039.

Van der Ploeg, F., 2011. Natural resources: Curse or blessing? Journal of Economic Literature 49, 366–420.

Rambachan, A., Roth, J., 2020. An honest approach to parallel trends. Unpublished manuscript, Harvard University.[99] .

Sachs, J.D., Warner, A.M., 1999. The big push, natural resource booms and growth. Journal of Development Economics 59, 43–76.

Sachs, J.D., Warner, A.M., 2001. The curse of natural resources. European Economic Review 45, 827–838.

Silles, M.A., 2009. The causal effect of education on health: Evidence from the United Kingdom. Economics of Education Review 28, 122–128.

Smith, B., 2015. The resource curse exorcised: Evidence from a panel of countries. Journal of Development Economics 116, 57–73.

Stijns, J.P., 2006. Natural resource abundance and human capital accumulation. World Development 34, 1060–1083.

Street, B., 2018. The impact of economic opportunity on criminal behavior: Evidence from the fracking boom. Working paper.

Sutter, M., Kocher, M.G., Glätzle-Rützler, D., Trautmann, S.T., 2013. Impatience and uncertainty: Experimental decisions predict adolescents' field behavior. American Economic Review 103, 510–31.

Torvik, R., 2002. Natural resources, rent seeking and welfare. Journal of Development Economics 67, 455–470.

Velasco, J.L., 1988. Poblacion, migracion y empleo en el Ecuador. ILDIS, Quito, Ecuador. chapter Las migraciones internas en el Ecuador: una aproximacion geografica.

Vespa, J., 2017. The Changing Economics and Demographics of Young Adulthood: 1975-2016. Technical Report P20-579. United States Census Bureau.

World Bank, 1979a. Ecuador - Development problems and prospects: Main report. Technical Report 2373-EC, Washington, DC. World Bank.

World Bank, 1979b. Ecuador - Development problems and prospects: Sectors and regions. Technical Report 2373-EC, Washington, DC. World Bank.

World Bank, 1979c. Ecuador - Development problems and prospects: Technical annexes and statistical appendix. Technical Report 2373-EC, Washington, DC. World Bank.

Online Appendix A. Summary Statistics by Region

Table A.4: Sample Means - Regions without Universities

	Full Sample	Born in 1948-1954	Born in 1955-1961
Proportion Women	0.51	0.51	0.51
Age	56.76	60.78	53.85
Proportion Informal Workers in 2012	0.13	0.11	0.14
Proportion Employees in 2012	0.30	0.29	0.31
Proportion Professional Workers in 2012	0.57	0.60	0.55
Monthly Wage for Employees in 2012	875.13	938.74	838.76
Proportion Vehicle Owners	0.15	0.14	0.16
Average age of vehicle	16.80	17.72	16.19
Proportion Home Owners	0.80	0.82	0.78
Proportion Home Owners with More than 2 Rooms	0.56	0.58	0.55
Proportion Home Owners with Home above Median Quality	0.26	0.26	0.25

Notes: The data corresponds to 2014 unless otherwise noted. Column 1 presents means for the full sample, that is individuals who were born in Ecuador between 1948 and 1961. Column 2 considers individuals born between 1948 and 1954, that is the cohorts who turned 18 before the oil boom in 1973. Column 3 considers individuals born between 1955 and 1961, that is the cohorts who turned 18 after the oil boom.

Table A.5: Sample Means - Amazon Region

	Full Sample	Born in 1948-1954	Born in 1955-1961
Proportion Women	0.51	0.51	0.51
Age	56.45	60.78	53.75
Proportion Informal Workers in 2012	0.15	0.12	0.17
Proportion Employees in 2012	0.28	0.26	0.30
Proportion Professional Workers in 2012	0.57	0.62	0.54
Monthly Wage for Employees in 2012	986.75	1055.67	957.11
Proportion Vehicle Owners	0.12	0.10	0.13
Average age of vehicle	11.56	12.51	11.10
Proportion Home Owners	0.84	0.86	0.82
Proportion Home Owners with More than 2 Rooms	0.57	0.57	0.56
Proportion Home Owners with Home above Median Quality	0.19	0.19	0.19

Notes: The data corresponds to 2014 unless otherwise noted. Column 1 presents means for the full sample, that is individuals who were born in Ecuador between 1948 and 1961. Column 2 considers individuals born between 1948 and 1954, that is the cohorts who turned 18 before the oil boom in 1973. Column 3 considers individuals born between 1955 and 1961, that is the cohorts who turned 18 after the oil boom.

Table A.6: Sample Means - Regions with Liberal Arts Colleges

	Full Sample	Born in 1948-1954	Born in 1955-1961
Proportion Women	0.51	0.51	0.51
Age	56.86	60.82	53.85
Proportion Informal Workers in 2012	0.15	0.13	0.17
Proportion Employees in 2012	0.33	0.32	0.34
Proportion Professional Workers in 2012	0.52	0.55	0.49
Monthly Wage for Employees in 2012	1007.60	1073.02	969.63
Proportion Vehicle Owners	0.20	0.19	0.21
Average age of vehicle	14.27	14.88	13.84
Proportion Home Owners	0.76	0.79	0.74
Proportion Home Owners with More than 2 Rooms	0.59	0.60	0.58
Proportion Home Owners with Home above Median Quality	0.37	0.36	0.37

Notes: The data corresponds to 2014 unless otherwise noted. Column 1 presents means for the full sample, that is individuals who were born in Ecuador between 1948 and 1961. Column 2 considers individuals born between 1948 and 1954, that is the cohorts who turned 18 before the oil boom in 1973. Column 3 considers individuals born between 1955 and 1961, that is the cohorts who turned 18 after the oil boom.

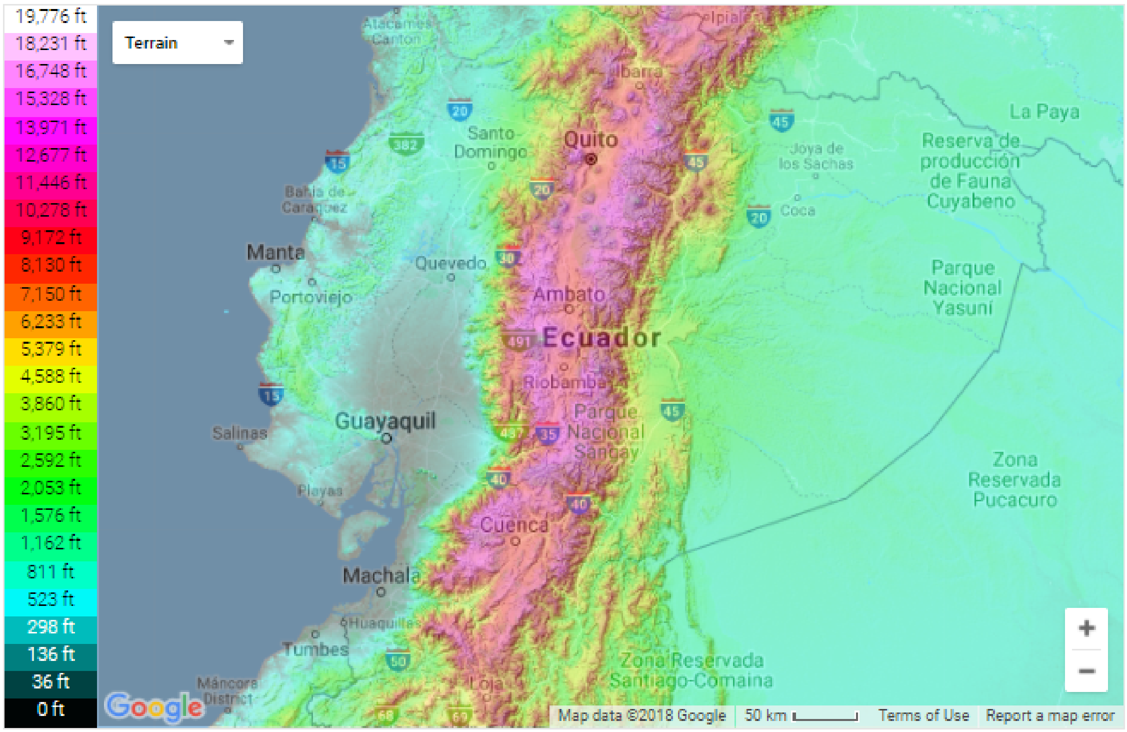
Table A.7: Sample Means - Regions with Full Universities

	Full Sample	Born in 1948-1954	Born in 1955-1961
Proportion Women	0.51	0.52	0.51
Age	56.55	60.75	53.80
Proportion Informal Workers in 2012	0.20	0.17	0.22
Proportion Employees in 2012	0.36	0.36	0.36
Proportion Professional Workers in 2012	0.44	0.47	0.42
Monthly Wage for Employees in 2012	1131.85	1209.54	1092.63
Proportion Vehicle Owners	0.19	0.19	0.19
Average age of vehicle	16.17	16.96	15.65
Proportion Home Owners	0.76	0.79	0.73
Proportion Home Owners with More than 2 Rooms	0.60	0.63	0.58
Proportion Home Owners with Home above Median Quality	0.51	0.53	0.49

Notes: The data corresponds to 2014 unless otherwise noted. Column 1 presents means for the full sample, that is individuals who were born in Ecuador between 1948 and 1961. Column 2 considers individuals born between 1948 and 1954, that is the cohorts who turned 18 before the oil boom in 1973. Column 3 considers individuals born between 1955 and 1961, that is the cohorts who turned 18 after the oil boom.

Online Appendix B. Ecuador's Geography

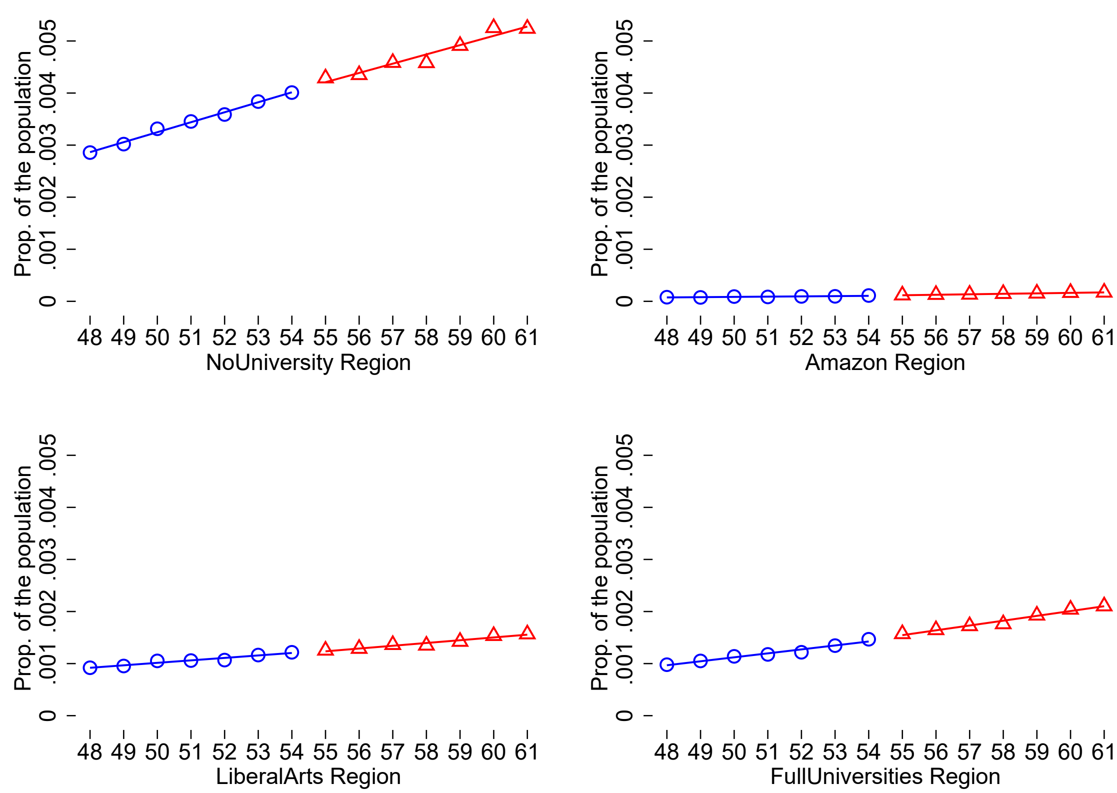
Figure B.11: Geographic Regions in Ecuador



Notes: This figure presents an altitude map for Ecuador. The Andes mountains split the country into three regions with dramatic altitude differences. In a horizontal distance of almost 320 miles in the middle of the country, the altitude increases from sea level to 16,000 feet and then drops to 800 feet.

Online Appendix C. Design tests

Figure C.12: Population Distribution by Birth Cohort and Region



Notes: This figure presents the distribution of the population in Ecuador for the cohorts born in 1948–1961 by region of birth (McCrary, 2008). The cohorts born in 1955–1961 (red triangles) were exposed to the oil boom before turning 18.

Online Appendix D. Universities and Technical Schools during the 1970s

Table D.8: Young Adults Living with their Parents in Ecuador

	18-30 years old	18-24 years old
1962	33.8%	45.4%
1974	36.5%	46.5%
1982	37.4%	48.3%
1990	39.4%	51.0%
2001	40.6%	51.0%
2010	40.7%	51.5%

Notes: This table presents the proportion of young adults who live with their parents according to Ecuador's population censuses of 1962, 1974, 1982, 1990, 2001 and 2010.

Table D.9: Universities and Colleges in Ecuador during the 1970s

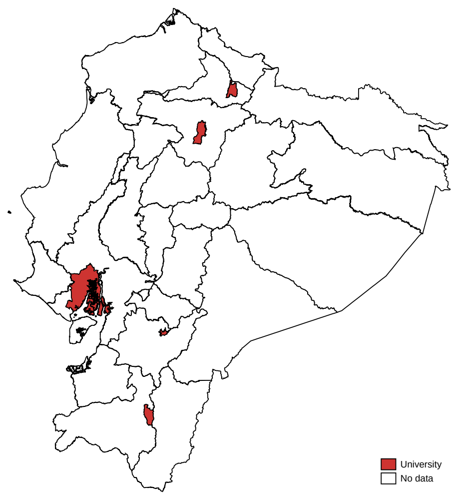
	Open since	Province
Universidad de Cuenca	1867	Azuay
Universidad del Azuay	1968	Azuay
Universidad Catolica de Cuenca	1970	Azuay
ESPOCH*	1973	Chimborazo
Universidad Tecnica de Machala*	1969	El Oro
Universidad Tecnica Luis Vargas Torres de Esmeraldas*	1970	Esmeraldas
Universidad de Guayaquil	1883	Guayas
Escuela Superior Politecnica del Litoral	1958	Guayas
Universidad Laica Vicente Rocafuerte de Guayaquil	1966	Guayas
Universidad Nacional de Loja+	1943	Loja
Universidad Tecnica Particular de Loja*	1971	Loja
Universidad Tecnica de Babahoyo*	1971	Los Rios
Universidad Tecnica de Manabi*	1959	Manabi
Universidad Central del Ecuador	1621	Pichincha
Escuela Politecnica Nacional	1869	Pichincha
Escuela Politecnica del Ejercito	1922	Pichincha
Pontificia Universidad Catolica del Ecuador	1946	Pichincha
Universidad Tecnica de Ambato*	1969	Tungurahua

*Technical school focused on agriculture during the 1970s

+ Had a second campus in the Imbabura province in the north of the country

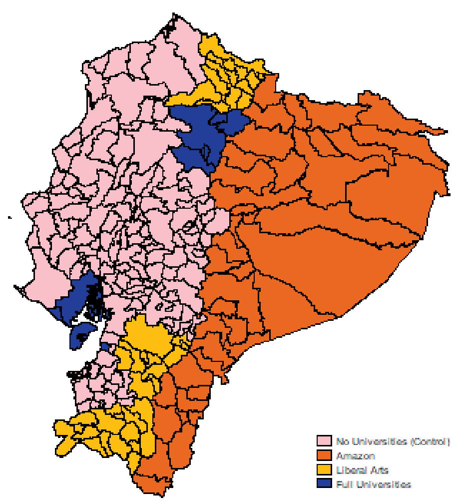
Notes: This table presents list of universities and technical colleges that functioned in Ecuador during the 1970s. Technical colleges focused on agriculture at that time. The Table lists the institution's name, its opening date and the province where it is located.

Figure D.13: Cities with Universities in Ecuador before the Oil Boom



Notes: This figure shows the geographical distribution of the cities with universities in Ecuador before the oil boom.

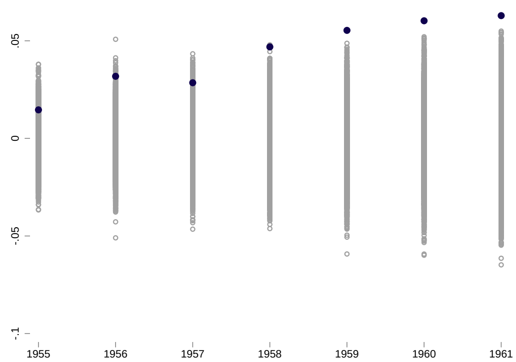
Figure D.14: Regions by Effect of the Boom



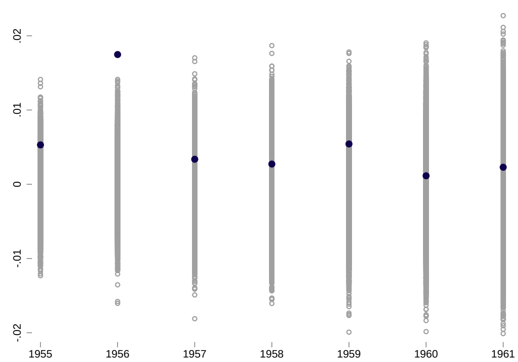
Notes: In this figure, I combine geographic regions with the location of universities before the oil boom and the location of the oil industry to divide the country into four different areas. The oil industry is located in the Amazon region.

Online Appendix E. Additional Graphs and Tables on the Effect of the Oil Boom on Education

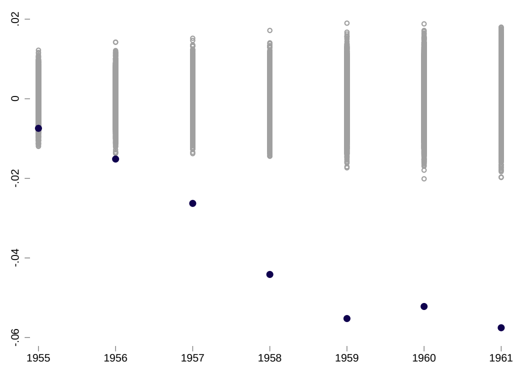
Figure E.15: Region Permutation Results – Estimated Coefficients



(a) Amazon Region



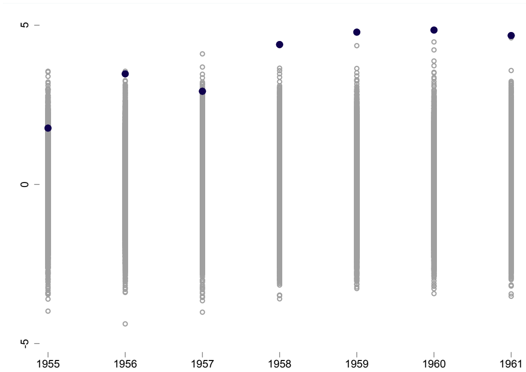
(b) Liberal Arts Colleges



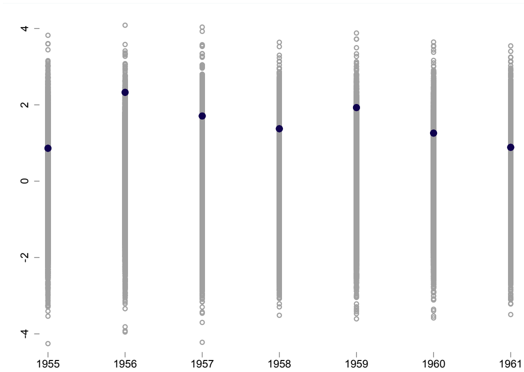
(c) Full Universities

Notes: This figure presents the results of a permutation exercise where I randomly reassigned individuals to regions and estimated the effect of the boom on college completion for the cohorts born in 1955–1961 on 10,000 random samples. The grey dots are the estimates from the simulated samples, and the blue dots are the main effects.

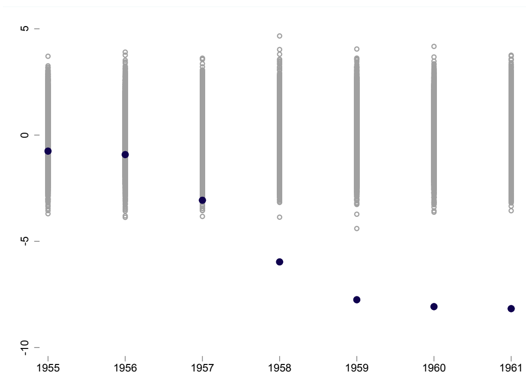
Figure E.16: Region Permutation Results – t-Values



(a) Amazon Region



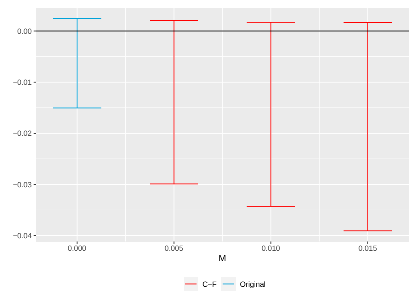
(b) Liberal Arts Colleges



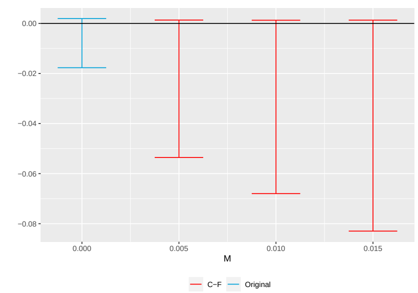
(c) Full Universities

Notes: This figure presents the results of a permutation exercise where I randomly reassigned individuals to regions and estimated the effect of the boom on college completion for the cohorts born in 1955–1961 on 10,000 random samples. The grey dots are the t-values from the simulated samples, and the blue dots are the t-values associated with the main effects.

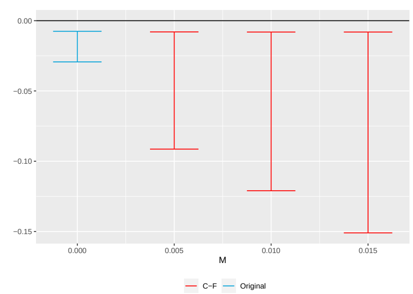
Figure E.17: Sensitivity Analysis to Further Deviations in Trends - Full Universities Region



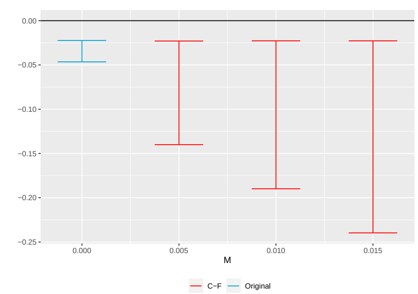
(a) 1955 cohort



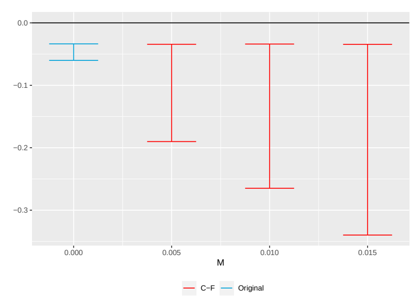
(b) 1956 cohort



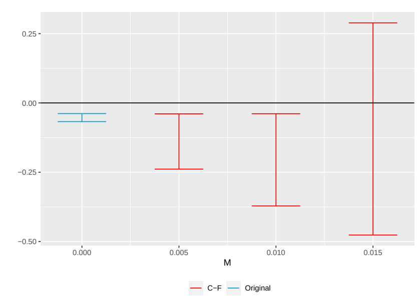
(c) 1957 cohort



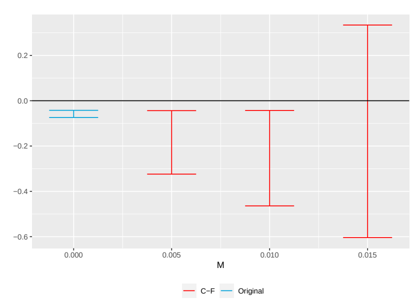
(d) 1958 cohort



(e) 1959 cohort



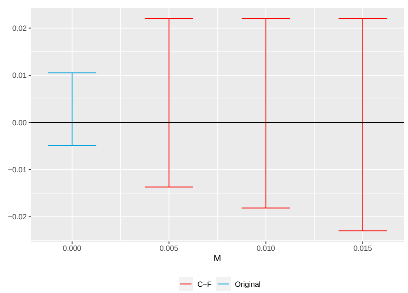
(f) 1960 cohort



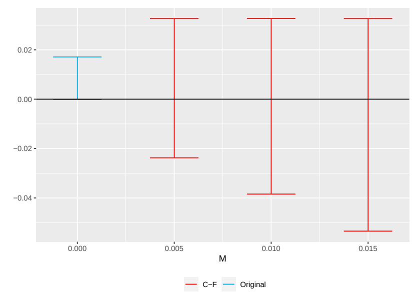
(g) 1961 cohort

Notes: This figure presents confidence sets robust to further non-linearities in regional trends for the effect of the boom on college completion for the cohorts born in 1955–1961. These confidence sets follow the methods of Rambachan and Roth (2020). In Ecuador, the difference in trends captures regional differences in labor markets, wealth, and political power that would have continued in the absence of the boom. Given this setting, I follow Rambachan and Roth's (2020) suggestion and impose monotonicity restrictions on the differential trends. I check the sensitivity of the results up to the largest slope change observed for the untreated cohorts. The blue line corresponds to the main estimates and the red lines to the sensitivity checks.

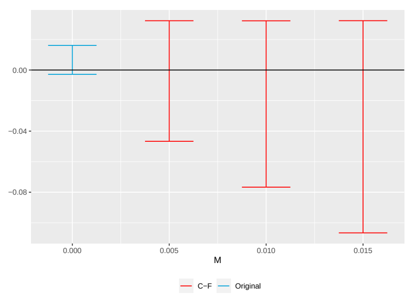
Figure E.18: Sensitivity Analysis to Further Deviations in Trends - Liberal Arts Region



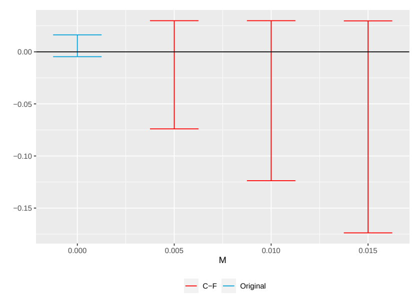
(a) 1955 cohort



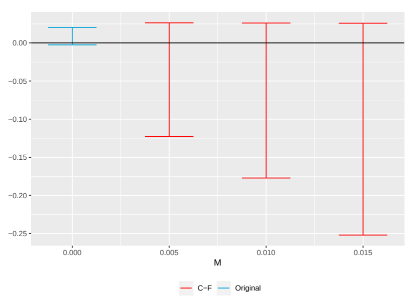
(b) 1956 cohort



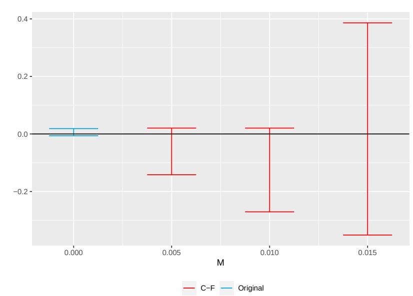
(c) 1957 cohort



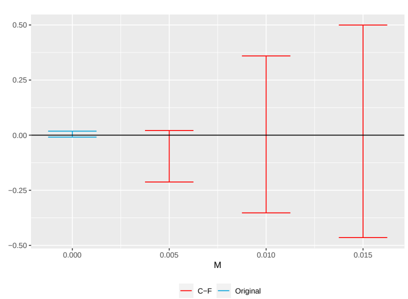
(d) 1958 cohort



(e) 1959 cohort



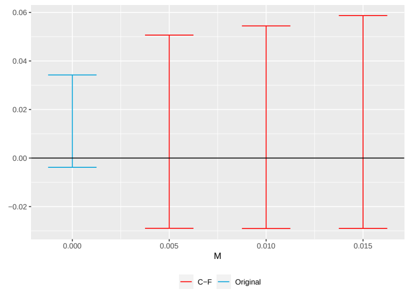
(f) 1960 cohort



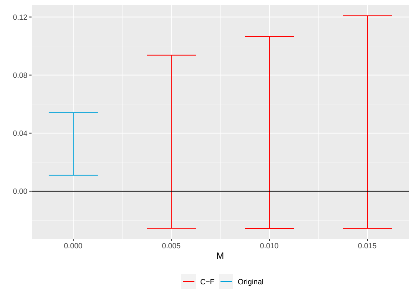
(g) 1961 cohort

Notes: This figure presents confidence sets robust to further non-linearities in regional trends for the effect of the boom on college completion for the cohorts born in 1955–1961. These confidence sets follow the methods of Rambachan and Roth (2020). In Ecuador, the difference in trends captures regional differences in labor markets, wealth, and political power that would have continued in the absence of the boom. Given this setting, I follow Rambachan and Roth's (2020) suggestion and impose monotonicity restrictions on the differential trends. I check the sensitivity of the results up to the largest slope change observed for the untreated cohorts. The blue line corresponds to the main estimates and the red lines to the sensitivity checks.

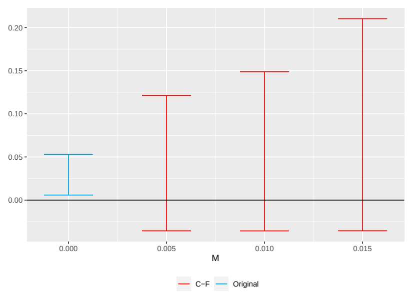
Figure E.19: Sensitivity Analysis to Further Deviations in Trends - Amazon Region



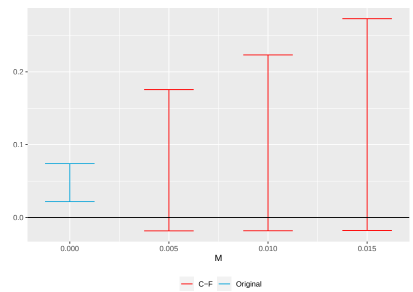
(a) 1955 cohort



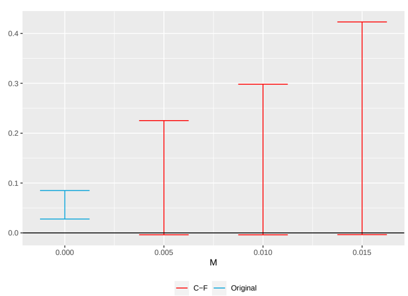
(b) 1956 cohort



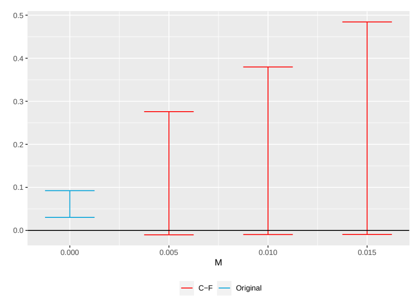
(c) 1957 cohort



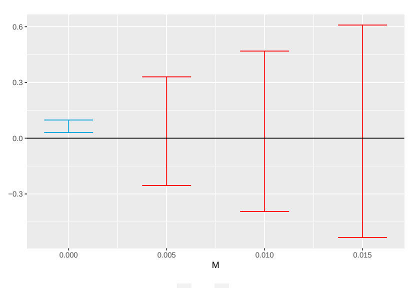
(d) 1958 cohort



(e) 1959 cohort



(f) 1960 cohort



(g) 1961 cohort

Notes: This figure presents confidence sets robust to further non-linearities in regional trends for the effect of the boom on college completion for the cohorts born in 1955–1961. These confidence sets follow the methods of Rambachan and Roth (2020). In Ecuador, the difference in trends captures regional differences in labor markets, wealth, and political power that would have continued in the absence of the boom. Given this setting, I follow Rambachan and Roth's (2020) suggestion and impose monotonicity restrictions on the differential trends. I check the sensitivity of the results up to the largest slope change observed for the untreated cohorts. The blue line corresponds to the main estimates and the red lines to the sensitivity checks.

Table E.10: Effects of Exposure to the Oil Boom Before Turning 18 on College Completion – Quadratic Trend

	1955	1956	1957	1958	1959	1960	1961	1955-1961
Full Universities	-0.003	-0.004	-0.014	-0.029	-0.041	-0.046	-0.051	-0.029
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.006)	(0.006)	(0.004)
	(0.003)	(0.002)	(0.003)	(0.004)	(0.007)	(0.009)	(0.008)	(0.005)
Liberal Arts	0.003	0.009	0.007	0.006	0.009	0.006	0.005	0.006
	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.004)
	(0.003)	(0.004)	(0.005)	(0.006)	(0.009)	(0.009)	(0.011)	(0.006)
Amazon Region	0.015	0.032	0.028	0.047	0.055	0.060	0.063	0.045
	(0.008)	(0.009)	(0.010)	(0.011)	(0.012)	(0.012)	(0.013)	(0.009)
	(0.010)	(0.010)	(0.012)	(0.014)	(0.013)	(0.020)	(0.019)	(0.013)

Notes: This table presents the effect of exposure to the oil boom before turning 18 on the probability of completing college for the cohorts born in 1955–1961. Estimates control for a quadratic trend. The first seven columns present the effect for each cohort. The last column shows the average of these effects across cohorts using population as weights. Standard errors are in parentheses. The first row of standard errors corresponds to heteroskedastic robust standard errors. The second row of standard errors are clustered at the canton level for robustness (215 clusters). The estimation sample includes all individuals born in Ecuador between 1948 and 1955 ($n = 1,711,538$)

Table E.11: Effects of Exposure to the Oil Boom Before Turning 18 on Primary and Secondary Education

	1955	1956	1957	1958	1959	1960	1961	1955-1961
				a. Primary Education				
Full Universities	0.012	0.000	0.005	0.012	0.021	0.028	0.034	0.017
	(0.005)	(0.005)	(0.005)	(0.006)	(0.007)	(0.007)	(0.008)	(0.005)
	(0.004)	(0.005)	(0.006)	(0.006)	(0.007)	(0.010)	(0.011)	(0.006)
Liberal Arts	0.006	-0.008	-0.002	-0.014	-0.014	-0.007	-0.008	-0.007
	(0.005)	(0.006)	(0.006)	(0.007)	(0.007)	(0.008)	(0.009)	(0.006)
	(0.005)	(0.006)	(0.007)	(0.008)	(0.011)	(0.011)	(0.012)	(0.008)
Amazon Region	-0.016	-0.046	-0.063	-0.082	-0.111	-0.136	-0.147	-0.091
	(0.015)	(0.016)	(0.018)	(0.020)	(0.021)	(0.023)	(0.025)	(0.018)
	(0.019)	(0.021)	(0.019)	(0.028)	(0.026)	(0.037)	(0.037)	(0.025)
				b. Secondary Education				
Full Universities	0.002	0.012	0.020	0.032	0.033	0.033	0.029	0.024
	(0.004)	(0.005)	(0.005)	(0.006)	(0.006)	(0.007)	(0.008)	(0.005)
	(0.003)	(0.004)	(0.005)	(0.004)	(0.006)	(0.007)	(0.006)	(0.004)
Liberal Arts	-0.001	-0.001	-0.001	0.011	0.005	0.008	0.007	0.004
	(0.004)	(0.004)	(0.005)	(0.005)	(0.006)	(0.006)	(0.007)	(0.004)
	(0.004)	(0.004)	(0.004)	(0.005)	(0.006)	(0.006)	(0.008)	(0.005)
Amazon Region	-0.008	-0.011	0.009	-0.007	-0.003	-0.006	-0.005	-0.004
	(0.011)	(0.012)	(0.014)	(0.015)	(0.016)	(0.018)	(0.019)	(0.013)
	(0.008)	(0.011)	(0.013)	(0.020)	(0.016)	(0.018)	(0.019)	(0.014)

Notes: This table presents the effect of exposure to the oil boom before turning 18 on the probability of completing primary and secondary education for the cohorts born in 1955–1961. The first seven columns present the effect for each cohort. The last column shows the average of these effects across cohorts using population as weights. Standard errors are in parentheses. The first row of standard errors corresponds to heteroskedastic robust standard errors. The second row of standard errors are clustered at the canton level for robustness (215 clusters). The estimation sample includes all individuals born in Ecuador between 1948 and 1955 ($n = 1,711,538$).

Table E.12: Effects of Exposure to the Oil Boom Before Turning 18 on College Completion by Gender

	1955	1956	1957	1958	1959	1960	1961	1955-1961
				Women				
Full Universities	0.001	0.007	-0.001	-0.014	-0.026	-0.040	-0.043	-0.018
	(0.005)	(0.005)	(0.006)	(0.006)	(0.007)	(0.007)	(0.008)	(0.005)
	(0.002)	(0.004)	(0.009)	(0.012)	(0.014)	(0.017)	(0.017)	(0.011)
Liberal Arts	0.001	0.001	0.010	0.009	0.013	0.012	0.008	0.008
	(0.004)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.007)	(0.005)
	(0.004)	(0.005)	(0.006)	(0.007)	(0.011)	(0.012)	(0.012)	(0.007)
Amazon Region	0.012	0.016	0.031	0.031	0.054	0.041	0.053	0.036
	(0.011)	(0.011)	(0.013)	(0.013)	(0.015)	(0.016)	(0.017)	(0.012)
	(0.011)	(0.012)	(0.012)	(0.013)	(0.015)	(0.019)	(0.021)	(0.012)
				Men				
Full Universities	-0.007	-0.015	-0.026	-0.044	-0.055	-0.052	-0.058	-0.039
	(0.006)	(0.006)	(0.007)	(0.007)	(0.008)	(0.009)	(0.010)	(0.007)
	(0.006)	(0.004)	(0.012)	(0.010)	(0.008)	(0.007)	(0.010)	(0.008)
Liberal Arts	0.005	0.017	0.003	0.003	0.005	0.001	0.002	0.005
	(0.005)	(0.006)	(0.006)	(0.007)	(0.007)	(0.008)	(0.008)	(0.006)
	(0.004)	(0.006)	(0.007)	(0.007)	(0.010)	(0.010)	(0.013)	(0.007)
Amazon Region	0.017	0.048	0.026	0.063	0.056	0.079	0.074	0.054
	(0.013)	(0.014)	(0.015)	(0.017)	(0.018)	(0.019)	(0.021)	(0.014)
	(0.016)	(0.015)	(0.017)	(0.018)	(0.019)	(0.026)	(0.024)	(0.018)

Notes: This table presents the effect of exposure to the oil boom before turning 18 on the probability of completing college for the cohorts born in 1955–1961 by gender. The first seven columns present the effect for each cohort. The last column shows the average of these effects across cohorts using population as weights. Standard errors are in parentheses. The first row of standard errors corresponds to heteroskedastic robust standard errors. The second row of standard errors are clustered at the canton level for robustness (215 clusters). The estimation sample includes all individuals born in Ecuador between 1948 and 1955 (870,046 women and 841,492 men).

Table E.13: Effects of Exposure to the Oil Boom Before Turning 18 on College Completion – Distance to Full Universities Estimates

	Inverse Distance	Inverse Distance $\times$ Cohort: 1955	1956	1957	1958	1959	1960	1961
Estimate	0.111	0.004	0.004	-0.005	-0.019	-0.032	-0.035	-0.037
	(0.002)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
	(0.020)	(0.004)	(0.004)	(0.005)	(0.007)	(0.008)	(0.012)	(0.011)

Notes: This table presents the effect of exposure to the oil boom before turning 18 on the probability of completing college for the cohorts born in 1955–1961 using inverse distance to full universities to determine treatment intensity. I estimate $college\ completion_{irt} = \alpha_t + \lambda_r t + \beta InverseDistance_r + \sum_{t>1948}^{1961} \theta_{rt} InverseDistance_r \cdot BirthYear_t + u_{irt}$, where $InverseDistance_r$ is the inverse distance from the canton of birth to the closest full university. The sample excludes the Amazon region to ensure monotonicity ($n = 1,682,616$). Standard errors are in parentheses. The first row of standard errors corresponds to heteroskedastic robust standard errors. The second row of standard errors are clustered at the canton level for robustness (174 clusters).

Table E.14: Effects of Exposure to the Oil Boom Before Turning 18 on the Proportion of Women

	1955	1956	1957	1958	1959	1960	1961	1955-1961
Full Universities	0.002	-0.001	0.002	0.003	0.008	-0.008	0.002	0.001
	(0.005)	(0.005)	(0.006)	(0.006)	(0.007)	(0.007)	(0.008)	(0.006)
	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.005)	(0.005)	(0.004)
Liberal Arts	0.007	0.003	0.002	0.001	0.007	0.001	0.0002	0.003
	(0.005)	(0.006)	(0.006)	(0.007)	(0.007)	(0.008)	(0.009)	(0.006)
	(0.006)	(0.005)	(0.007)	(0.008)	(0.008)	(0.009)	(0.010)	(0.007)
Amazon Region	0.004	-0.006	-0.004	0.003	-0.006	-0.015	0.018	-0.001
	(0.015)	(0.016)	(0.018)	(0.020)	(0.022)	(0.023)	(0.026)	(0.018)
	(0.017)	(0.016)	(0.016)	(0.018)	(0.021)	(0.022)	(0.025)	(0.017)

Notes: Standard errors are in parentheses. The first row of standard errors corresponds to heteroskedastic robust standard errors. The second row of standard errors are clustered at the canton level for robustness (174 clusters). The estimation sample includes all individuals born in Ecuador between 1948 and 1955 ($n = 1,711,538$).

Table E.15: Randomization Inference P-values of the Effect of the Boom on College Completion

	1955	1956	1957	1958	1959	1960	1961
Full Universities	0.0262	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Liberal Arts	0.1405	0.0001	0.4180	0.5561	0.2747	0.8307	0.6948
Amazon Region	0.1553	0.0050	0.0164	0.0005	0.0002	0.0001	0.0002

Notes: This table presents randomization inference p-values of the effect of exposure to the oil boom before turning 18 on the probability of college completion for the cohorts born in 1955–1961. These p-values correspond to the estimates reported in Figure 7. The p-values are based on a permutation exercise with 10,000 replications.

Table E.16: Effects of Exposure to the Oil Boom Before Turning 18 on College Completion – Restricted Sample

	1955	1956	1957	1958	1959	1960	1961	1955-1961
Full Universities	-0.005	-0.007	-0.020	-0.037	-0.051	-0.058	-0.065	-0.037
	(0.004)	(0.004)	(0.005)	(0.005)	(0.006)	(0.006)	(0.007)	(0.005)
	(0.002)	(0.002)	(0.003)	(0.006)	(0.008)	(0.013)	(0.011)	(0.006)
Liberal Arts	0.000	0.004	0.005	0.000	0.001	0.001	-0.005	0.001
	(0.004)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.007)	(0.005)
	(0.004)	(0.004)	(0.007)	(0.010)	(0.015)	(0.015)	(0.017)	(0.010)
Amazon Region	-0.006	0.018	0.009	0.027	0.027	0.032	0.034	0.022
	(0.008)	(0.009)	(0.009)	(0.010)	(0.011)	(0.012)	(0.012)	(0.008)
	(0.009)	(0.008)	(0.008)	(0.011)	(0.010)	(0.015)	(0.011)	(0.008)

Notes: This table presents the effect of exposure to the oil boom before turning 18 on the probability of completing college for the cohorts born in 1955–1961. Sample is restricted to individuals who in 2014 live in the canton where they were born ($n = 1,185,789$). The first seven columns present the effect for each cohort. The last column shows the average of these effects across cohorts using population as weights. Standard errors are in parentheses. The first row of standard errors corresponds to heteroskedastic robust standard errors. The second row of standard errors are clustered at the canton level for robustness (215 clusters).

Online Appendix F. Unobserved shocks on early educational attainment

As discussed above, the main threat to identification would be the presence of other shocks that had varied effects across different cohorts or regions. Section 4.2 discussed shocks associated with composition changes across regions and ruled out this concern. However, shocks that affect early educational attainment differently across regions could still present an issue.

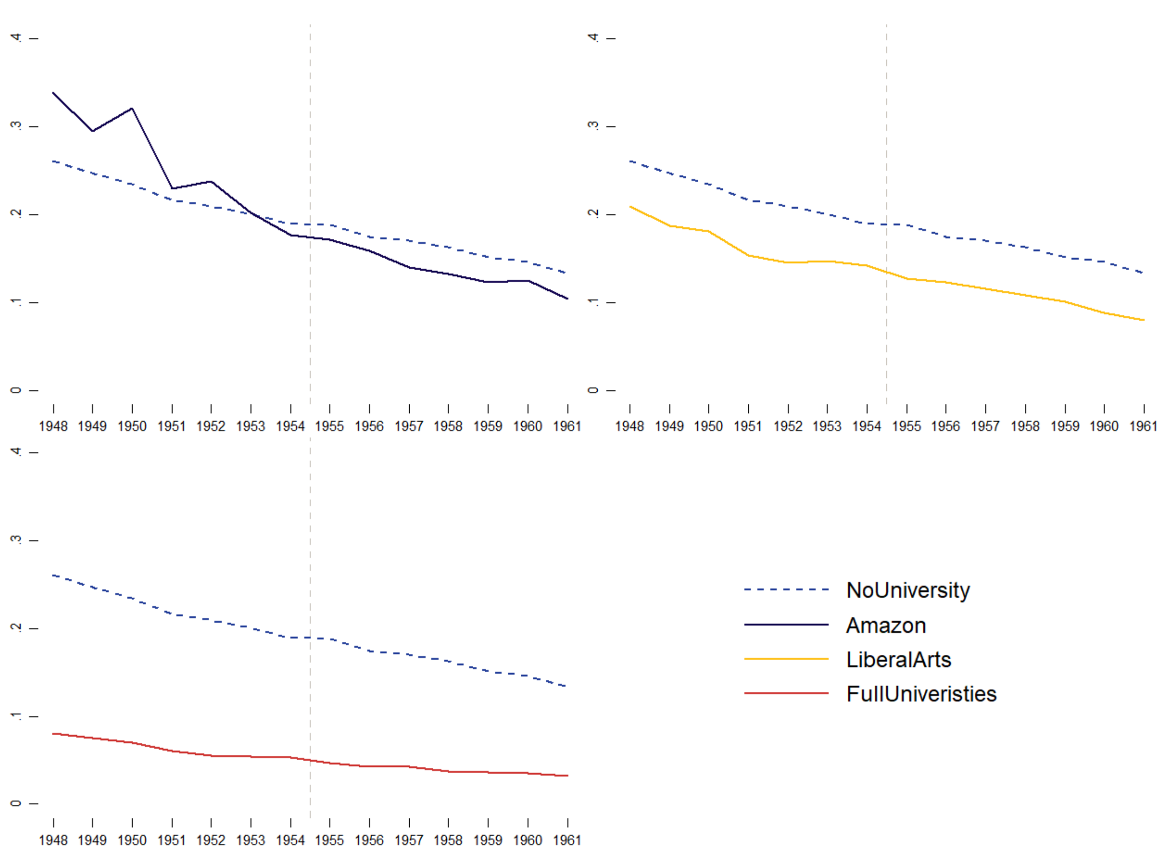
Two types of shocks would prevent us from interpreting the estimates in Figure 7 as the causal effect of exposure to the oil boom before turning 18. The first type is shocks before the oil boom that decreased early educational attainment to a greater degree in cities with full universities than in regions with no universities. If individuals did not complete their primary education, it would have been impossible for them to go to college. This type of shock seems unlikely, given that the cities with full universities were the richest in the country. Second, the same interpretation concern would arise if a policy had increased early educational attainment in the Amazon region to a greater degree than in the regions with no universities before the oil boom. Any such policies are unlikely given the isolation of the Amazon region at that time.

I check if unobserved early education-related shocks affected the probability of not completing any educational level for the treated cohorts (Appendix Table F.17, Appendix Figures F.20 and F.21). Compared to the regions without universities, the proportion of people with no education decreased by 1.3 percentage points in the cities with full universities (23.4 percent of the baseline) and increased by 5.1 percentage points in the Amazon region (26.9 percent of the baseline).

These estimates show opposite outcomes from the hypothesized concerns because they are a consequence of literacy campaigns that took place during the 1980s and the early 1990s. These campaigns focused on teaching working-age adults how to read and write. They started in the cities of Quito and Guayaquil and spread outward to the rest of the coastland areas and the mountain regions. These campaigns barely reached the Amazon region.

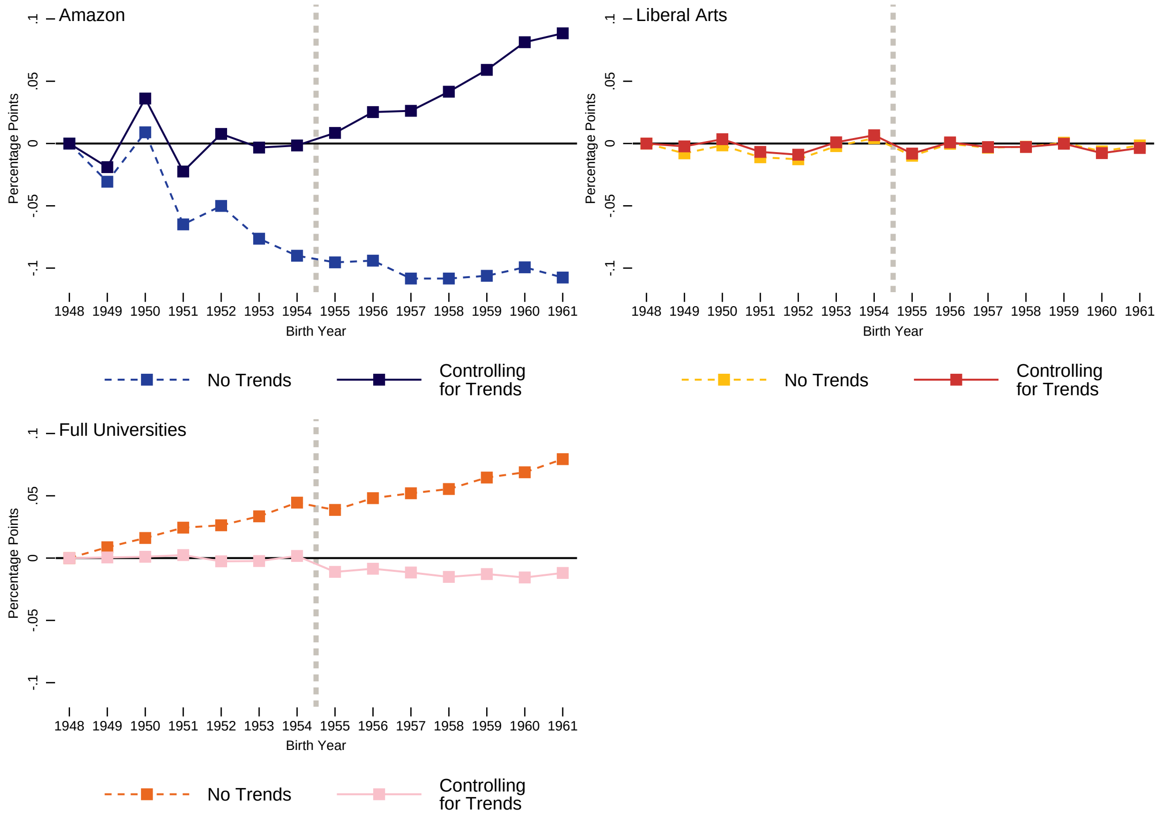
These results suggest that some additional individuals could potentially have gone to college in the cities with full universities compared to the control. This would attenuate the negative effect of the oil boom on college completion rates in this region. Thus, these results suggest that the estimates in Figure 7 are a lower bound of the real effect.

Figure F.20: Population with no Completed Education by Birth Cohort



Notes: This figure presents the evolution of the proportion of the population with no completed education in Ecuador for the cohorts born in 1948–1961. The horizontal axis plots the year of birth. The country is divided into four regions depending on the geographic location and type of universities before the oil boom. The cohorts born in 1955-1961 were exposed to the oil boom before turning 18.

Figure F.21: Effects on the Probability of Not Completing Any Educational Level



Notes: This figure presents dynamic difference-in-difference estimates of the effects of unobserved shocks on the probability of not completing any educational level. Dashed lines present conventional difference-in-difference estimates, and solid lines control for linear differential trends. The region without universities is the control, and the estimates omit the 1948 cohort.

Table F.17: Effects on the Probability of Not Completing Any Educational Level

	1955	1956	1957	1958	1959	1960	1961	1955-1961
Full Universities	-0.011	-0.009	-0.012	-0.015	-0.013	-0.016	-0.012	-0.012
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)	(0.003)
	(0.003)	(0.003)	(0.003)	(0.004)	(0.005)	(0.005)	(0.006)	(0.004)
Liberal Arts	-0.008	0.001	-0.003	-0.003	0.000	-0.008	-0.004	-0.003
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.006)	(0.006)	(0.004)
	(0.004)	(0.005)	(0.005)	(0.006)	(0.007)	(0.008)	(0.009)	(0.006)
Amazon Region	0.009	0.025	0.026	0.042	0.059	0.081	0.088	0.051
	(0.012)	(0.013)	(0.014)	(0.016)	(0.017)	(0.019)	(0.021)	(0.015)
	(0.015)	(0.016)	(0.017)	(0.021)	(0.022)	(0.026)	(0.032)	(0.020)

Notes: This table presents the effects of unobserved shocks on the probability of not completing any educational level for the cohorts born in 1955–1961. The first seven columns present the effect for each cohort. The last column shows the average of these effects across cohorts using population as weights. Standard errors are in parentheses. The first row of standard errors corresponds to heteroskedastic robust standard errors. The second row of standard errors are clustered at the canton level for robustness (215 clusters). The estimation sample includes all individuals born in Ecuador between 1948 and 1955 ($n = 1,711,538$).

Online Appendix G. Are the estimates a lower bound of the true effect?

The results in Section 4.3 capture the change in college completion rates in the different regions over the change of college completion in the regions with no universities. If exposure to the oil boom before turning 18 had a small, negative effect on educational attainment in the latter regions, as suggested by Figure 5, then the estimates are a lower bound of the real effect. However, if exposure to the oil boom had a positive effect in the regions without universities, then the estimates in Section 4.3 would overstate the effect. To address this concern, I re-estimate Equation 2 using people who became Ecuadorian by naturalization as the control group. According to Ecuador's 2010 census, 82.3 percent of these individuals entered Ecuador after they turned 18, and 75.7 percent entered after they turned 24. While 18 percent of naturalized Ecuadorians could have been exposed to the oil boom, Appendix Figure G.22 indicates no change in the level or trend of college completion rates between foreign-born individuals who turned 18 before and after 1973. Thus, it is likely that, for the majority of this group, attending college was not affected by the oil boom.[36]

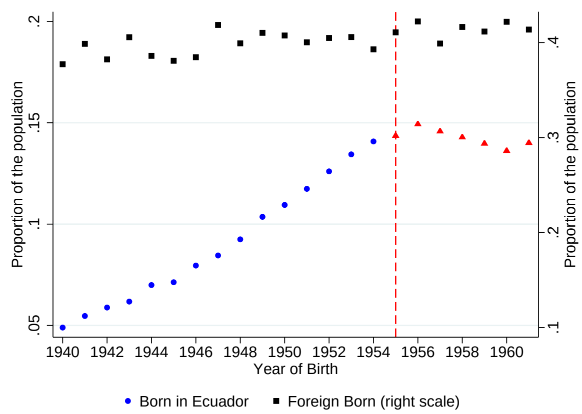
Appendix Table G.18 presents these results. The estimates follow the same pattern but are between two and four times larger than the estimates in Figure 7. The cities with full universities are still the most strongly affected region. Exposure to the oil boom decreased college completion by 7.7 percentage points for the treated cohorts in these areas (32.9 percent of the baseline). Additionally, the point estimates indicate that exposure to the oil boom decreased college completion by 4.8 percentage points for the cohorts born in 1955–1961 in the regions without universities (42.9 percent of the baseline). This effect is similar to that in the regions with liberal arts colleges, where exposure to the oil boom decreased college completion by 4.2 percentage points. The difference in the point estimates between these two regions is not statistically significant for any cohort, which is consistent with the main results. These results confirm that we can take the main estimates in Figure 7 as a conservative measure of the true effect.

In this specification, exposure to the oil boom does not affect college completion in the

[36]However, it is also possible that these individuals became Ecuadorians as a result of the oil boom. This selection could bias the estimates for outcomes related to the labor market and wealth.

Amazon region. This estimate, together with the main result for this region as well as the decrease in college completion in all the other regions, further suggests that the presence of the oil industry countered the increase of low-skilled productivity that affected the rest of the country. As mentioned above, the oil industry may have increased the returns of education in the Amazon region through its role in improving connectivity with Quito and enhancing the local economy. This result also implies that the estimates for the Amazon region are an upper bound of the real effect.

Figure G.22: College Completion for Native Born and Foreign Born



Notes: This figure presents the evolution of college completion for individuals born between 1940 and 1961. Blue circles and red triangles represent people born in Ecuador. The cohorts born in 1955–1961 (red triangles) turned 18 years old during the oil boom in the 1970s. The black squares represent people born outside of Ecuador, who became Ecuadorians later in life, mostly after the oil boom.

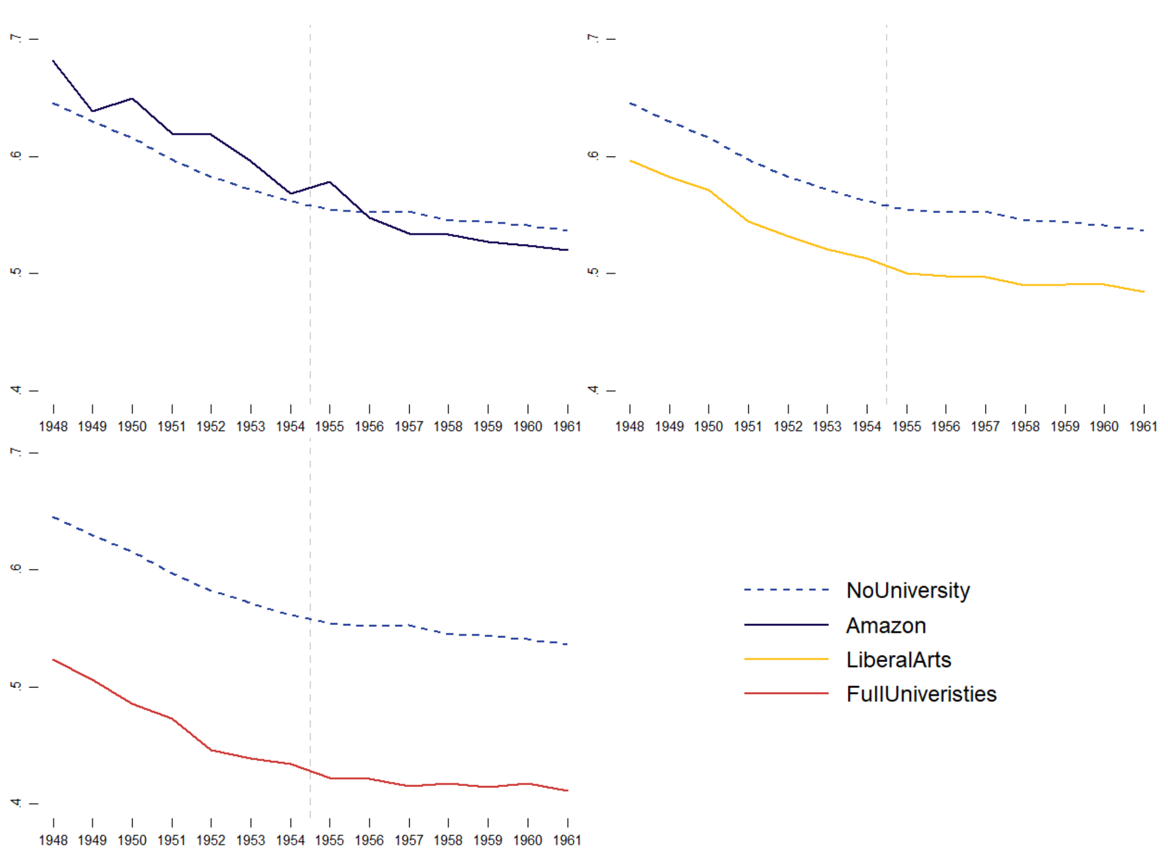
Table G.18: Effects of Exposure to the Oil Boom Before Turning 18 on College Completion using Foreign-Born Ecuadorians as Control

	1955	1956	1957	1958	1959	1960	1961	1955-1961
Full Universities	-0.022	-0.039	-0.036	-0.078	-0.095	-0.121	-0.122	-0.077
	(0.012)	(0.013)	(0.014)	(0.016)	(0.017)	(0.019)	(0.020)	(0.014)
	(0.003)	(0.001)	(0.002)	(0.003)	(0.006)	(0.008)	(0.007)	(0.004)
Liberal Arts	-0.016	-0.027	-0.015	-0.043	-0.045	-0.069	-0.067	-0.042
	(0.012)	(0.013)	(0.014)	(0.016)	(0.017)	(0.019)	(0.020)	(0.014)
	(0.002)	(0.003)	(0.004)	(0.005)	(0.008)	(0.009)	(0.010)	(0.006)
Amazon Region	-0.004	-0.004	0.007	-0.002	0.001	-0.015	-0.009	-0.004
	(0.014)	(0.016)	(0.017)	(0.018)	(0.020)	(0.022)	(0.024)	(0.016)
	(0.010)	(0.009)	(0.012)	(0.013)	(0.012)	(0.020)	(0.019)	(0.013)
No Universities	-0.019	-0.035	-0.022	-0.049	-0.054	-0.075	-0.072	-0.048
	(0.012)	(0.013)	(0.014)	(0.015)	(0.017)	(0.018)	(0.020)	(0.013)
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)

Notes: This table presents the effect of exposure to the oil boom before turning 18 on the probability of completing college for the cohorts born in 1955–1961 using foreign-born Ecuadorians as control. The first seven columns present the effect for each cohort. The last column shows the average of these effects across cohorts using population as weights. Standard errors are in parentheses. The first row of standard errors corresponds to heteroskedastic robust standard errors. The second row of standard errors are clustered at the canton level for robustness (215 clusters). The estimation sample includes Ecuadorians (native and naturalized) born between 1948 and 1955 ($n = 1,754,059$).

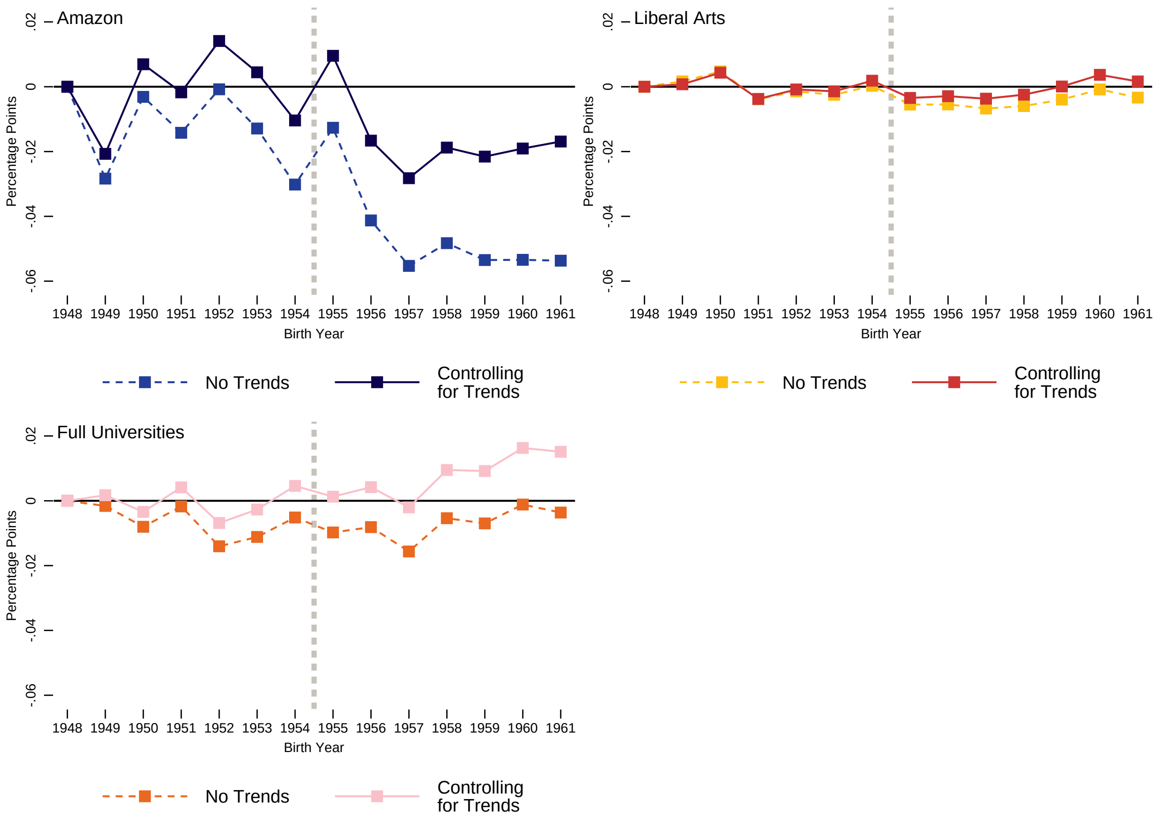
Online Appendix H. Additional Graphs on the Effect of the Oil Boom on Informal Employment

Figure H.23: Population Working Informally in 2012 by Birth Cohort



Notes: This figure presents the evolution of the proportion of the population working informally in Ecuador for the cohorts born in 1948–1961. The data correspond to 2012. The horizontal axis plots the year of birth. The country is divided into four regions depending on the geographic location and type of universities before the oil boom. The cohorts born in 1955–1961 were exposed to the oil boom before turning 18.

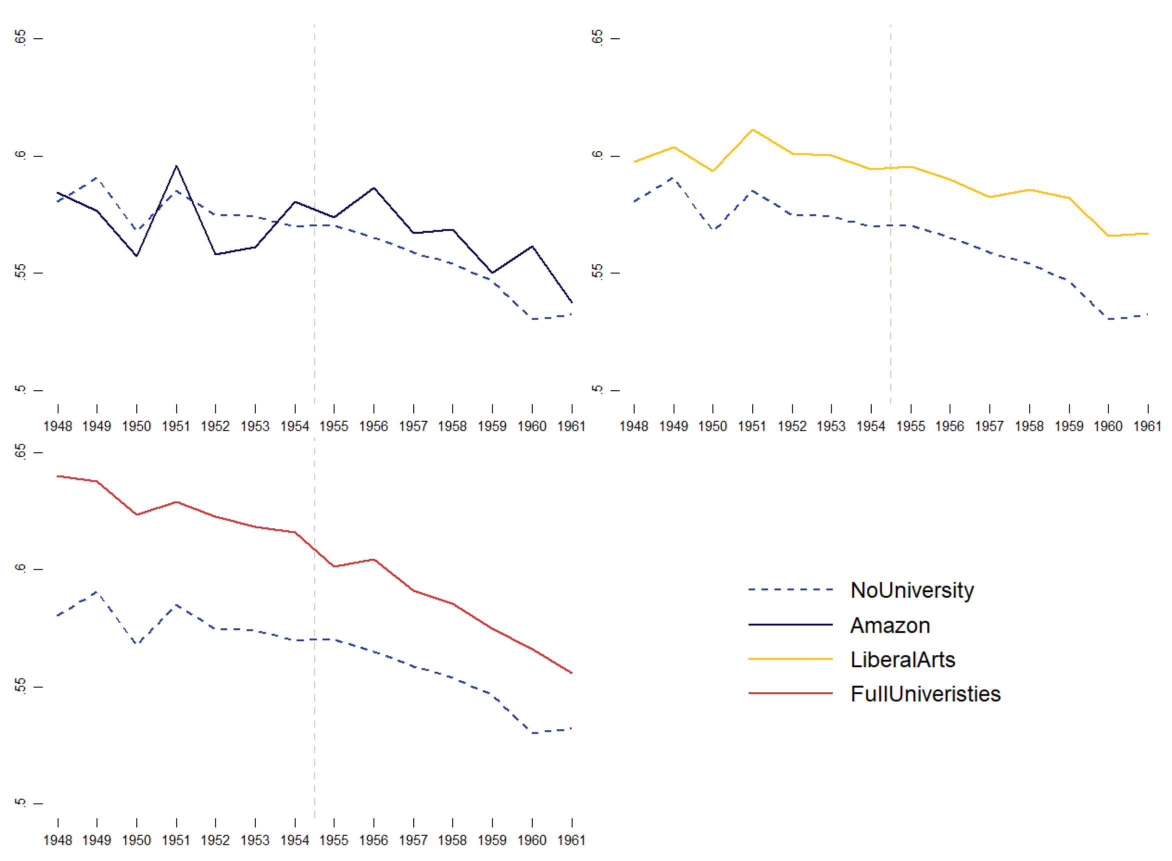
Figure H.24: Effects of Exposure to the Oil Boom Before Turning 18 on Informal Employment



Notes: This figure presents dynamic difference-in-difference estimates of the effect of exposure to the oil boom before turning 18 on the probability of working informally in 2012. Dashed lines present conventional difference-in-difference estimates, and solid lines control for linear differential trends. The region without universities is the control, and the estimates omit the 1948 cohort.

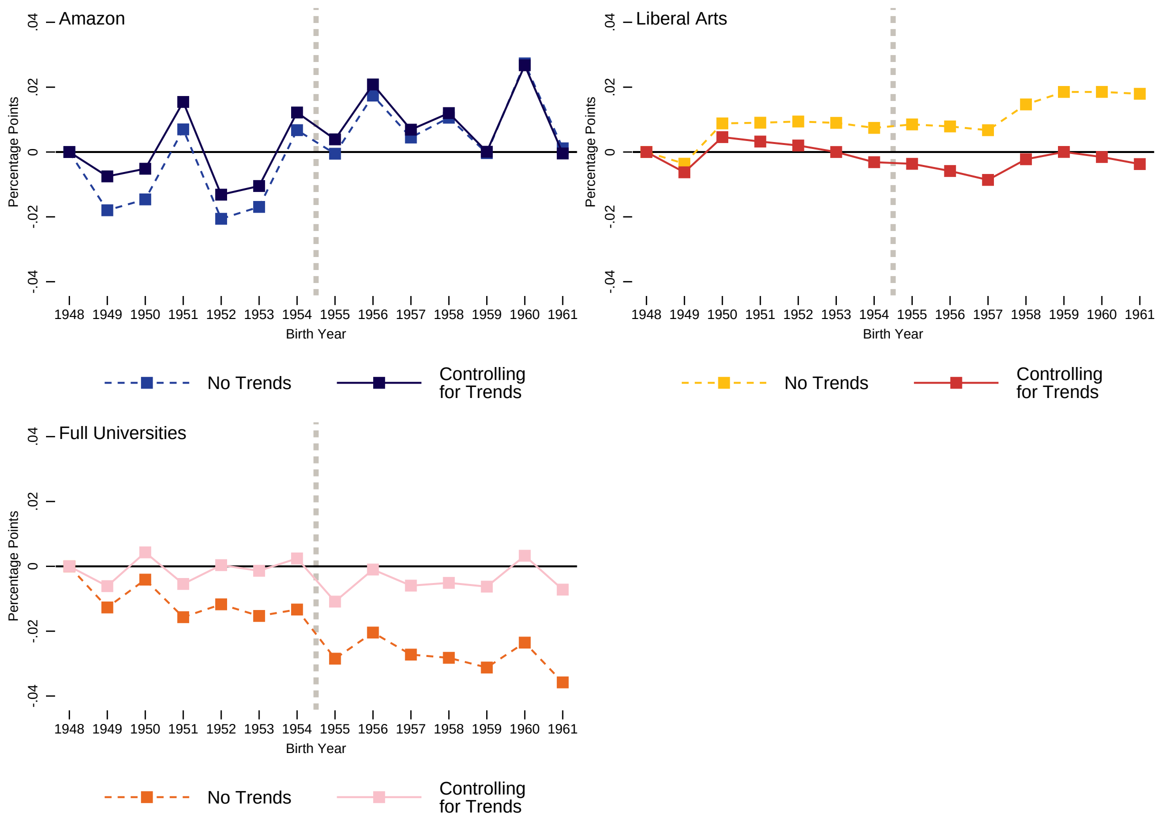
Online Appendix I. Additional Graphs on the Effect of the Oil Boom on Wealth

Figure I.25: Population Owning a Home with more than two Rooms in 2010 by Birth Cohort



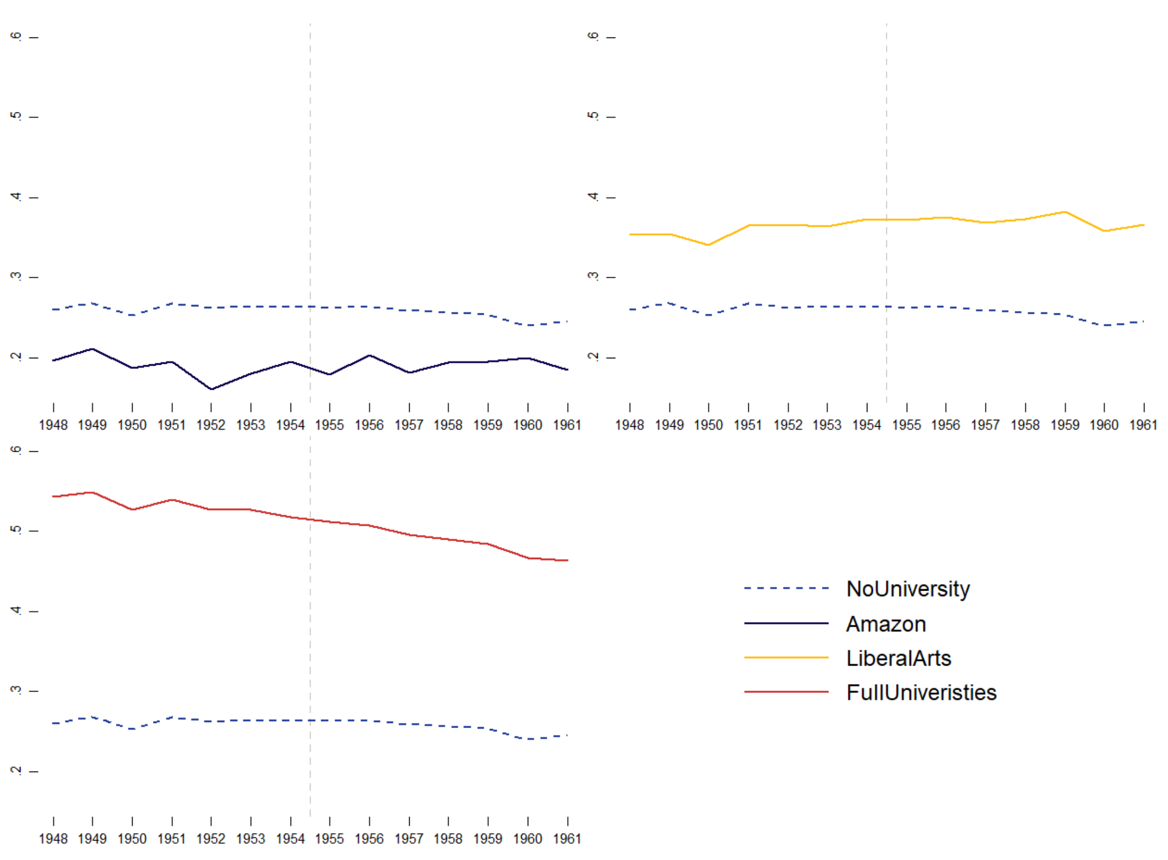
Notes: This figure presents the evolution of the proportion of the population who owns a home with more than two rooms in Ecuador for the cohorts born in 1948–1961. The data correspond to 2010. The horizontal axis plots the year of birth. The country is divided into four regions depending on the geographic location and type of universities before the oil boom. The cohorts born in 1955-1961 were exposed to the oil boom before turning 18.

Figure I.26: Effects of Exposure to the Oil Boom Before Turning 18 on the Probability of Owning a Home with more than two Rooms



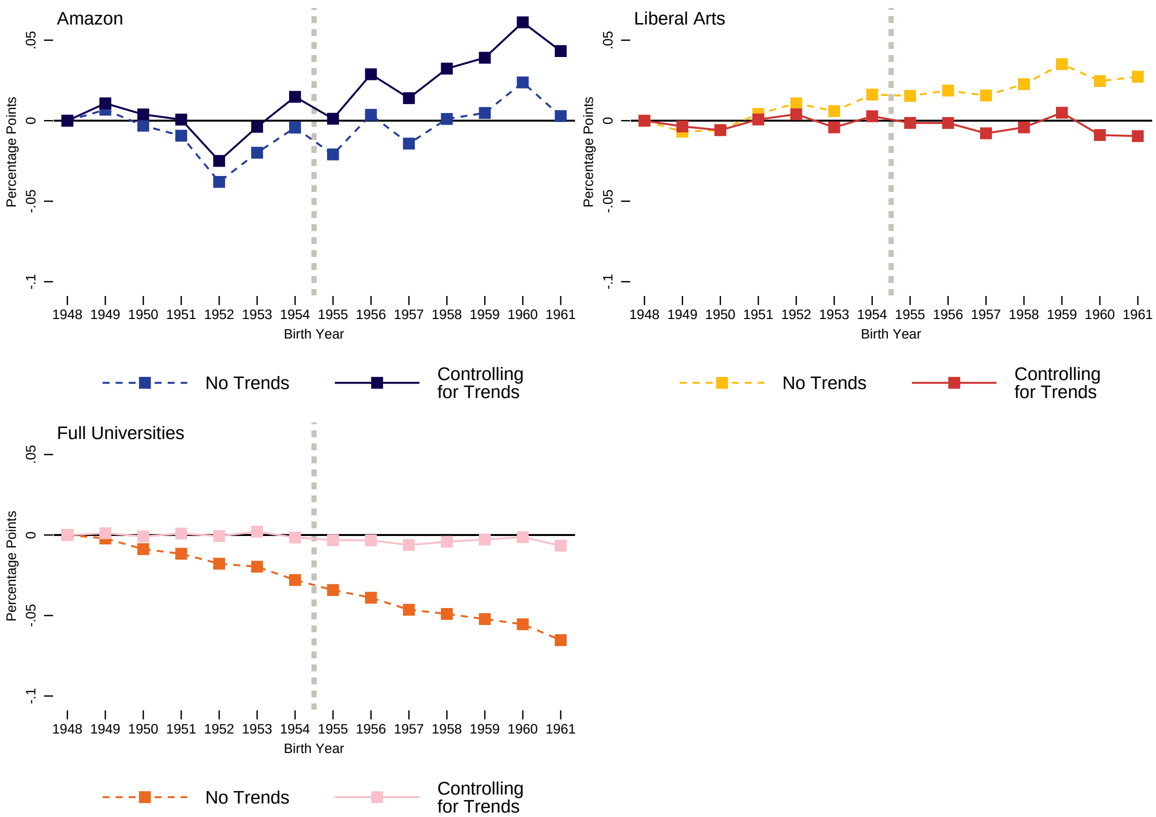
Notes: This figure presents dynamic difference-in-difference estimates of the effect of exposure to the oil boom before turning 18 on the probability of owning a home with more than two rooms in 2010. Dashed lines present conventional difference-in-difference estimates, and solid lines control for linear differential trends. The region without universities is the control, and the estimates omit the 1948 cohort.

Figure I.27: Population Owning a Home of Quality above the Median in 2010 by Birth Cohort



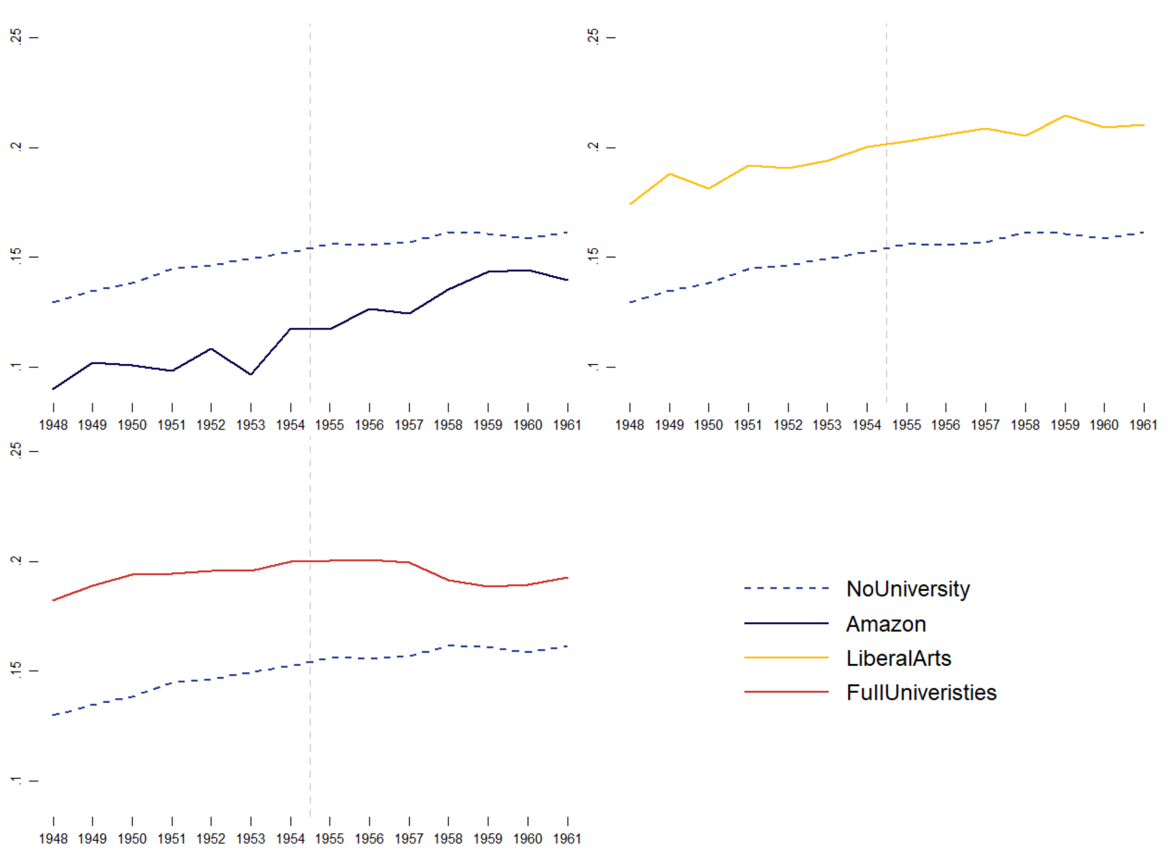
Notes: This figure presents the evolution of the proportion of the population who owns a home of quality above the median of the quality index in Ecuador for the cohorts born in 1948–1961. The data correspond to 2010. The horizontal axis plots the year of birth. The country is divided into four regions depending on the geographic location and type of universities before the oil boom. The cohorts born in 1955–1961 were exposed to the oil boom before turning 18.

Figure I.28: Effects of Exposure to the Oil Boom Before Turning 18 on the Probability of Owning a Home of Quality above the Median



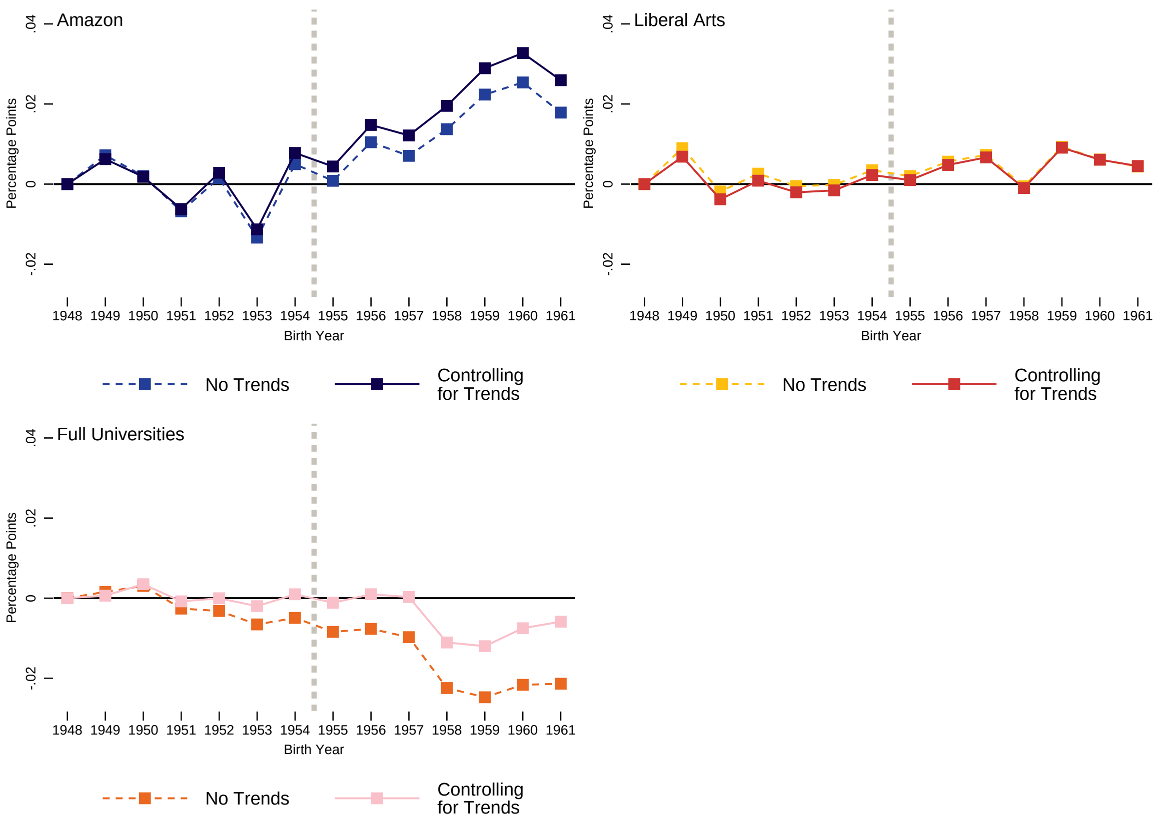
Notes: This figure presents dynamic difference-in-difference estimates of the effect of exposure to the oil boom before turning 18 on the probability of owning a home of quality above the median of the quality index in 2010. Dashed lines present conventional difference-in-difference estimates, and solid lines control for linear differential trends. The region without universities is the control, and the estimates omit the 1948 cohort.

Figure I.29: Population Owning a Vehicle in 2013 by Birth Cohort



Notes: This figure presents the evolution of the proportion of the population who owns a vehicle in Ecuador for the cohorts born in 1948–1961. The data correspond to 2013. The horizontal axis plots the year of birth. The country is divided into four regions depending on the geographic location and type of universities before the oil boom. The cohorts born in 1955–1961 were exposed to the oil boom before turning 18.

Figure I.30: Effects of Exposure to the Oil Boom Before Turning 18 on the Probability of Owning a Vehicle



Notes: This figure presents dynamic difference-in-difference estimates of the effect of exposure to the oil boom before turning 18 on the probability of owning a vehicle in 2013. Dashed lines present conventional difference-in-difference estimates, and solid lines control for linear differential trends. The region without universities is the control, and the estimates omit the 1948 cohort.

Online Appendix J. Event Study Analysis

The evolution of college completion across birth cohorts presented in Figure 3 suggests a second strategy to estimate the effect of exposure to the boom. In the absence of the boom, we should expect that college completion across cohorts follows a constant time process. In other words, we would expect college completion to increase smoothly across birth cohorts. This setting is similar to event studies in the finance literature (MacKinlay, 1997). For example, this approach has been used to quantify deviations from a "normal" return in company returns in finance. The researcher models the constant or mean return in the market to quantify by how much observed returns deviate from the expected return (MacKinlay, 1997).

Following the setup in finance, to estimate the effect of exposure to the boom, we can estimate the constant time process using the older cohorts who were not exposed to the boom before turning 18. I estimate the following equation for individual i born in year t using only cohorts born before 1955

$$y_{it} = \alpha + \beta_1 t + \beta_2 t + u_{it} \tag{J.1}$$

where y_{it} is college completion. Then, I use the estimated time process to predict college completion for the cohorts born since 1995. The effect of exposure to the boom is the difference between observed college completion and predicted college completion. I bootstrap the entire procedure to calculate standard errors and follow the same procedure to estimate the effect on informality, car ownership, and homeownership.

The identifying assumption under this approach is that the estimated time process is a good counterfactual for changes in college completion across birth cohorts in the absence of the oil boom. That is, predicted college completion from the time process has the role the comparison group has in a traditional difference in differences design. Predicting the time process involves more assumptions than a difference in differences design with a comparison group. However, in this case, the finance-like event study approach is a helpful robustness check since we would expect college completion to evolve smoothly in the absence of the boom. Moreover, if the regions without universities are a comparison group in the primary estimation strategy, the aggregate effect estimated by the finance-like event study should be an average of the effects I estimate across regions using the difference in differences design.

Table J.19: Effects of Exposure to the Oil Boom Before Turning 18 on College Completion - Event Study

	Not Exposed Cohorts							
	1948	1949	1950	1951	1952	1953	1954	
Effect	-0.001	0.002	-0.001	-0.001	0.000	0.001	0.000	
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	
	Exposed Cohorts							
	1955	1956	1957	1958	1959	1960	1961	1955-1961
Effect	-0.005	-0.006	-0.016	-0.026	-0.035	-0.045	-0.047	-0.027
	(0.002)	(0.003)	(0.004)	(0.005)	(0.007)	(0.008)	(0.011)	(0.006)

Notes: This table presents the effect of exposure to the oil boom before turning 18 on the probability of completing college. The first seven columns present the effect for each cohort. The last column shows the average of these effects across cohorts using population as weights. Heteroskedastic robust standard errors are in parentheses. The sample includes 1,711,538 individuals.

This suggests that the aggregate effects should be slightly smaller than the effect on the region with full universities.

Appendix Table J.19 presents the event study estimates for college completion. For the cohorts who turned 18 before the oil boom, the point estimates are small and insignificant. For the exposed cohorts, the estimates are slightly smaller than the effects estimated for the region with full universities presented in Figure 7 and follow the same pattern. Younger cohorts are more affected. The average effect is 2.6 percentage points, slightly smaller than the average effect for the cities with full universities.

Appendix Table J.20 presents the event study estimates for informal employment. Again, the estimates for the exposed cohorts are very similar in magnitude to the estimates for the full university regions presented in Figure 8.

Appendix Table J.21 presents the event study estimates for homeownership. For owning a house with more than two rooms, the estimates are similar to the main results reported in Figure 9. The point estimates are small and insignificant, similar in magnitude to the main results. For owning a house of quality above the median of the quality index, the event study estimates are negative and significant, in contrast to the main results in Table 5 that

Table J.20: Effects of Exposure to the Oil Boom Before Turning 18 on Informal Employment - Event Study

	Not Exposed Cohorts							
	1948	1949	1950	1951	1952	1953	1954	
Effect	-0.001	0.000	0.003	0.000	-0.002	-0.001	0.001	
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	
	Exposed Cohorts							
	1955	1956	1957	1958	1959	1960	1961	1955-1961
Effect	0.002	0.008	0.013	0.014	0.016	0.019	0.014	0.013
	(0.003)	(0.004)	(0.006)	(0.008)	(0.010)	(0.013)	(0.016)	(0.009)

Notes: This table presents the effect of exposure to the oil boom on the probability of working informally informally in 2012. The first seven columns present the effect for each cohort. The last column shows the average of these effects across cohorts using population as weights. Heteroskedastic robust standard errors are in parentheses. The sample includes 1,711,538 individuals.

suggested negligible effects.

Appendix Table J.22 presents the event study estimates for vehicle ownership. The point estimates are small and statistically insignificant. Like the main results in Figure 10, the confidence intervals rule out meaningful effects.

In conclusion, the event study estimates are very similar to the difference in difference estimates reported in the main paper. The only meaningful differences are the results on owning a house of quality above the median of the quality index that suggest a negative effect. Since the event study requires stronger assumptions than the difference in differences design, this difference does not necessarily imply that the boom caused a reduction in quality homeownership. However, more caution should be taken when interpreting the results on homeownership.

Table J.21: Effects of Exposure to the Oil Boom Before Turning 18 on Home Ownership - Event Study

	a. Owning a house with more than two rooms							
	Not Exposed Cohorts							
	1948	1949	1950	1951	1952	1953	1954	
Effect	-0.001	0.007	-0.010	0.007	-0.001	0.001	-0.001	
	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	
	Exposed Cohorts							
	1955	1956	1957	1958	1959	1960	1961	1955-1961
Effect	0.000	0.000	-0.005	-0.005	-0.008	-0.018	-0.015	-0.008
	(0.003)	(0.005)	(0.007)	(0.010)	(0.013)	(0.016)	(0.020)	(0.011)
	b. Owning a house of quality above the median of the quality index							
	Not Exposed Cohorts							
	1948	1949	1950	1951	1952	1953	1954	
Effect	-0.001	0.007	-0.010	0.006	0.000	0.001	-0.001	
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	
	Exposed Cohorts							
	1955	1956	1957	1958	1959	1960	1961	1955-1961
Effect	-0.005	-0.005	-0.015	-0.020	-0.024	-0.045	-0.045	-0.024
	(0.003)	(0.004)	(0.006)	(0.009)	(0.011)	(0.014)	(0.018)	(0.009)

Notes: This table presents the effect of exposure to the oil boom on the probability of owning a home with more than two rooms (Panel a) and on the probability of owning a home of quality above the median of the quality index. Home ownership is measured in the 2010 census. The first seven columns present the effect for each cohort. The last column shows the average of these effects across cohorts using population as weights. Heteroskedastic robust standard errors are in parentheses. The sample includes 1,287,721 individuals.

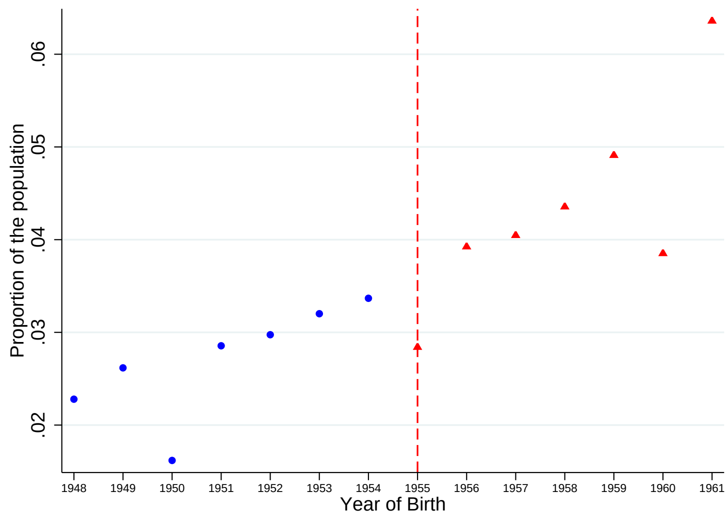
Table J.22: Effects of Exposure to the Oil Boom Before Turning 18 on Vehicle Ownership - Event Study

	Not Exposed Cohorts							
	1948	1949	1950	1951	1952	1953	1954	
Effect	-0.001	0.002	-0.001	0.001	-0.001	-0.001	0.001	
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	
	Exposed Cohorts							
	1955	1956	1957	1958	1959	1960	1961	1955-1961
Effect	0.001	0.001	0.001	0.001	0.001	-0.001	0.003	0.001
	(0.002)	(0.003)	(0.004)	(0.006)	(0.008)	(0.010)	(0.012)	(0.006)

Notes: This table presents the effect of exposure to the oil boom on the probability of owning at least one vehicle in 2013. The first seven columns present the effect for each cohort. The last column shows the average of these effects across cohorts using population as weights. Heteroskedastic robust standard errors are in parentheses. The sample includes 1,711,538 individuals.

Online Appendix K. College Completion in Indonesia

Figure K.31: College Completion by Birth Cohort in Indonesia



Notes: This figure presents the evolution of college completion for the cohorts born in Indonesia between 1948 and 1961. The cohorts born between 1955 and 1961 (red triangles) turned 18 during the 1970s oil boom. This figure uses data from a 10 percent random sample of Indonesia's 2010 population census (Minnesota Population Center). The drops correspond to birth years that are multiples of five. Individuals with low education round their age/year of birth to the closest multiple of five. This rounding happens in self-reported data sets from several developing countries.