A BLESSING OR A CURSE? THE LONG-TERM EFFECT OF RESOURCE BOOMS ON HUMAN CAPITAL

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August 2019

Abstract

Resource booms may reduce human capital accumulation. These booms can increase the opportunity costs of education by favoring low-skill jobs, which makes it optimal for individuals to interrupt their education. If so, pecuniary and non-pecuniary benefits of education can be lost. I use 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 cost of college attendance, I find that exposure to the boom decreased college completion, increased low-skill occupations and had no long-term effects on wealth accumulation.

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

Keywords: Resource booms, Development, Long-term effects, Educational attainment, Wealth

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The author is grateful for comments from Steve Puller, Jason Lindo, Ragan Petrie, Joanna Lahey, and Simon Cueva, as well as the participants of the Texas A&M University Applied Microeconomics Brown Bag Seminar, APPAM Student Conference 2017, SEA 2018 and ASSA/AEA 2019.

1 Introduction

Is resource abundance a blessing or a curse for a country? A priori, we would expect that natural resources boost economic development, but, since the work of Sachs and Warner (1999, 2001), there is ample suggestive evidence that resource-rich countries tend to underperform in several dimensions.[1] Of particular concern is the possibility that resource booms reduce human capital accumulation. These booms are shocks that affect labor market conditions making low-skill occupations more attractive.[2] In this sense, resource booms increase the opportunity cost of education, and some individuals find it optimal to drop out of high school/college and enter the workforce.

However, it is not clear whether these effects are temporary or permanent. On the one hand, if individuals anticipate that the resource boom is temporary, they could plan to return to school at a later date. On the other hand, as time passes, life events impose costs on returning to school, and the time horizon for the returns of education to realize decreases. These two 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.

In this paper, I use proprietary individual-level data to document the long-term effect of the 1970s' oil boom on educational attainment. In 1973, Ecuador started oil production, and its price 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 targeted to highway spending, electricity and agriculture infrastructure, and subsidies (Acosta, 2006;

[1] There is a large literature that documents a negative cross-country correlation betwen resource abundance and economic growth (Sachs and Warner, 1999, 2001; Gylfason, 2001; Torvik, 2002; Papyrakis and Gerlagh, 2004, 2007; James and Aadland, 2011). More recent evidence suggests that the apparent negative correlation between resources and economic growth was the product of endogenous measures of resource abundance (Stijns, 2006; Smith, 2015). There is also country-level evidence that natural resource abundance is negatively correlated with educational attainment (Gylfason, 2001; Papyrakis and Gerlagh, 2004, 2007), although these results are sensitive to different measures of resource abundance (Stijns, 2006). See Van der Ploeg (2011) for a review of this literature.

[2] There is evidence that labor demand shocks from "fracking" favor the less educated (Bartik et al., 2017; Kearney and Wilson, 2017). In cases where the state owns mineral rights, government policies can facilitate the development of low-skill, labor-intensive occupations (De La Torre et al., 2015).

World Bank, 1979a). These expenditures lowered the cost of starting new business on commerce and construction in the entire country, which increased the productivity of low-skill jobs by 93 percent and shifted employment in the country to these occupations. (World Bank, 1979a). This shift suggests that the opportunity cost of college attendance increased, making it less appealing to attend college. I estimate the reduced form effects of exposure to this shock on college completion measured 40 years after the boom.

I use an intensity difference-in-differences design that compares changes in college completion across cohorts who turned 18 before and after 1973, to changes in college completion across geographic regions with different costs of college attendance.[3] I compare cohorts who by 1973 had already decided to go to college or not to cohorts who were still in high school and thinking about going or not to college. Also, I show that differences in costs of attending college across regions imply that shocks that increase the opportunity cost of education affect these regions differently. Theoretically, individuals go to college when its benefits are higher than its costs. Lower costs allow students with lower ability and income to go to college. Hence, the marginal student who attends college from regions with low costs should have less ability and income than the marginal student from regions with high costs. This difference makes regions with low costs more sensitive to shocks that increase the productivity of low-skill jobs. Thus, exposure to the oil boom should affect college completion more in regions with low costs than in regions with high costs.

In Ecuador during the 1970s, differences in the costs of attending college stemmed from the fact that universities were located only in five cities, with the two largest cities concentrating college supply.[4] This fact, 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 regions with universities. Hence, regions without universities should be the least affected by the boom and constitute the

[3] Jäger et al. (2019) use a similar cohort and region-based approach to estimate the effect of unemployed insurance on job separations.

[4] No new universities opened around the time of the oil boom, and most universities were public and free at the time. I use the terms *college* and *university* interchangeably.

baseline group. This design recovers the change in college completion in the regions with universities over the change of college completion in regions without universities.[5] Thus, as long as the oil boom negatively affects college completion in the baseline regions, I recover a lower bound of the real effect.

The results show that exposure to a resource boom decreased completed educational attainment. Consistent with the theoretical predictions, exposure to the oil boom had heterogeneous effects across regions. College completion decreased the most in the cities that concentrated the majority of universities at the time. 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 unobserved shock, it would attenuate the estimates on college completion.

The long-term reduction of college completion is consistent with a model of rational individuals who stopped their educational attainment in response to lower returns of education in the long-run. I provide four pieces of evidence supporting this mechanism. First, if the oil boom increased the returns of education in a region, then completed educational attainment should have increase there. In the Amazon region, the boom had a direct positive effect on connectivity and local income because the oil fields are located there. Hence, the oil boom plausibly increased the returns of education in this region. Consequently, exposure to the oil boom increased college completion by 4.5 percentage points (58.5 percent of the baseline).

Second, the shift in employment towards low-skill jobs lasted long after the boom. Employment in commerce, low-skill services (food preparations, repairs, transportation, housekeeping), construction, and other low-skill occupations increased from 25.2 percent in 1962 to 39.4 percent in 1982 and 55.5 percent in 2010, while employment in manufacturing industries decreased from 13.6 percent in 1962 to 12.6 percent in 1982 and 10.1 percent in 2010. Third, consistently with these shifts in employment and the effects of the boom on college completion, I find that in the cities with full universities, exposure to the oil boom

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

before turning 18 increased the likelihood of working informally in 2012 by 0.8 percentage points (1.9 percent of the baseline) and decreased this probability by 1.7 percentage points (3 percent of the baseline) in the Amazon region.

Finally, the literature on the returns of education implies that educational attainment should have translated into lower wealth accumulation. However, 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. Also, 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). These results indicate that adverse effects on wealth were limited, which together with the previous three pieces of evidence suggest that the oil boom induced a long-term reduction of the returns of education, and it was optimal for the exposed cohorts to interrupt their educational attainment.

This study's findings contribute to two different strands of literature. The first literature documents the effect of resource booms on outcomes related to growth and living conditions. Part of this literature documents the effect of resource shocks on educational attainment, finding that exposure to resource booms decreased high school enrollment in resource-rich areas in the short-term (Black et al., 2005b; Cascio and Narayan, 2017) but have no effect on self-reported completed educational attainment (Emery et al., 2012). Other studies consider the effect 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 education (Løken, 2010; Løken et al., 2012), (iv) effect of income on health spending (Acemoglu et al., 2013); and (v) public expenditure and corruption (Caselli and Michaels, 2013).

My study contributes to this literature in two ways. First, this paper addresses data limitations that usually prevent studying long-term effects in both 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 educational attainment. These biases particularly limit our ability to detect negative effects. By addressing these issues, I document that exposure to a resource boom can decrease college completion in the long-term, a new result in the literature. Second, the Amazon region's case suggests a policy mechanism to counter the negative effect of a resource boom on educational attainment. Policymakers can use part of the windfall from the boom to reduce the costs of attending college.

Finally, in assessing the long-term effects of resource booms on educational attainment and wealth, this study joins the broader literature examining the impacts of changes in short-run opportunity costs on educational attainment and labor markets. Previous studies have analyzed 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 broader 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. As developing countries depend heavily on natural resources, this result has significant implications for their growth potential. From an individual perspective, while the estimates suggest no long-term effect on wealth accumulation, they do not account for losing positive externalities of education. In particular, I find that exposure to the oil boom before turning 18 increased the number of children in the cities with full universities by 0.04 (1.7 percent of the baseline). This estimate, together with no apparent effect on wealth, suggests fewer resources per children that together with less-educated parents may have affected their development. From the country's perspective, lower human capital levels may constrain the development of high-skill industries (Becker and Woessmann, 2010; Becker et al., 2011), which may hamper the country's long-term growth potential.

2 Stylized Facts about the Ecuadorian Oil Boom

In the early 1970s, Ecuador found oil in its Amazon region and began extracting it in 1972-1973. 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. Oil output increased from 0 to 28.6 million barrels in 1972 and 76.2 million barrels in 1973, stabilizing around this level in the rest of the decade.[6] In 1974, oil's price raised from $4.20 per barrel to $13 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 e). Oil became a major source of fiscal revenue because, in Ecuador, the state owns all mineral rights and is the main actor in the oil industry (Figure 1 Panels c and d). From 1973 to 1980, oil represented 34 percent of total fiscal revenue, up from almost zero in the previous decade. Non-oil tax revenue share decreased from 93.7 percent of total revenue in 1971 to 64.6 percent in 1980.

[Figure 1 about here.]

The government channeled these funds to new expenditures. According to Ecuador's Central Bank, government expenditures, mainly personnel expenses, increased 659 percent from 1972 to 1980. Capital expenditures grew 603 percent. The government focused these 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, 1979b).[7] The government also financed interest rate subsidies for certain sectors; price controls on agricultural products; and subsidies on gasoline and other fuels (World Bank, 1979a; Cisneros et al., 1988; Acosta, 2006). All these transfers grew 851 percent from 1972 to 1980. Also, the abundance of oil funds facilitated an implicit transfer in the form of lax tax collection efforts.

[6] At the beginning of the twentieth century, Ecuador found small oil deposits in its coastlands. The government leased this field to the Anglo-Ecuadorian Oil Company (now part of British Petroleum), who only paid taxes on its profits. Official statistics do not include output nor revenue from this field.

[7] In contrast to Indonesia's case (Duflo, 2001), spending on education infrastructure was minimal.

Notably, the oil boom did not lead to an increase in the industrial sector's share in the economy. Until 1965, Ecuador's economy relied heavily on agriculture, in particular growing products for export. In 1965, the country followed the rest of Latin America and adopted a series of policies to promote growth in the industrial sector by replacing imports of manufactured products with local production (Larrea, 1989; Acosta, 2006). Ecuador maintained these policies throughout the 1970s. However, these policies were not effective in expanding the manufacturing sector. According to the World Bank (1979b), the manufacturing sector's share of real GDP barely increased from 17 percent in 1970 to 18 percent in 1977. 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).[8]

We may think that employment in the manufacturing sector fell due to the adoption of capital-intensive technologies 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-skill non-agricultural sectors increased 93 percent, from $806 to $1,556. Labor productivity of low-skill jobs increased after the oil boom because subsidies and price controls lowered the relative cost of capital in these occupations. For instance, it was cheaper to purchase small machinery (cooking appliances, drink dispensers, sewing machines) and vehicles than before the oil boom. Higher productivity implies higher earnings for people who worked in commerce, construction, and low-skill services. Consequently, individuals would have had the incentive to work in occupations with lower skill requirements.

[Figure 2 about here.]

Unfortunately, there is no income data in Ecuador for the 1970s to look for a change in low-skill earnings directly. To address this limitation, I use a revealed preference approach. If the oil boom made low-skill jobs more appealing by increasing earnings, then people would

[8] In 1965, Ecuador also started an agrarian reform to redistribute land from large landowners to their workers. This reform was not effective (World Bank, 1979b). In 1975, it distributed only 16 percent of the allocated land to 17 percent of the potential beneficiaries.

have chosen to work in those occupations. Figure 2 uses census data on employment to show that after the boom employment shifted from agriculture to other low-skill sectors, consistent with the increase in productivity. Employment in agriculture decreased 21.7 percentage points between 1962 and 1982, while employment in low-skill occupations increased by 14.1 percentage points and employment in high-skill jobs increased by only 7.5 percentage points.[9] These dynamics suggest that, at least in the short-run, some individuals exposed to the boom in high school might have chosen to forgo a college education. Moreover, the fact that this change in employment's 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.

3 Theoretical Framework

3.1 The Decisions to Drop Out and Return to School

Human capital accumulation models predict that because of the substantial increase in productivity of low-skill jobs due to the oil boom, some individuals may have stopped their education, at least in the short run (Becker, 1964; Black et al., 2005b; Charles et al., 2015). Low skills jobs became more appealing for young adults because of higher income, increasing the opportunity cost of finishing high school/going to college and decreasing the perceived returns of education.

Economic theory does not give a precise prediction of the long-run effect of this type of shock. It is plausible that individuals take advantage of booms to save and return to school in the future. This would imply zero long-run effect on educational attainment. However, age imposes costs on the decision to return to school. The horizon to receive the earnings premium of education decreases with age, and the cost of returning to school may increase. Life events, such as marriage or having children, make it more challenging to go back to school. These costs imply that if the person has been out of school for more than a threshold

[9] Employment increased in governmental "high-skill" jobs (administration, education, health). At that time, teaching did not require a college degree, and there were specialized high schools that trained teachers.

number of years, then the optimal decision is to keep working. This threshold depends on the gap between high skills and low skills earnings. The smaller the difference, the shorter the period when it is optimal to return to school. Also, if agents expect that the natural resource boom will be a permanent shock, then the likelihood of returning to school decreases. Limited information may induce agents to believe that the shock could be long-lasting.

In summary, if natural resource booms have long-term effects on educational attainment is an empirical question. It is important to note that a reduction of completed education should imply a long-term increase in employment in low-skill occupations.

3.2 Heterogeneity across Regions

A homogeneous shock that increases the opportunity cost of education or reduces the returns of education in a country can have different effects across its regions if they have different costs of education. This result follows 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

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

where the first term ($E_t[\Pi_{t+k}|\Lambda_t]$) captures the expected returns of college attendance conditional on all information available Λ_t, the second term ($(1+b)F$) is the direct cost of college attendance (tuition, fees, living costs), the third term ($\kappa(1-\theta_i)$) is the psychological cost of education, and the last term (Y_t^0) is the opportunity cost of college attendance in the form of lost wages. The authors assume that the lifetime value of going to 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.

[Figure 3 about here.]

With this model, I show that a homogeneous shock that increases the opportunity cost

of education or reduces the returns of education in a country can have different effects across its 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 larger in region A than in region B. Now, suppose that both regions are affected by a shock that increases the opportunity cost of college attendance (Y_t^0) or decreases the returns of education ($E_t[\Pi_{t+k}|\Lambda_t]$) homogeneously 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 affected depends on the magnitude of the difference in costs and the shape of Φ_θ. Given the shape of the distribution, the larger the difference in costs, the more likely it is that the cheaper region will be the most affected. Figure 3 presents this result assuming a linear lifetime value of college.

The previous result depends on three factors: (i) significant differences of college attendance costs across regions, (ii) the shape of the ability distribution across regions, and (iii) homogeneous changes in the returns of education across regions. Regarding (i), in Ecuador before the oil boom, universities were concentrated in five cities, increasing the costs of attending college for the rest of the country (see Section 5.2). For (ii), before the oil boom, only 9 percent of the population in regions without universities attended college, which increases to 20 percent in regions with universities. These rates imply that in the entire country, only the right tail of the ability distribution attended college, and only individuals with very high ability from regions without universities went to college. These differences suggest that regardless of the shape of the ability distribution, the marginal student who went to college from a region without universities had higher ability than the marginal student who went to college from a region with universities. Finally, regarding (iii), while the oil boom was a national level shock, government expenditures concentrated in the largest cities, which also had the universities (World Bank, 1979b). This fact suggests that the opportunity cost of college attendance might have increased more in these cities, leading to a more substantial decrease in college attendance than in regions without universities.

The Ecuadorian setup suggests that the marginal student from high-cost regions had substantially higher ability and income than the marginal student from low-cost regions. Thus, the marginal student from high-cost regions should have been less sensitive to shocks that increase the productivity of low-skill jobs. Hence, exposure to the oil boom should have affected college completion less in regions with high costs than in regions with low costs. I use this result to define the base region to estimate the effects of exposure to the 1973 oil boom with an intensity difference-in-differences design.

4 Data

I have access to proprietary data from a financial services company in Ecuador. This company collects comprehensive demographic data of the adult population in the country.[10] I observe gender, year of birth, marital status, number of children, canton of birth,[11] canton of residence, highest completed education level, type of occupation, income for employees, and car ownership. Also, I use homeownership data from Ecuador's 2010 Population Census.[12] 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 before turning 18.

Ideally, to adequately control for life-cycle fluctuations, we would be able to observe these cohorts at different points in time when they have the same age. However, the demographic information corresponds to 2014, car ownership to 2013, labor market data to 2012, and homeownership to 2010. This concern is not likely to alter the results because the observed outcomes should be determined for these cohorts. For instance, the probability of owning a house should not depend on age for these individuals, given that they were between 49 and

[10] Sources include banks, other financial institutions, and web scrapping to fill gaps. Credit applications collect demographic information from Ecuador's national identification cards.

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

[12] 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 from Ecuador's population censuses of 1962, 1974, and 1982 to construct the labor participation statistics reported in Section 2. These data are reported by the Minnesota Population Center (2017), which collected the data from Ecuador's national statistics agency.

62 years old in 2010. We would expect that most individuals decide to buy a house or not before they turn 49. Also, at 62, individuals are young enough to live independently in their own home, even if they decided to downsize. Hence, homeownership should not be affected by age for these cohorts.[13] Similar reasoning applies to the other outcomes in Table 1.

Table 1 presents descriptive statistics for the full sample. Women were 51 percent of these cohorts, and on average, these individuals were 57 years old in 2014. Table 1 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 individuals 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 1 about here.]

Table 1 also presents labor participation indicators as of 2012.[14] The data have three categories: (i) informal workers, people who work in low-skill occupations, often self-employed, and who are not fully declaring taxes; (ii) employees, who work for a firm and receive a monthly wage; and (iii) professional workers, who are self-employed and registered with the Ecuadorian tax office. More than 50 percent 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. The homeownership rate is close to 80 percent. It is important to note that in developing countries, the quality of housing is a relevant issue. Hence, homeownership decreases to 57 percent if we consider owning a house with more than two rooms. I also combine data from the Census on the type of construction, materials used, water source, type of sewage, and garbage disposal into an index of housing quality. Homeownership of houses above the median of the quality index is 33 percent. There are no substantial differences in homeownership between individuals who turned 18 before and after the boom.

[13] Home value could be changing, but this variable is not present in the data.

[14] In 2012, individuals born in 1948 were 64 years old, below the legal threshold for retirement.

5 The Long-Term Effect of the Oil Boom on Human Capital Accumulation

5.1 Descriptive Analysis

Figure 4 presents the evolution of the highest completed schooling level for individuals born in Ecuador between 1940 and 1961 measured in 2014.[15] For example, if a person dropped high school, then her highest completed education level is primary school. For those born until 1955, the proportion of people with no education or primary education was decreasing, while the proportion of individuals with secondary education or college was increasing.[16] These trends are expected for a developing country.[17]

[Figure 4 about here.]

However, 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 4). Naively, if we extend the pre-1955 cohort trend, Figure 4 suggests that exposure to the oil boom at the end of high school decreased college completion by around two percentage points. As less people completed college, the positive trend of secondary education became steeper, and the negative trend of elementary education flattened. These changes suggest that college completion dropped due to a mix of people who chose not to enter/complete college and people who chose to drop out of high school.[18]

This abrupt change in college completion is consistent with low-skill jobs becoming more appealing because of the oil boom. As discussed in Section 3.1, higher productivity of low

[15] Cohorts born after 1961 are affected by a series of additional shocks: a short war in 1981, the oil bust and a declaration of default in 1982, and an earthquake in 1986 that destroyed the only oil pipeline in the country. These shocks confound each other, so I focus on the effect of 1973 oil boom.

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

[17] Economic conditions were relatively stable until 1973, and the economy grew at an average annual rate of 5.4 percent from 1960 to 1973. A civilian dictator ruled Ecuador from June 1970 to February 1972, who was replaced by a military dictatorship from February 1972 to August 1979. However, this was a peaceful period in contrast with other dictatorships in Latin America. Also, there are no dips in college completion in 1970, 1971, and 1972, which would have been consistent with repression at the beginning of a dictatorship.

[18] Child labor was illegal, but children were allowed to work informally in agriculture or other low-skill jobs.

skill occupations increases the opportunity cost of education, which makes some individuals interrupt high school/college in the short term. If the returns of education decreased in the long-run, the cost of returning to school was increasing in age, or agents believed that the shock was going to last long, then some people could have chosen not to return to school, leading to the drop in college completion observed in 2014.

Figure 4 also shows that there is no change in the trend of people with no education for the cohorts born between 1948 and 1961, suggesting that there were no shocks that affected early educational attainment of these cohorts 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 thinking about going to college. In the next sections, I develop an empirical strategy to rigorously estimate how exposure to the oil boom before turning 18 affected college completion.

5.2 Regional Variation in the Costs of College Attendance

[Figure 5 about here.]

In Section 3.2, I show that if regions in a country have different costs of college attendance, then we should expect that a shock that increases the opportunity cost of education affects college completion more in regions with low costs than in regions with high costs. In Ecuador in the 1970s, geographic differences in these costs stem from the fact that universities were located only in five cities of the country with no new openings in that period (Figure 5). Four universities were located in Quito, the capital, three in Guayaquil, three in Cuenca, and one 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). The rest of the country only had agricultural technical schools.[19]

[19] Only one new technical school opened in 1973. These schools are coded as secondary in Figure 4. Appendix Table A.2 lists all universities and technical school that functioned until 1989.

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 their early 30s, especially while they are still studying.[20] Thus, people born in a city with universities could live with their parents while they studied, significantly lowering the cost of education. These students did not have to rent a place to live (Ecuadorian universities do not offer dorms).

[Figure 6 about here.]

Altitude differences partly determined the distribution of universities in the country and increased transportation costs, which further lowered the cost of attending college for people who lived in cities with universities. The Andes mountains split the country into four regions with dramatic altitude differences (Figure 6 Panel a).[21] For example, near the middle of the country, in a horizontal distance of 190 miles, altitude increases from sea level to 16,000 feet and drops to 800 feet. These sharp differences in altitude increased travel costs within relatively short distances. For instance, travel between the two largest cities in the country in the 1970s took half an hour by airplane or 10 hours by car.

I define four areas with different costs of college attendance combining the location of the universities with the four geographic regions (Figure 6 Panel b). The first area corresponds to regions without universities that had the highest college attendance costs. The second region corresponds to areas of influence of the cities of Cuenca, Loja, and Ibarra that had access to liberal arts colleges. The third region corresponds to the cities of Quito and Guayaquil that had access to full universities and the lowest costs.

The last region corresponds to the Amazon jungle, in the east of the country. While this region did not have universities, it harbors the oil fields. Before the oil boom, the Amazon

[20] 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 people aged 18 to 24. For comparison, Vespa (2017) reports that in 1975, in the United States, 26 percent of adults aged 18 to 34 lived with their parents or in college dorms.

[21] Ecuador has an additional region, the Galapagos that lie 1,000 kilometers of its coast. I do not include this region in the analysis because these islands had almost no native-born population and were isolated from the continent at the time of the oil boom.

region was sparsely populated, and it only had one highway that connected it to the rest of the country. Agriculture, commerce, and other low-skill services concentrated 70 percent of employment in the region. This situation changed dramatically after the oil boom because all the new oil fields that started production in 1973 are there. The government built a new highway from the capital to the Amazon region to access the oil fields, and legally established that municipalities in the Amazon region receive 10 percent of fiscal revenue from oil (Acosta, 2006). . This transfer plus spillovers from the oil industry into the local economy contributed to increasing employment in high-skill occupations from 25 percent in 1962 to 26.8 percent in 1982, the highest change in the country. These two factors suggest that the oil boom might have decreased college attendance costs in the Amazon region compared to the rest of the country that did not have universities.

5.3 Empirical Strategy

To estimate the effect of exposure to the oil boom before turning 18 on college completion, I use an intensity difference-in-differences design that compares changes in outcomes across cohorts of individuals who turned 18 before and after 1973, to changes in outcomes across geographic regions with different costs of college attendance.[22]

To define the baseline group in this comparison, I follow the predictions of the model in Section 3.2. Regions without universities should be the least affected by the oil boom. Appendix Figure A.2 shows that for cohorts who turned 18 before the oil boom, regions without universities had substantially lower levels of college attendance than regions with full universities. Almost 7 percent of the 1948 cohort in these regions completed college, compared to 16 percent of those born in major cities. This gap of 9 percentage points increased to 12 percentage points for the 1954 cohort, who turned 18 right before the boom. These magnitudes suggest that differences in the cost of attendance were large enough such that the marginal

[22] Jäger et al. (2019) use a similar design comparing afected and unaffected cohorts across different regions to estimate the effect of unemployed insurance on job separations in Austria. For other applications of this type of design, see Acemoglu et al. (2004), Gregg et al. (2006), Finkelstein (2007), Baez (2011), and Felfe et al. (2015).

student who attended college from regions without universities had substantial higher ability and income than the marginal student from regions with universities. A similar, although less marked gap, exists between regions with liberal arts colleges and the regions without universities, which is consistent with a smaller difference in the cost of college attendance between these regions.[23]

This design estimates the change in college completion since 1948 in each region over the change observed in the regions without universities. Hence, as long as the oil boom decreased college completion in the baseline region (suggested by Appendix Figure A.2), I recover a lower bound of the real effect. For individual i, born in region r in year t

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

with region and year of birth fixed effects, α_r and α_t. The coefficients θ_{rt} capture the effect of exposure to the oil boom for each cohort. Appendix Figure A.2 shows that regions with universities and liberal arts colleges not only had a higher level of college completion but also had a steeper trend across birth cohorts than regions without universities. These differences in trends are consistent with the differences in college attendance costs across regions. Thus, I control for differential cohort trends in outcomes, $\lambda_r t$. These trends also capture any remaining variation from age differences and the life cycle across cohorts.

Given the need to control for trends, the identification assumption is that in the absence of the oil boom, differences in college completion across regions would have continued on the same trends. Given this assumption, there are two main concerns to interpreting θ_{rt} as the causal effect of exposure to the oil boom before turning 18. Migration across regions due to the oil boom presents the first threat to identifying its effect. Velasco (1988) using data from

[23]For the Amazon region, Appendix Figure A.2 shows that cohorts who turned 18 before the oil boom had lower levels of college attendance than the rest of the country that did not have access to universities. This gap is consistent with the model in Section 3.2 because the Amazon region was very isolated before the oil boom. However, as discussed above, the presence of the oil industry in this region could have plausibly decreased the costs of college attendance after the oil boom. For this reason, I take the Amazon region as a separate region.

the 1962, 1974, and 1982 population censuses, shows that during the oil boom, Quito and Guayaquil received an influx of low-skill immigrants from the rest of the country. Thus, in 2014, the cities with full universities have 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, I assign individuals to regions using their canton of birth.

The second identification challenge is that there could be other shocks that have different effects across cohorts or regions. 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 mechanically decreases the proportion of people who completed college. This shock would bias the estimates downwards. Conversely, the estimates would be biased upwards if college-educated individuals born in cities with full universities after 1955 were more likely to migrate to other countries than older cohorts. To asses if population composition shocks are a concern, I apply a version of McCrary (2008) population density test. This type of shocks would create discontinuities or kinks in the distribution of the population who turned 18 years old around the oil boom, but Appendix Figure A.1 shows that these issues are not present in the data. The trends are almost identical across regions without discontinuities or kinks. These results suggest that shocks related to changes in the population composition 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) find that in models that include fixed effects we should use cluster 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 the 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 research, treatment is turning 18 after 1973. Thus, in the absence of past regional shocks that affect fertility, in any given region the probability that one individual turns 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.

5.4 Results

[Figure 7 about here.]

Figure 7 and Table 2 present the estimates of the effect of exposure to the oil boom before turning 18 on college completion. Figure 7 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 5.2 and disappear after controlling for linear trends. From this point onward, I control for trends in all estimates.

[Table 2 about here.]

Table 2 presents the estimates of the effect of exposure to the oil before turning 18. The first seven columns show the coefficients plotted in Figure 7 for the treated cohorts, born between 1955 and 1961, and the last column averages these effect across cohorts weighting the estimates by population. In all regions, the estimates get larger for the youngest cohorts in the sample. This pattern is consistent with more prolonged exposure to the oil boom, which gives younger individuals more time to see the shift in the labor market towards low-skill jobs and perceive decreasing returns of education. Longer exposure may also bias their

perception regarding the expected duration of the boom. Younger individuals may have been more likely to believe that the boom was a permanent change in the economy.

Regions with full universities were the most affected by the oil boom, which is consistent with the theoretical prediction in Section 3.2. Exposure to the oil boom decreased college completion by 2.9 percentage points for the treated cohorts in these cities. This change represents 12.2 percent of the college completion rate of individuals who turned 18 in 1954.[24]

In contrast, college completion did not significantly change for the region with liberal arts colleges. In this region, universities only offered majors related to law and the humanities, implying that some people still had to move to regions with full universities. This fact suggests that differences in the cost of college attendance between the region with liberal arts colleges and the control were not large enough to drive a significant effect.

The estimates in Table 2 also show that exposure to the oil boom increased college completion in the Amazon region by 4.5 percentage points for the treated cohorts (58.5 percent of the baseline). As mentioned above, this region benefited from connectivity infrastructure and spillovers from the oil industry after the boom, which potentially reduced college attendance costs and increased the returns of education. In line with the framework in Section 3.2, lowers costs are consistent with the increase in college completion in this region.

People who did not attend college should have either dropped out of high school or finished high school but did not enroll in college (Section 5.1). The estimates in Appendix Table A.4 show that the cities with full universities, where college completion decreased, completion of primary and secondary education increased, particularly for the youngest cohorts. In the Amazon region, where college completion increased, primary education completion decreased with no significant effect on completion of secondary education. These changes are consistent with the lower costs of attending college in this region because of the boom. In the region with liberal arts colleges, there is no significant change in primary or secondary education, which is consistent with the absence of an effect on college completion.

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

Appendix Table A.3 presents the effect of exposure to the oil boom by gender. The point estimates for both 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 affected the 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 affected by the increase in low-skill productivity that followed. In the Amazon region, exposure to the oil boom increased college completion 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 on the regions with liberal arts colleges for both genders.

5.5 Further Evidence for the Validity of the Research Design

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

5.5.1 Permutation Exercise

[Figure 8 about here.]

To check if the results are robust to the definition of the regions, I conducted a permutation test. I randomly reassigned individuals to regions and reestimated the effect of exposure to the boom on 10,000 random samples. Figure 8 presents these results. The effects of the boom in the region with full universities and in the Amazon region are clear outliers in the distribution of effects, while the effects in the region with liberal arts colleges are not different from the random estimates. Randomization inference p-values confirm that the effects in the region with full universities and the Amazon region are significant, while there is no significant effect on the region with liberal arts colleges (Appendix Table A.5).

5.5.2 Unobserved Shocks on Early Educational Attainment

As discussed above, the main threat to identification would be the presence of other shocks that had different effects across cohorts or regions. Section 5.3 discusses shocks associated with composition changes across regions and rules out this concern. However, shocks that affect early educational attainment differently across regions could still be a problem.

Two types of shocks would prevent us from interpreting the estimates in Table 2 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 more in cities with full universities than in regions with no universities. If individuals did not complete their primary education, it would be impossible for them to go to college. However, this type of shock seems unlikely, given that cities with full universities were the richest in the country. Second, the same interpretation concern would arise if some policy increased early educational attainment in the Amazon region more than in regions with no universities before the oil boom. For instance, missionaries frequently visited the Amazon region during the 1960s to improve early education, which could have allowed some individuals to go to college.

[Table 3 about here.]

I check if unobserved early education-related shocks affected the probability of not completing any educational level for the treated cohorts. Table 3, Appendix Figure A.3, and Appendix Figure A.4 show these results. Compared to regions without universities, the proportion of people with no education decreased in cities with full universities (1.3 percentage points, 23.4 percent of the baseline) and increased in the Amazon region (5.1 percentage points, 26.9 percent of the baseline). These estimates go in the opposite direction of the hypothesized concerns. These results mean that because of higher early education, more people could 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 in this region. In the Amazon region, fewer people could have gone to college compared to the control because

of lower early educational attainment. This would attenuate the positive effect of the oil boom on college completion in this region. Thus, these results suggest that the estimates in Table 2 are a lower bound of the real effect.

[Figure 9 about here.]

5.5.3 Are the Estimates a Lower Bound of the True Effect?

The results in Section 5.4 capture the change in college completion 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 Appendix Figure A.2, then the estimates are a lower bound of the real effect. However, if exposure to the oil boom had a positive effect in regions without universities, then the estimates in Section 5.4 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 after they turned 24. While 18 percent of naturalized Ecuadorians could have been exposed to the oil boom, Figure 9 shows that there is no change in the level or trend of college completion between foreign-born individuals who turned 18 years old before and after 1973. Thus, it is likely that for the majority of this group, the decision to go to college was not affected by the oil boom.[25]

[Table 4 about here.]

Table 4 presents these results. The estimates follow the same pattern but are two to four times larger than the estimates in Table 2. Cities with full universities are still the most 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,

[25]However, it is also possible that these individuals became Ecuadorians because of the oil boom. This selection could bias the estimates. Particularly, it is not valid to use naturalized Ecuadorians as a control for outcomes related to the labor market and wealth.

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 regions without universities (42.9 percent of the baseline). This effect is similar to that in 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, consistent with the main results. These results confirm that we can take the main estimates in Table 2 as a conservative measure of the true effect.

In this specification, exposure to the oil boom did not affect college completion in the Amazon region. This estimate, together with the main result for this region, and the decrease in college completion in all the other regions, suggests that the presence of the oil industry countered the increase of low-skill productivity that affected the country. As mentioned above, the oil industry may have decreased the cost of college attendance in the Amazon region by 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.

In summary, exposure to the 1973 oil boom before turning 18 caused a drop in educational attainment on those who turned 18 years old after the oil boom. In the next section, I discuss the potential mechanisms behind this long-term reduction in human capital.

6 Potential Mechanisms behind the Long-term Reduction in Educational Attainment

The results in Section 5 provide quasi-experimental evidence that a natural resource boom can cause a permanent decrease in completed educational attainment. However, the theoretical discussion in Section 3.1 implies that there could be more than one mechanism behind this effect. On the one hand, lower completed educational attainment could have been the result of a rational decision, if the increase of low-skill earnings was large to compensate for the loss of human capital accumulation over a person's lifetime. Also, the temporary resource boom

could have created a permanent shift in the structure of the economy towards low-skill 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.

On the other hand, lack of information or present-biased preferences could have made individuals overstate the expected duration of the boom, and when myopic agents realized that the boom ended, age-related costs may have prevented them from resuming their education (Sutter et al., 2013; Castillo et al., 2011; 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".

To bring light on the mechanism, in this Section I discuss four results: (i) the effects of college completion in the Amazon region, (ii) descriptive shifts in employment from 1962 to 2010, (iii) the effect of exposure to the oil boom of working in low-skill occupations, and (iv) the effect of exposure to the oil boom on wealth.

6.1 College Completion Increased in the Amazon Region

Section 5.4 shows that exposure to the oil boom before turning 18 increased college completion in the Amazon region. As discussed in Section 5.2, this is the only region in Ecuador where the oil boom plausibly had a positive effect on jobs that require higher skills because of spillovers from the oil industry. Thus, the returns of education may have increased after the boom in this region. Thus, rational individuals would increase their educational attainment.

6.2 The Structure of the Labor Market Shifted to Low-skill Occupations

As discussed in Section 2, the oil boom led to an increase in productivity of low-skill occupations (93 percent between 1972 and 1975) because oil revenue enabled the government to finance subsidies and price controls that lowered the cost of starting small businesses related to commerce and construction (World Bank, 1979a). As a consequence, Figure 2 shows that

employment composition in Ecuador changed after the oil boom. Employment in commerce, low-skill services (food preparations, repairs, transportation, housekeeping), construction, and other low-skill occupations increased from 25.2 percent in 1962 to 33.44 percent in 1982, while employment in manufacturing industries decreased from 13.6 percent in 1962 to 12.6 percent in 1982. More generally, Figure 2 shows that after the oil boom employment mainly shifted from agriculture to low-skill services. Employment in agriculture decreased 21.7 percentage points between 1962 and 1982, while employment in low-skill occupations increased by 14.1 percentage points and employment in high-skill jobs increased by only 7.5 percentage points in jobs provided by the government (public administration, health, and education).

This composition change in employment did not revert nor switch to high-skill occupations after the oil boom. Low-skill jobs importance in the economy grew until 2010. Figure 2 shows that agriculture's share in employment decreased until 2010, which is expected for a developing country as it improves living conditions. However, employment shifted to low-skill services and not to occupations that require higher skills. In particular, in 1982 the share of non-agriculture low-skill jobs was 39.4 percent and increased to 55.5 percent in 2010, while the share of high-skill occupations decreased from 25.8 percent to 22.8 percent in the same period. These changes suggest that the oil boom changed the structure of the labor market by enhancing the importance of low-skill jobs. This change would decrease the returns of education in the country in the long-run and should result in a higher likelihood of employment in low-skill jobs for the treated cohorts.

6.3 Are Long-term Labor Market Effects Consistent with the Changes in Educational Attainment?

[Table 5 about here.]

The theoretical discussion in Section 3 implies that a long-term reduction in educational attainment should come in hand with a long-term increase in the probability of working in low-skill jobs. This response should be more marked if employment in the country shifted

towards these occupations. Ideally, I would estimate the effect of exposure to the oil boom on the probability of working on these jobs, but the available data do not report specific occupations. The data have an aggregate measure that classifies an individual as an "informal" worker in 2012 if at least one of the three following conditions holds: (i) she works in a low-skill job (as an employee or self-employed); (ii) she is retired; or (iii) she has working age but is not registered with the Ecuadorian tax office. 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 still active in the labor market. In that year, those individuals born in 1948 were 64 years old, below the legal threshold for retirement. I estimate the effect of exposure to the oil boom on this measure of informality.

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) in the cities with full universities and decreased this probability by 1.7 percentage points (3 percent of the baseline) in the Amazon region (Table 5, Appendix Figure A.5, and Appendix Figure A.6). There is no statistically or economically significant change in the probability of working informally in 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 market-oriented to low-skill jobs.[26]

6.4 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 have translated into lower levels of wealth, absent a change in the returns of education.

[26] 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. While there is a gap in earnings, 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 of individuals who work formally as employees in companies. The fact that exposure to the oil boom increases the probability of working informally in some regions implies that I would need to account for sample selection to estimate the effect of the oil boom on earnings of employees. However, the fact that informal employment decreases for the Amazon region violates monotonicity across regions. Hence, I cannot use bounding procedures as in Lee (2009) to account for selection in the sample.

However, if wealth is not affected in the long-run, this would be consistent with rational individuals optimally choosing to stop their education because low-skill earnings compensated lower human capital accumulation. I proxy wealth through homeownership in 2010 and vehicle ownership in 2013.

In developing countries, the quality of housing is a relevant issue to determine wealth. Commonly, poor households 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 for those born in 1948-1961, but it does not necessarily reflect wealth. To better capture wealth, I follow two approaches. First, I estimate the effect of exposure to the oil boom on the probability of owning a house with more than two rooms. Second, I construct an index of housing quality combining data on the type of construction; materials used in floors, walls, and ceilings; water source; type of sewage; and garbage disposal. 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 higher wealth.

As mentioned in Section 4, fluctuations from the life-cycle could be a potential concern. Specifically, home quality could be more likely to depend on age. Regarding this potential concern, the first indicator captures owning a house with more than two rooms overall, meaning owning a home with at least a kitchen and another room. Even if individuals downsize as they age, it is not likely that they would choose to decrease their living standard drastically to owning only one room. The second indicator captures quality based on construction type and access to basic services. While these home traits could improve with age, including cohort trends that capture life-cycle fluctuations attenuates this concern.

[Table 6 about here.]

Exposure to the oil boom did not affect homeownership in the regions with full universities (Table 6 and Appendix Figures A.7, A.8, A.9, and A.10). Panel (a) shows that 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), not significant

at conventional levels. The standard errors rule out effects larger than two percentage points in any direction (3 percent of the baseline). There is no significant effect on the region with liberal arts colleges. Panel (b) shows similar results in terms of the effect of exposure to the oil boom on the probability of owning a house of quality above the median of the quality index.

In the Amazon region, where college completion increased, Panel (a) shows that treated cohorts have a higher likelihood of owning a house with more than two rooms (1 percentage point, 1.8 percent of the baseline). In this region, the points estimates are imprecise and fluctuate across cohorts. In Panel (b), exposure to the oil boom before turning 18 increased the probability of owning a house of quality above the median by 3.3 percentage points (17 percent of the baseline). These results are consistent with higher educational attainment in this region.

[Table 7 about here.]

Table 7, Appendix Figure A.11, and Appendix Figure A.12 show that exposure to the oil boom before turning 18 did not affect on the probability of owning at least one vehicle in cities with full universities. For the treated cohorts, exposure to the oil boom decreased the probability of owning a vehicle by 0.5 percentage points (2.8 percent of the baseline). The point estimates are small and statistically indistinguishable from zero. For the Amazon region, the point estimates are imprecise but 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), again in line with the effects on educational attainment.

In summary, the four pieces of evidence together suggest that the long-term reduction in educational attainment is consistent with a model of rational individuals who reduce their educational attainment in response to lower returns of education in the long-run. The long-term reduction in human capital, together with no significant change in wealth is consistent with the hypothesis that the oil boom changed the structure of the Ecuadorian labor market by enhancing the importance of informal low-skill jobs.

7 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-run. The results indicate that educational attainment decreased without affecting wealth accumulation. This finding is consistent with a model of fully informed rational individuals who reduce their educational attainment in response to a shock that decreases the returns of education.

The results suggest that fiscal policy has role in the propagation of natural resource shocks, in particular in cases where the state owns resource rights. The long-term reduction in educational attainment in Ecuador is consistent with policies that increased low-skills productivity at the time and were applied again in Latin America in the resource boom in the 2000s. De La Torre et al. (2015) find descriptive evidence that low-skill productivity increased in resource-rich Latin American countries during the commodity price boom, driven by public spending policies similar to the ones Ecuador implemented in the 1970s.[27] Thus, the latest resource boom might have decreased completed education in Latin America.

Also, it is plausible that policies that increase productivity in high-skill occupations produce a different effect. The case of Indonesia, another oil producing developing country, gives suggestive evidence in this direction. During the 1960s and 1970s, the Indonesian government started promoting industrialization to increase exports of manufactured goods (Elias and Noone, 2011). Also, Indonesia invested in education infrastructure (Duflo, 2001). Appendix Figure A.15 shows that there is no drop in college completion after the oil boom. There is an increase in the trend for those individuals who turned 18 years old after the oil boom. More studies are needed to fully understand how fiscal spending can modulate the effects of natural resource booms. Evaluating the counterfactual of what would have happened if the exposed cohorts completed more education and received the effects of the oil

[27] 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.

boom is an important question for future research.

Given these results, can we tell if natural resources a blessing or a curse? The estimates suggest that those individuals who turned 18 years old after the oil boom did not fare worse than their older peers regarding wealth accumulation. However, the drop in educational attainment caused by the oil boom could decrease social capital and civic engagement (McMahon, 2010; Dee, 2004; Milligan et al., 2004; Huang et al., 2009), have adverse effects on health (Silles, 2009; Brunello et al., 2016), affect safety in the country (Lochner and Moretti, 2004; Groot and van den Brink, 2010; Buonanno and Leonida, 2009), and negatively affect the well-being of the next generation (Behrman and Rosenzweig, 2002; Currie and Moretti, 2003; Mine Güneş, 2015). These factors can constrain a country's long-term growth potential. To preview these potential negative consequences, Appendix Table A.6, Appendix Figure A.13, and Appendix Figure A.14 present the effect of exposure to the oil boom on the number of children per person.[28] Exposure to the oil boom increased the number of children by 1.7 percent of the baseline in cities with full universities. This result and the fact that wealth did not decrease may imply fewer resources per children, which may lower their educational attainment and other future outcomes. In the Amazon region, exposure to the oil boom decreased the number of children by 4.5 percent of the baseline.

From a macroeconomic perspective, the results indicate that the oil boom decreased Ecuador's stock of human capital and may have affected its capacity to accumulate human capital for the next generation, which constrains the country's long-term growth potential. There is evidence that the drop in educational attainment can constraint the development of high-skill industries (Becker et al., 2011; Becker and Woessmann, 2010). Hence, a resource boom may not be a curse regarding individual wealth, but it can be a curse for society in the form of lost growth potential.

[28]There is no effect on the extensive margin of having children nor on the probability of never marrying.

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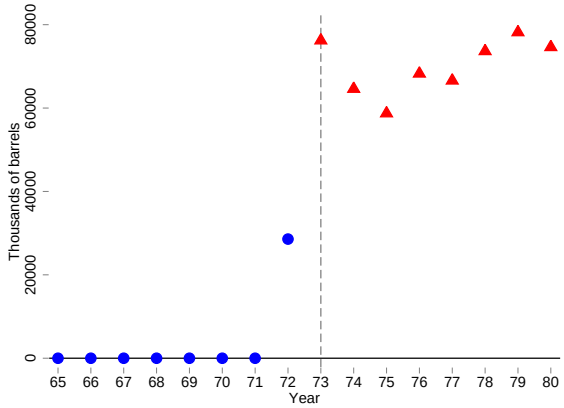
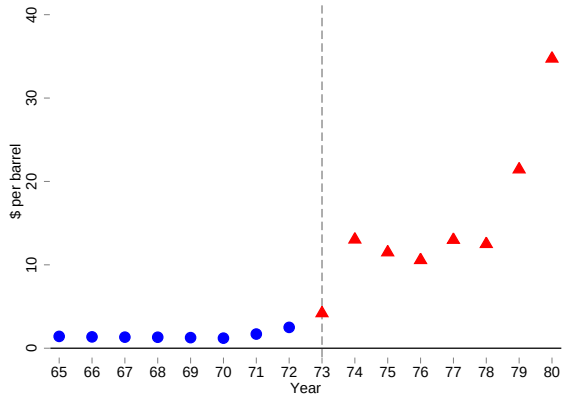
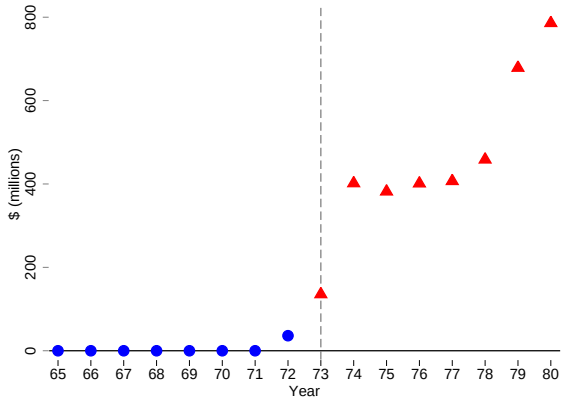
Figure 1: Oil Output and Price



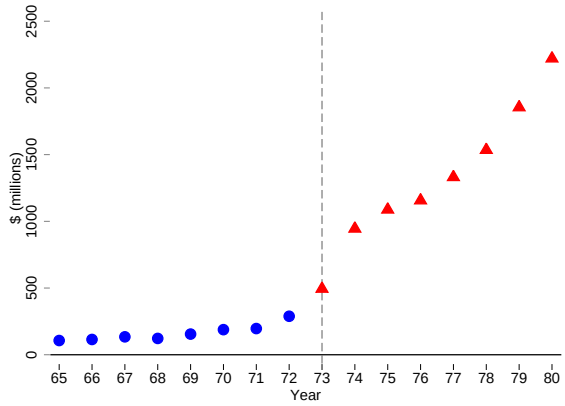
(a) Oil output



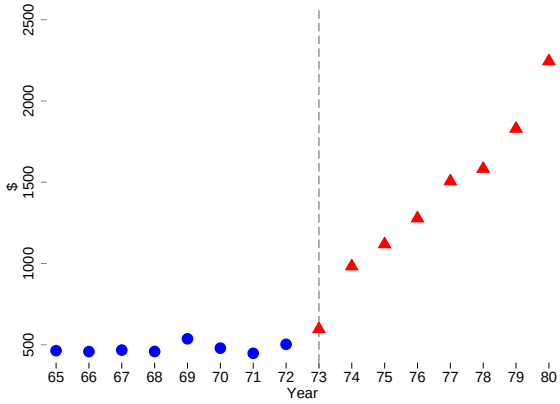
(b) Price ($ per barrel)



(c) Government's Revenue (Millions of $)



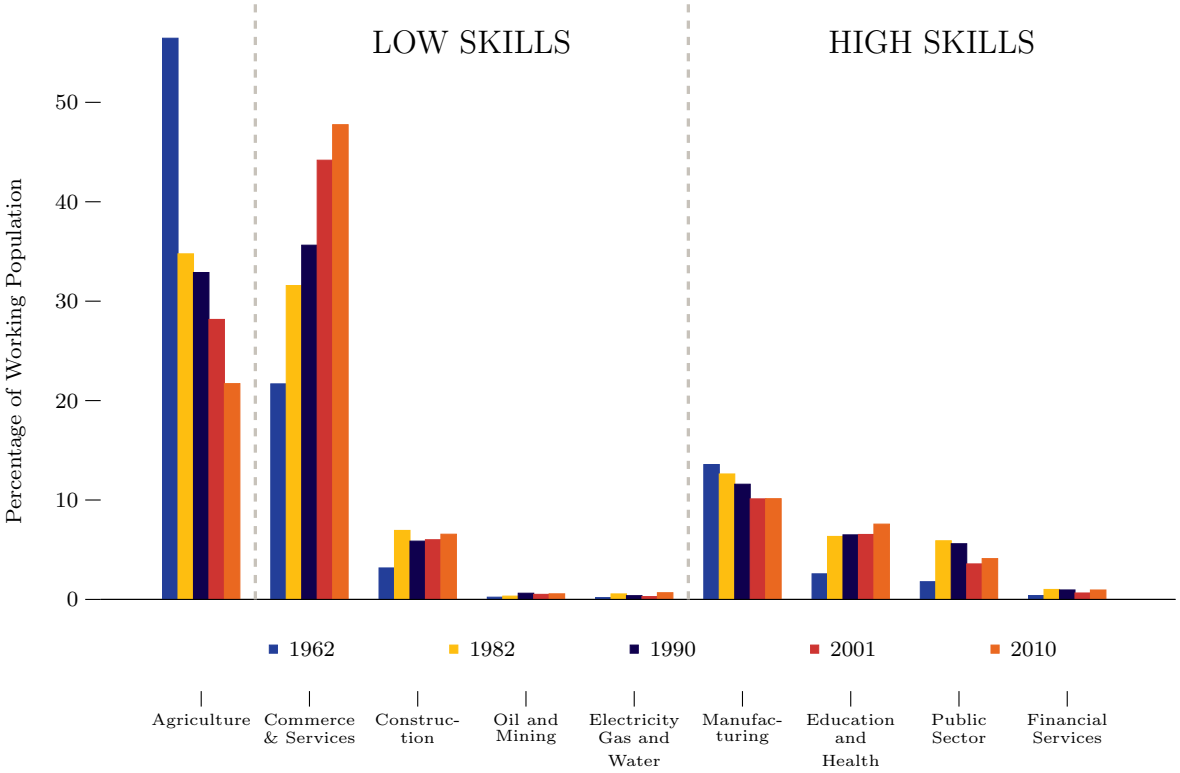
(d) Government's Oil Revenue (Millions of $)



(e) GDP per Capita

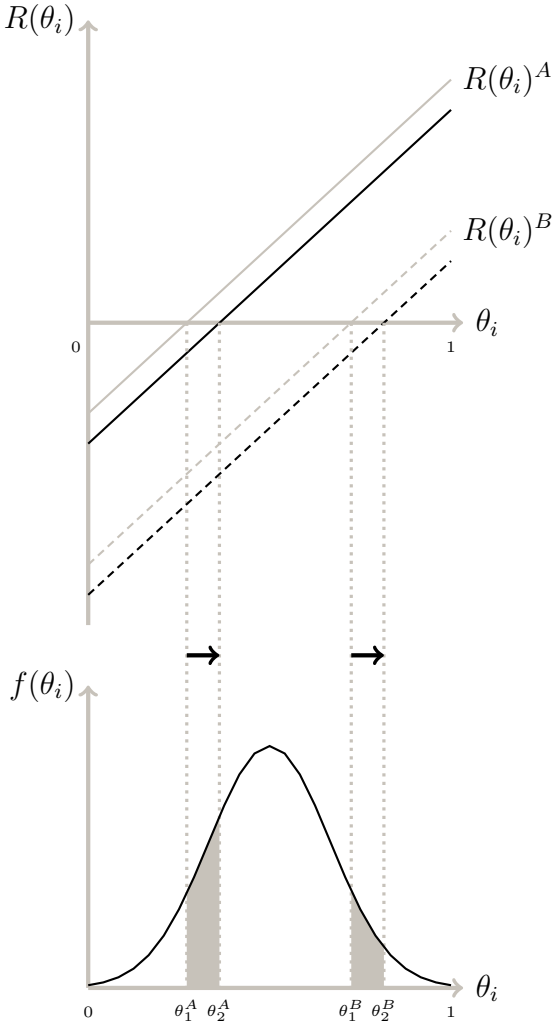
Notes: This Figure presents the evolution of Ecuador's crude oil output, its price, the government's revenue from oil exports, and GDP per capita from 1965 to 1980. Oil output data, government's oil revenue and GDP per capita is reported by Ecuador's Central Bank. Oil's price from 1965 to 1971 is the average price of OPEC, from 1972 onward it corresponds to the average price of Ecuador's oil exports as reported by Ecuador's Central Bank.

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



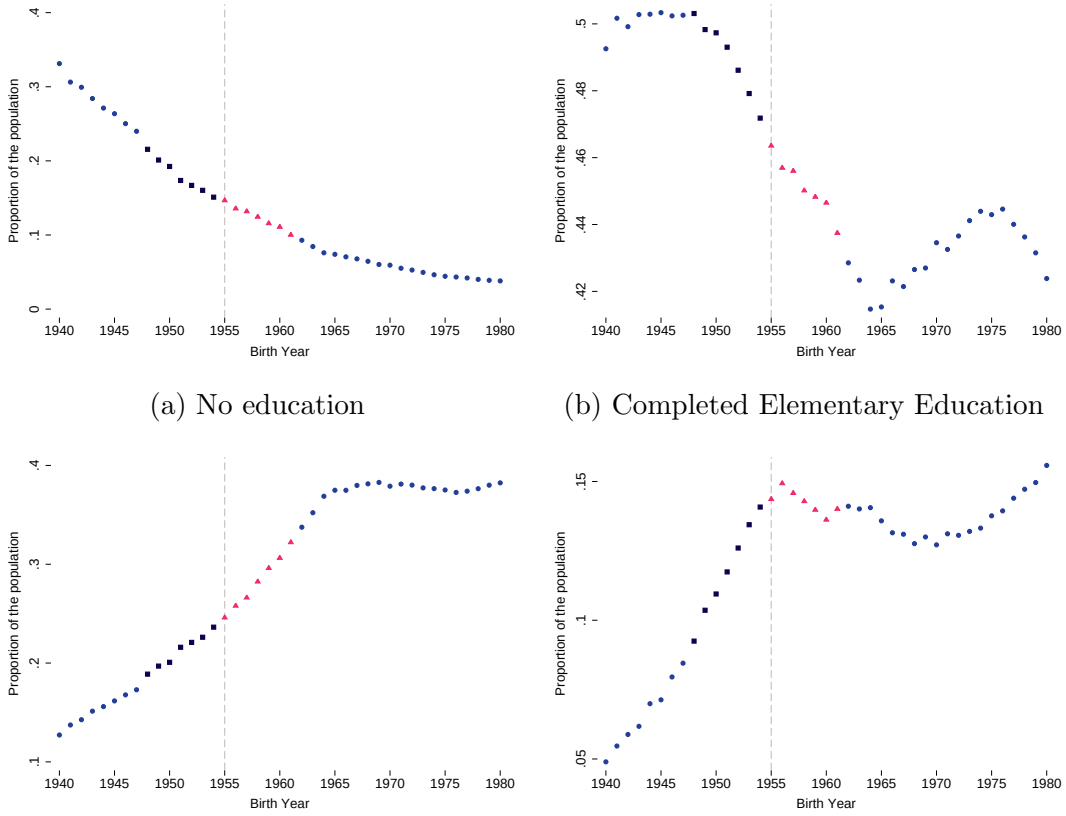
Notes: This Figure presents the proportion of the working population employed in each sector of the economy for 1962 and 1982. Data comes from Ecuador's 1962, 1982, 1990, 2001 and 2010 population censuses.

Figure 3: Effects of a Decrease in the Return of Education across Regions with Different Costs of College Attendance



Notes: This Figure shows how differences in costs of attending college between regions can lead to differences in the proportion of the populations that discontinues their education in the presence of a shock that increases the opportunity cost of college attendance homogeneously across regions.

Figure 4: Highest Level of Education Attainment by Birth Cohort



(a) No education

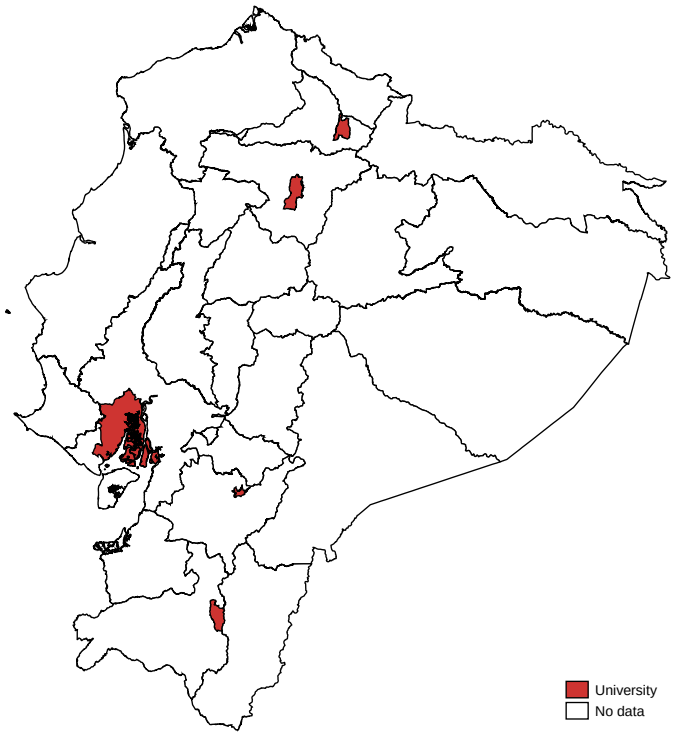
(b) Completed Elementary Education

(c) Completed Secondary Education

(d) Completed College or More

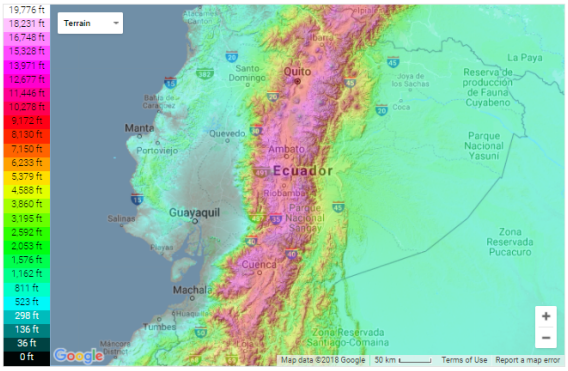
Notes: This Figure presents the evolution of the highest completed schooling level for the cohorts born in Ecuador between 1940 and 1961. For example, if a person dropped high school before completing 12th grade, then she completed elementary school. The cohorts born between 1955 and 1961 (red triangles) turned 18 during the oil boom in the 1970s.

Figure 5: Cities with Universities in Ecuador before the Oil Boom

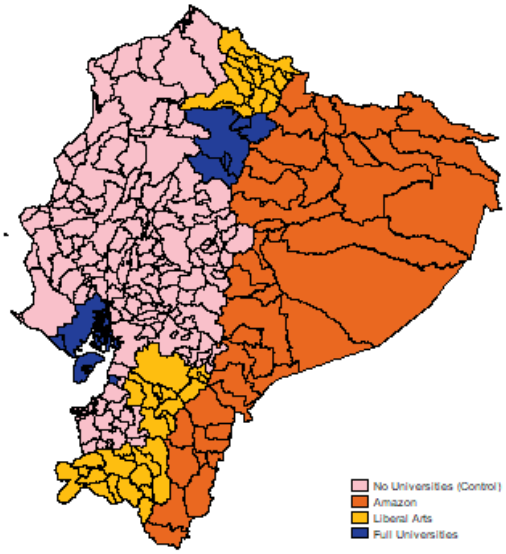


Notes: This Figure shows the geographical distribution of the cities with universities in Ecuador before the oil boom.

Figure 6: Regions by Cost of College Attendance



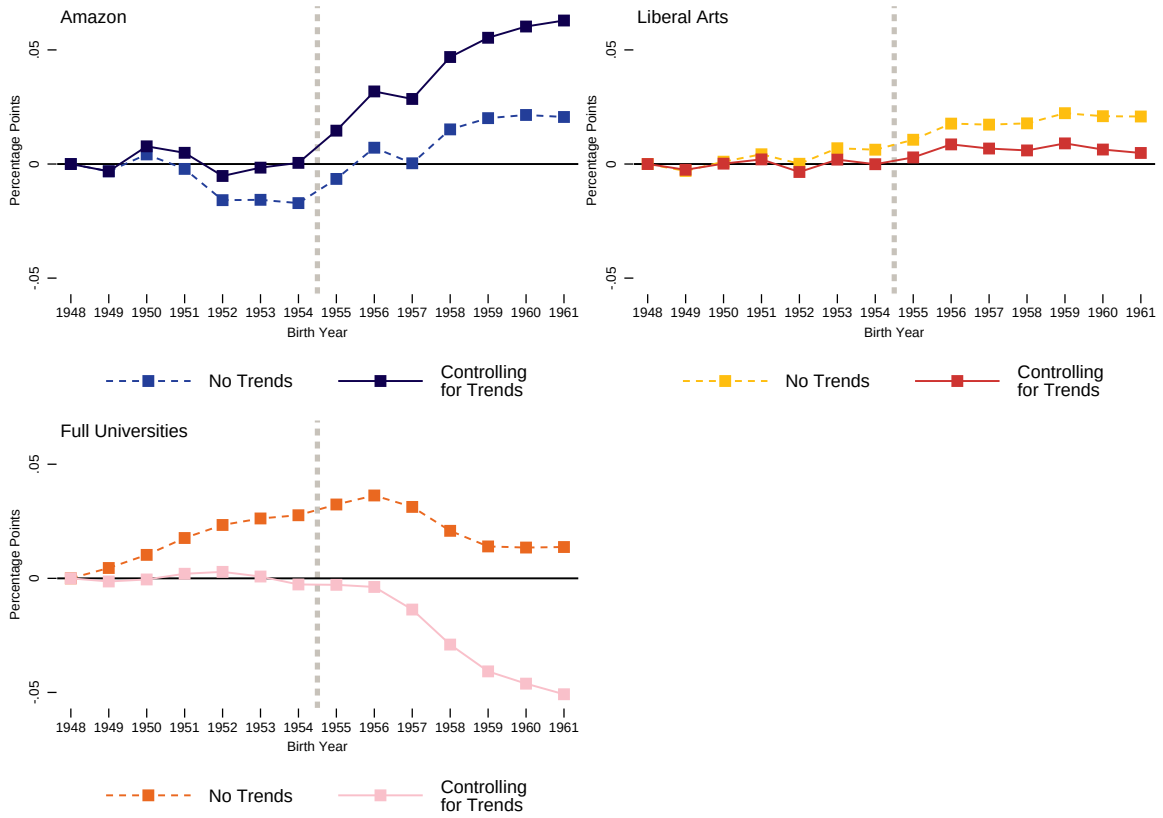
(a) Altitude Map



(b) Regions by Cost of College Attendance

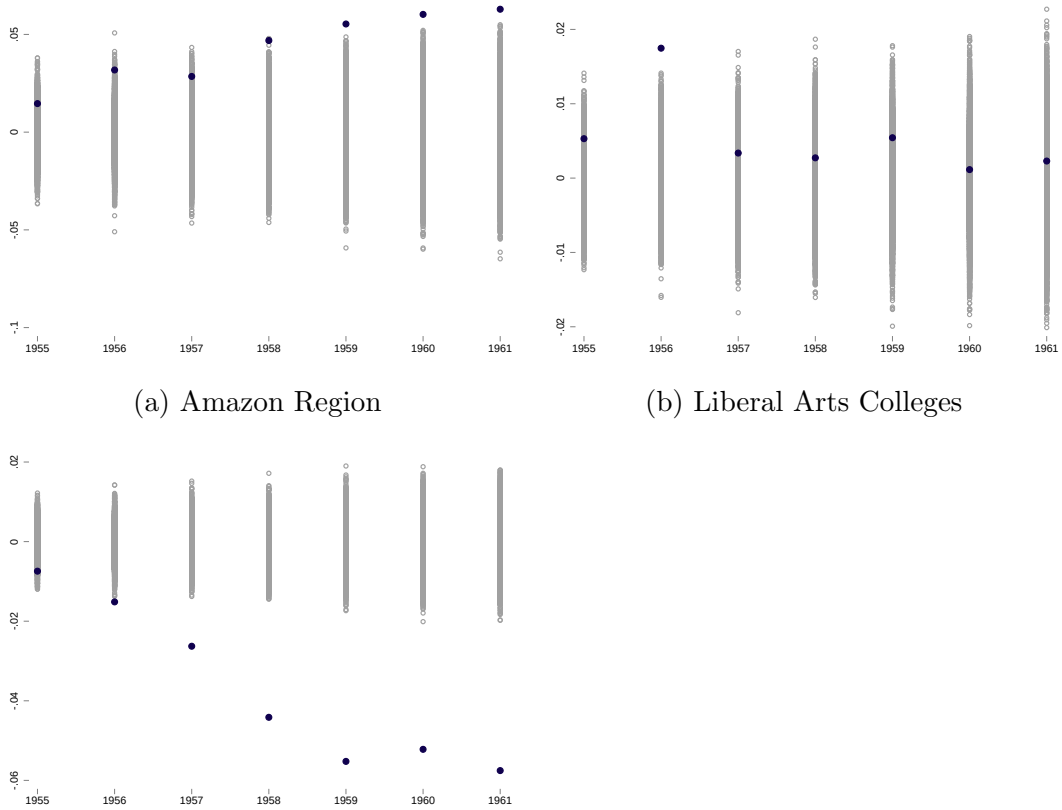
Notes: Panel (a) presents an altitude map for Ecuador. Roughly, the country can be divided into 4 regions by the mountain ranges that cross the country. In Panel (b) I combine geographic regions with the location of universities before the oil boom to divide the country in 4 different areas.

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



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 graduating from college. The region without universities is the base region.

Figure 8: Region Permutation Results



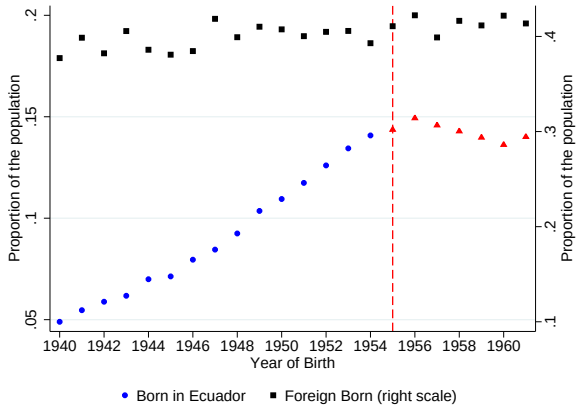
(a) Amazon Region

(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 between 1955 and 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 9: 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 between 1955 and 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, most likely after the oil boom.

Table 1: 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: this Table presents sample means for a subset of variables in the data. 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 years old before the oil boom in 1973. Column 3 considers individuals born between 1955 and 1961, that is the cohorts who turned 18 years old after the oil boom in 1973. Informal workers are people who work in low skills occupations, often self-employed, and who are not fully declaring taxes. Employees are people who work for a firm and receive a monthly wage. Professional workers are people who work independently and are registered with the Ecuadorian tax office.

Table 2: Effects of Exposure to the Oil Boom Before Turning 18 on College Completion

	1955	1956	1957	1958	1959	1960	1961	1955-1961
Full Universities	-0.0028	-0.0038	-0.0137	-0.0290	-0.0408	-0.0461	-0.0508	-0.0286
	(0.0038)	(0.0041)	(0.0045)	(0.0049)	(0.0053)	(0.0057)	(0.0062)	(0.0043)
	(0.0031)	(0.0021)	(0.0034)	(0.0043)	(0.0067)	(0.0093)	(0.0079)	(0.0047)
Liberal Arts	0.0029	0.0086	0.0068	0.0060	0.0090	0.0063	0.0048	0.0064
	(0.0034)	(0.0037)	(0.0040)	(0.0043)	(0.0047)	(0.0050)	(0.0055)	(0.0037)
	(0.0027)	(0.0038)	(0.0049)	(0.0061)	(0.0092)	(0.0095)	(0.0112)	(0.0064)
Amazon Region	0.0146	0.0318	0.0285	0.0469	0.0553	0.0603	0.0629	0.0450
	(0.0083)	(0.0092)	(0.0097)	(0.0107)	(0.0116)	(0.0124)	(0.0134)	(0.0092)
	(0.0105)	(0.0095)	(0.0122)	(0.0137)	(0.0127)	(0.0203)	(0.0194)	(0.0133)

Notes: This Table presents the effect of exposure to the oil boom before turning 18 on the probability of graduating from college 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 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 3: Effects on the Probability of Not Completing Any Educational Level

	1955	1956	1957	1958	1959	1960	1961	1955-1961
Full Universities	-0.0111	-0.0085	-0.0116	-0.0151	-0.0128	-0.0155	-0.0119	-0.0125
	(0.0027)	(0.0029)	(0.0032)	(0.0036)	(0.0039)	(0.0043)	(0.0047)	(0.0033)
	(0.0028)	(0.0030)	(0.0034)	(0.0044)	(0.0048)	(0.0051)	(0.0058)	(0.0039)
Liberal Arts	-0.0081	0.0009	-0.0028	-0.0028	-0.0002	-0.0077	-0.0036	-0.0035
	(0.0037)	(0.0040)	(0.0044)	(0.0049)	(0.0053)	(0.0058)	(0.0063)	(0.0044)
	(0.0044)	(0.0053)	(0.0053)	(0.0056)	(0.0065)	(0.0078)	(0.0086)	(0.0058)
Amazon Region	0.0085	0.0252	0.0263	0.0416	0.0591	0.0813	0.0885	0.0508
	(0.0118)	(0.0128)	(0.0141)	(0.0156)	(0.0172)	(0.0190)	(0.0208)	(0.0147)
	(0.0149)	(0.0158)	(0.0169)	(0.0213)	(0.0222)	(0.0261)	(0.0316)	(0.0204)

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 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 4: 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	-0.0218	-0.0392	-0.0357	-0.0776	-0.0950	-0.1215	-0.1224	-0.0772
	(0.0121)	(0.0132)	(0.0144)	(0.0159)	(0.0173)	(0.0189)	(0.0204)	(0.0139)
	(0.0027)	(0.0010)	(0.0024)	(0.0030)	(0.0058)	(0.0083)	(0.0067)	(0.0038)
Liberal Arts	-0.0161	-0.0268	-0.0152	-0.0426	-0.0452	-0.0690	-0.0668	-0.0417
	(0.0119)	(0.0131)	(0.0143)	(0.0157)	(0.0172)	(0.0187)	(0.0202)	(0.0136)
	(0.0022)	(0.0033)	(0.0043)	(0.0053)	(0.0085)	(0.0085)	(0.0104)	(0.0058)
Amazon Region	-0.0044	-0.0036	0.0065	-0.0017	0.0011	-0.0151	-0.0087	-0.0041
	(0.0141)	(0.0155)	(0.0168)	(0.0185)	(0.0202)	(0.0219)	(0.0236)	(0.0162)
	(0.0104)	(0.0093)	(0.0119)	(0.0134)	(0.0122)	(0.0198)	(0.0189)	(0.0130)
No Universities	-0.0190	-0.0354	-0.0220	-0.0486	-0.0543	-0.0753	-0.0716	-0.0481
	(0.0117)	(0.0128)	(0.0140)	(0.0154)	(0.0168)	(0.0183)	(0.0198)	(0.0133)
	(0.0016)	(0.0019)	(0.0024)	(0.0030)	(0.0035)	(0.0042)	(0.0042)	(0.0027)

Notes: This Table presents the effect of exposure to the oil boom before turning 18 on the probability of graduating from 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 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 ($n = 1,754,059$).

Table 5: Effects of Exposure to the Oil Boom Before Turning 18 on Informal Employment

	1955	1956	1957	1958	1959	1960	1961	1955-1961
Full Universities	0.0013	0.0042	-0.0020	0.0095	0.0092	0.0163	0.0151	0.0082
	(0.0047)	(0.0052)	(0.0057)	(0.0062)	(0.0068)	(0.0074)	(0.0081)	(0.0056)
	(0.0043)	(0.0049)	(0.0056)	(0.0059)	(0.0094)	(0.0178)	(0.0170)	(0.0094)
Liberal Arts	-0.0035	-0.0029	-0.0037	-0.0024	0.0001	0.0037	0.0016	-0.0008
	(0.0051)	(0.0056)	(0.0061)	(0.0067)	(0.0073)	(0.0079)	(0.0086)	(0.0059)
	(0.0043)	(0.0066)	(0.0074)	(0.0078)	(0.0090)	(0.0099)	(0.0117)	(0.0074)
Amazon Region	0.0095	-0.0166	-0.0282	-0.0188	-0.0216	-0.0191	-0.0169	-0.0166
	(0.0149)	(0.0161)	(0.0177)	(0.0193)	(0.0211)	(0.0229)	(0.0249)	(0.0174)
	(0.0165)	(0.0156)	(0.0232)	(0.0239)	(0.0262)	(0.0362)	(0.0351)	(0.0240)

Notes: This Table presents the effect of exposure to the oil boom on the probability of working informally informally in 2012 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 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 6: Effects of Exposure to the Oil Boom Before Turning 18 on Home Ownership

	1955	1956	1957	1958	1959	1960	1961	1955-1961
	a. Owning a house with more than two rooms							
Full Universities	-0.0109	-0.0010	-0.0059	-0.0051	-0.0063	0.0033	-0.0072	-0.0045
	(0.0053)	(0.0058)	(0.0064)	(0.0071)	(0.0077)	(0.0083)	(0.0091)	(0.0062)
	(0.0037)	(0.0045)	(0.0042)	(0.0040)	(0.0052)	(0.0078)	(0.0058)	(0.0039)
Liberal Arts	-0.0036	-0.0058	-0.0086	-0.0022	0.00003	-0.0015	-0.0037	-0.0036
	(0.0057)	(0.0063)	(0.0069)	(0.0076)	(0.0083)	(0.0089)	(0.0097)	(0.0065)
	(0.0054)	(0.0061)	(0.0063)	(0.0066)	(0.0074)	(0.0083)	(0.0096)	(0.0060)
Amazon Region	0.0039	0.0208	0.0069	0.0120	0.0001	0.0268	-0.0004	0.0101
	(0.0162)	(0.0178)	(0.0196)	(0.0215)	(0.0236)	(0.0254)	(0.0278)	(0.0192)
	(0.0149)	(0.0126)	(0.0148)	(0.0175)	(0.0211)	(0.0219)	(0.0226)	(0.0155)
	b. Owning a house of quality above the median of the quality index							
Full Universities	-0.0032	-0.0033	-0.0062	-0.0042	-0.0027	-0.0013	-0.0066	-0.0039
	(0.0053)	(0.0058)	(0.0063)	(0.0070)	(0.0076)	(0.0082)	(0.0090)	(0.0062)
	(0.0038)	(0.0053)	(0.0029)	(0.0040)	(0.0047)	(0.0068)	(0.0049)	(0.0035)
Liberal Arts	-0.0014	-0.0014	-0.0078	-0.0041	0.0050	-0.0089	-0.0096	-0.0043
	(0.0055)	(0.0061)	(0.0066)	(0.0073)	(0.0080)	(0.0085)	(0.0093)	(0.0063)
	(0.0053)	(0.0057)	(0.0053)	(0.0072)	(0.0078)	(0.0077)	(0.0104)	(0.0061)
Amazon Region	0.0012	0.0289	0.0140	0.0324	0.0391	0.0611	0.0433	0.0332
	(0.0128)	(0.0144)	(0.0155)	(0.0172)	(0.0189)	(0.0204)	(0.0222)	(0.0154)
	(0.0154)	(0.0162)	(0.0168)	(0.0212)	(0.0209)	(0.0273)	(0.0281)	(0.0198)

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 for the cohorts born in 1955-1961. 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 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 7: Effects of Exposure to the Oil Boom Before Turning 18 on Vehicle Ownership

	1955	1956	1957	1958	1959	1960	1961	1955-1961
Full Universities	-0.0011	0.0010	0.0003	-0.0111	-0.0120	-0.0075	-0.0059	-0.0055
	(0.0037)	(0.0040)	(0.0044)	(0.0049)	(0.0053)	(0.0058)	(0.0063)	(0.0043)
	(0.0020)	(0.0025)	(0.0035)	(0.0024)	(0.0038)	(0.0048)	(0.0055)	(0.0032)
Liberal Arts	0.0010	0.0048	0.0067	-0.0010	0.0091	0.0061	0.0045	0.0046
	(0.0040)	(0.0044)	(0.0048)	(0.0052)	(0.0057)	(0.0062)	(0.0067)	(0.0046)
	(0.0038)	(0.0046)	(0.0048)	(0.0056)	(0.0068)	(0.0065)	(0.0076)	(0.0052)
Amazon Region	0.0044	0.0148	0.0121	0.0195	0.0289	0.0327	0.0260	0.0209
	(0.0096)	(0.0105)	(0.0114)	(0.0125)	(0.0137)	(0.0148)	(0.0160)	(0.0111)
	(0.0125)	(0.0112)	(0.0163)	(0.0133)	(0.0177)	(0.0228)	(0.0207)	(0.0156)

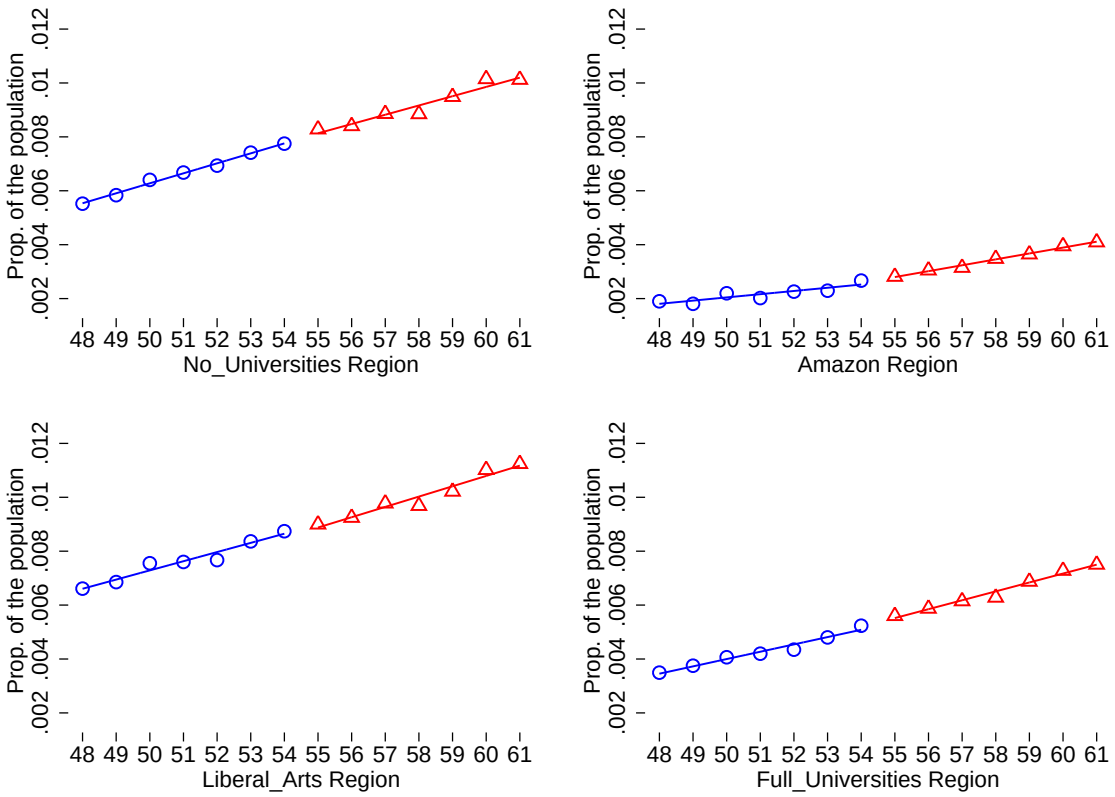
Notes: This Table presents the effect of exposure to the oil boom on the probability of owning at least one vehicle in 2013 for the cohorts born in 1955-1961 The first seven columns present the effect for each cohort. The last column shows the average of these effects across cohorts using using population 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 ($n = 1,711,538$).

A Appendix - For Online Publication

[Figure 10 about here.]

A.1 Design tests

Figure A.1: Population Distribution by Birth Cohort and Region



Notes: This Figure presents the distribution of the population in Ecuador for the cohorts born between 1948 and 1961 by region of birth. The cohorts born between 1955 and 1961 (red triangles) experienced the effects of the exploitation of oil in the Amazon region.

A.2 Universities and Technical Schools during the 1970s

Table A.1: 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%

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 A.2: 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

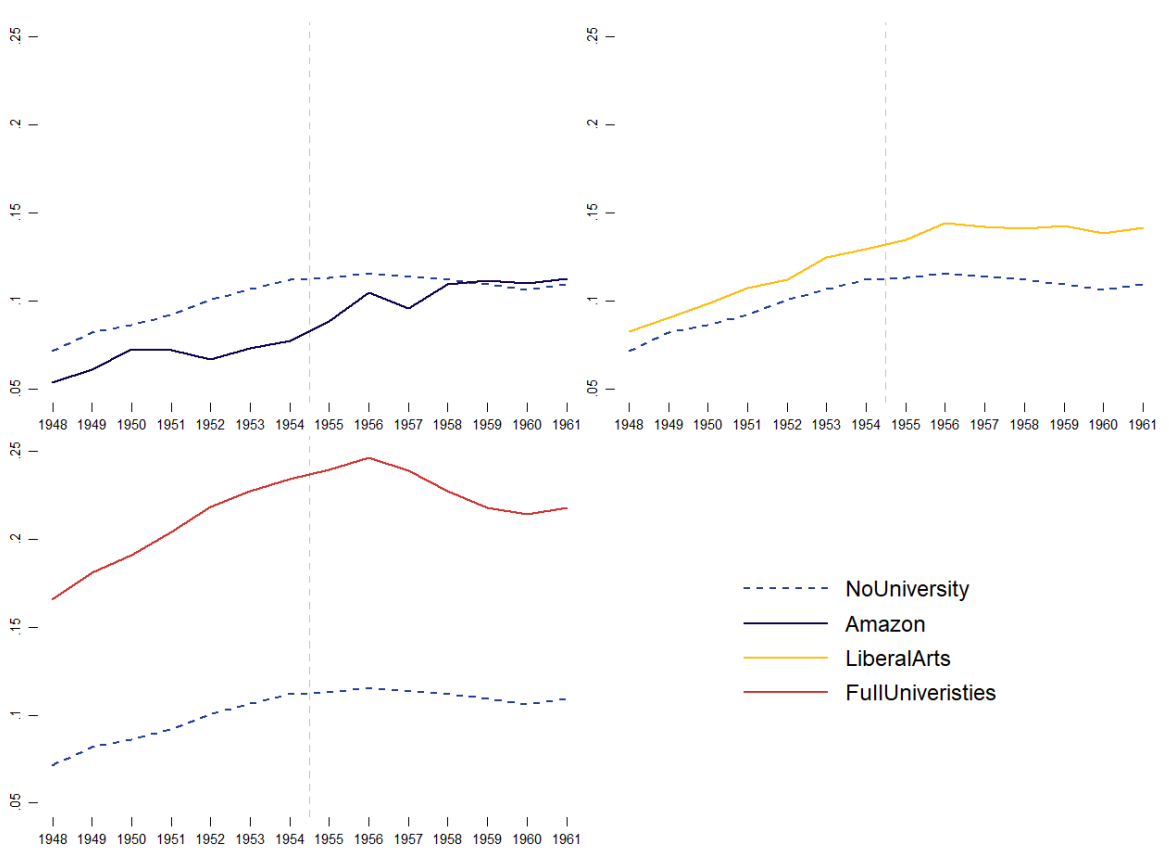
*Technical school focused on agriculture during the 1970s

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

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.

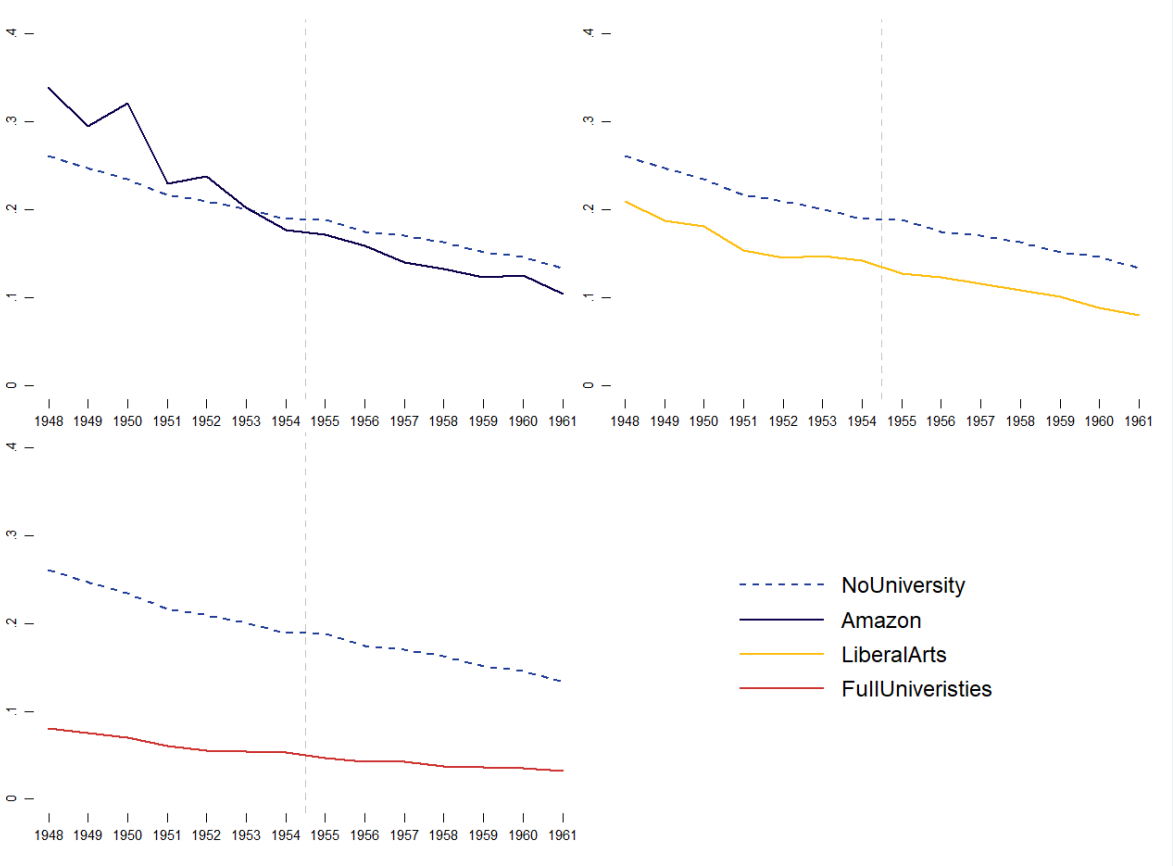
A.3 Additional Graphs and Tables on the Effect of the Oil Boom on Education

Figure A.2: College Completion by Birth Cohort



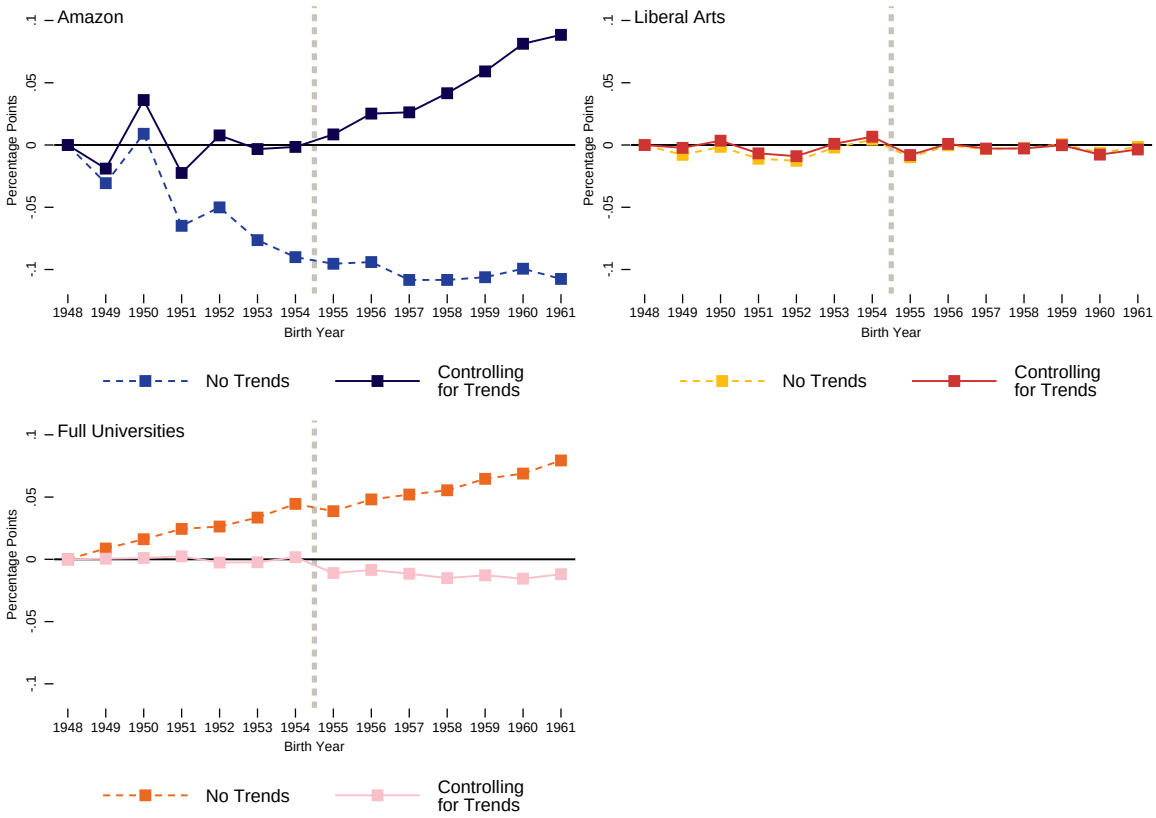
Notes: This Figure presents the evolution of the proportion of the population who graduated from college in Ecuador for the cohorts born between 1948 and 1961. The horizontal axis plots the year of birth. The country is divided into four regions depending on the geographic location and type of universities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

Figure A.3: 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 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 between were exposed to the oil boom before turning 18 years old.

Figure A.4: 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 differential trends. These estimates take the the region without universities as the base region.

Table A.3: 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	0.0014	0.0072	-0.0014	-0.0142	-0.0261	-0.0405	-0.0431	-0.0184
	(0.0049)	(0.0054)	(0.0058)	(0.0063)	(0.0068)	(0.0073)	(0.0080)	(0.0055)
	(0.0024)	(0.0039)	(0.0088)	(0.0118)	(0.0137)	(0.0171)	(0.0166)	(0.0107)
Liberal Arts	0.0011	0.0006	0.0102	0.0092	0.0129	0.0116	0.0078	0.0078
	(0.0043)	(0.0047)	(0.0051)	(0.0056)	(0.0060)	(0.0064)	(0.0070)	(0.0047)
	(0.0036)	(0.0049)	(0.0056)	(0.0070)	(0.0105)	(0.0116)	(0.0121)	(0.0073)
Amazon Region	0.0122	0.0159	0.0307	0.0313	0.0544	0.0408	0.0528	0.0357
	(0.0107)	(0.0115)	(0.0127)	(0.0135)	(0.0149)	(0.0157)	(0.0170)	(0.0116)
	(0.0109)	(0.0117)	(0.0116)	(0.0130)	(0.0145)	(0.0187)	(0.0214)	(0.0124)
					Men			
Full Universities	-0.0074	-0.0151	-0.0263	-0.0441	-0.0552	-0.0522	-0.0575	-0.0387
	(0.0057)	(0.0062)	(0.0067)	(0.0074)	(0.0080)	(0.0087)	(0.0095)	(0.0066)
	(0.0060)	(0.0040)	(0.0118)	(0.0097)	(0.0083)	(0.0069)	(0.0098)	(0.0076)
Liberal Arts	0.0053	0.0175	0.0034	0.0027	0.0054	0.0011	0.0023	0.0051
	(0.0052)	(0.0057)	(0.0061)	(0.0066)	(0.0072)	(0.0078)	(0.0084)	(0.0058)
	(0.0036)	(0.0058)	(0.0068)	(0.0073)	(0.0096)	(0.0099)	(0.0126)	(0.0072)
Amazon Region	0.0172	0.0479	0.0261	0.0631	0.0561	0.0787	0.0744	0.0544
	(0.0127)	(0.0143)	(0.0148)	(0.0166)	(0.0177)	(0.0193)	(0.0209)	(0.0144)
	(0.0161)	(0.0147)	(0.0168)	(0.0178)	(0.0195)	(0.0255)	(0.0243)	(0.0179)

Notes: This Table presents the effect of exposure to the oil boom before turning 18 on the probability of graduating from 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 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 A.4: 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	0.0118	0.0000	0.0051	0.0123	0.0207	0.0283	0.0339	0.0171
	(0.0045)	(0.0049)	(0.0054)	(0.0060)	(0.0065)	(0.0071)	(0.0077)	(0.0054)
	(0.0041)	(0.0051)	(0.0058)	(0.0065)	(0.0067)	(0.0094)	(0.0114)	(0.0060)
Liberal Arts	0.0058	-0.0084	-0.0025	-0.0137	-0.0142	-0.0071	-0.0082	-0.0071
	(0.0051)	(0.0056)	(0.0061)	(0.0067)	(0.0073)	(0.0079)	(0.0086)	(0.0059)
	(0.0049)	(0.0058)	(0.0076)	(0.0080)	(0.0115)	(0.0108)	(0.0124)	(0.0079)
Amazon Region	-0.0156	-0.0458	-0.0634	-0.0816	-0.1113	-0.1357	-0.1467	-0.0914
	(0.0150)	(0.0163)	(0.0179)	(0.0195)	(0.0214)	(0.0233)	(0.0254)	(0.0178)
	(0.0192)	(0.0210)	(0.0194)	(0.0283)	(0.0263)	(0.0370)	(0.0374)	(0.0254)
	b. Secondary Education							
Full Universities	0.0021	0.0123	0.0202	0.0318	0.0329	0.0334	0.0288	0.0240
	(0.0045)	(0.0049)	(0.0053)	(0.0059)	(0.0064)	(0.0070)	(0.0076)	(0.0052)
	(0.0027)	(0.0037)	(0.0051)	(0.0042)	(0.0063)	(0.0068)	(0.0058)	(0.0041)
Liberal Arts	-0.0006	-0.0011	-0.0015	0.0105	0.0054	0.0085	0.0069	0.0042
	(0.0040)	(0.0043)	(0.0047)	(0.0052)	(0.0057)	(0.0061)	(0.0066)	(0.0045)
	(0.0039)	(0.0042)	(0.0045)	(0.0053)	(0.0060)	(0.0064)	(0.0079)	(0.0047)
Amazon Region	-0.0075	-0.0113	0.0086	-0.0069	-0.0032	-0.0059	-0.0046	-0.0044
	(0.0113)	(0.0123)	(0.0137)	(0.0147)	(0.0162)	(0.0176)	(0.0191)	(0.0132)
	(0.0085)	(0.0110)	(0.0133)	(0.0198)	(0.0163)	(0.0183)	(0.0192)	(0.0136)

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 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 ($n = 1,711,538$).

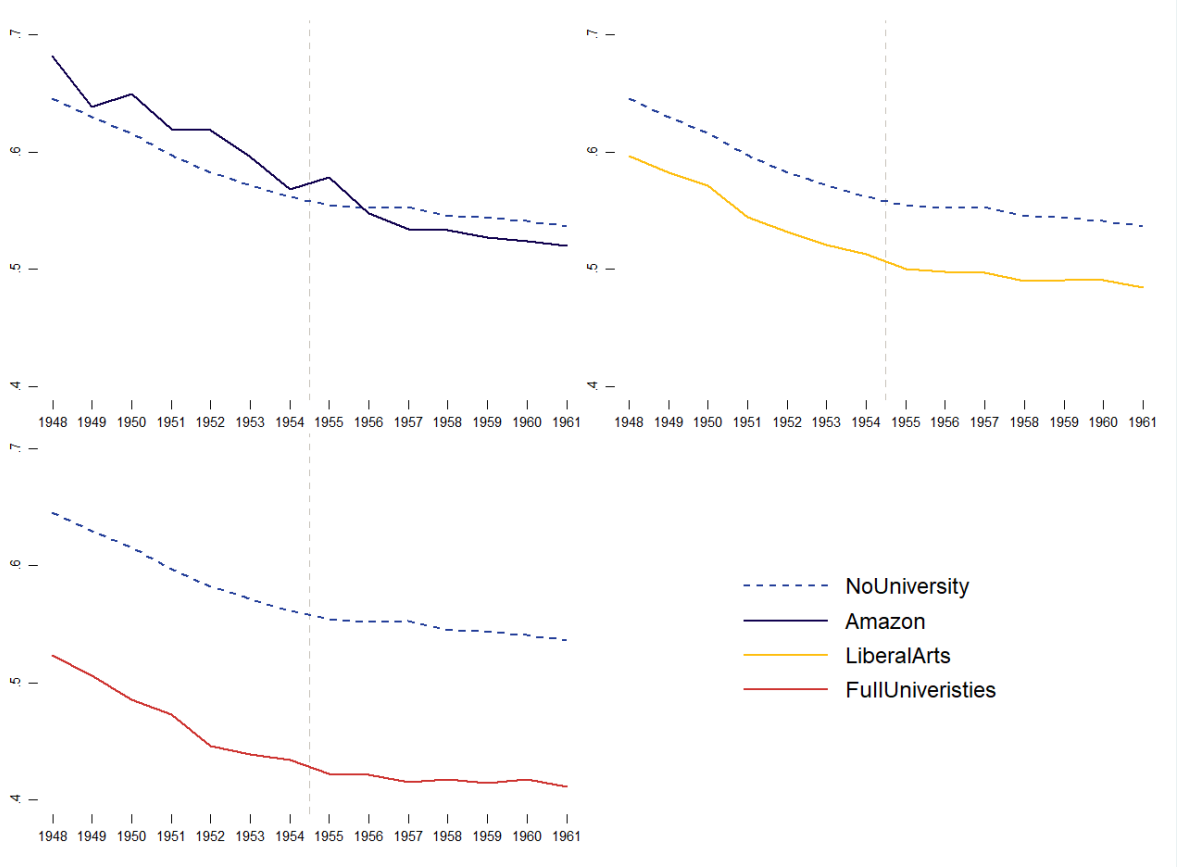
Table A.5: Randomization Inference P-values of the Effect of the Boom on College Completion

	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. The p-values are based on a permutation exercise with 10,000 replications.

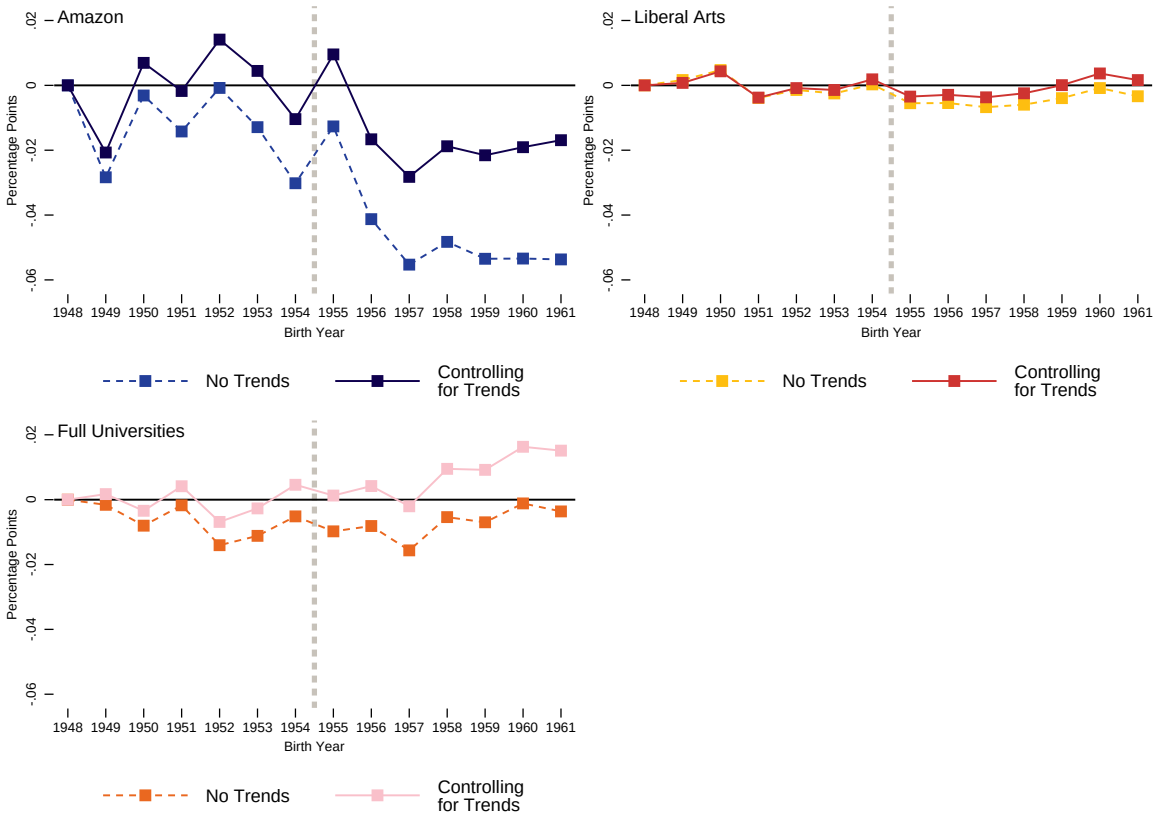
A.4 Additional Graphs on the Effect of the Oil Boom on Informal Employment

Figure A.5: 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 between 1948 and 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 between were exposed to the oil boom before turning 18 years old.

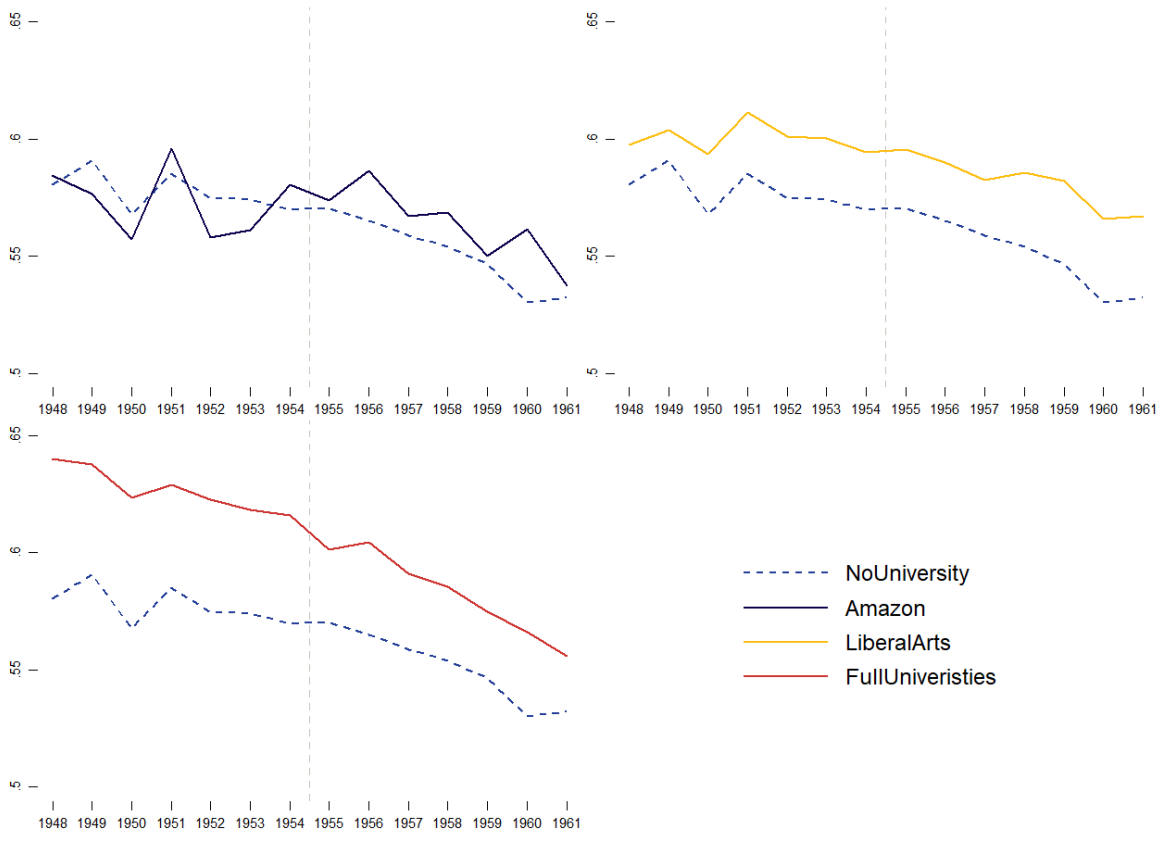
Figure A.6: Effects of Exposure to the Oil Boom Before Turning 18 on Informal Employment



Notes: This Figure presents dynamic difference in difference estimates of the 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 differential trends. These estimates take the the region without universities as the base region.

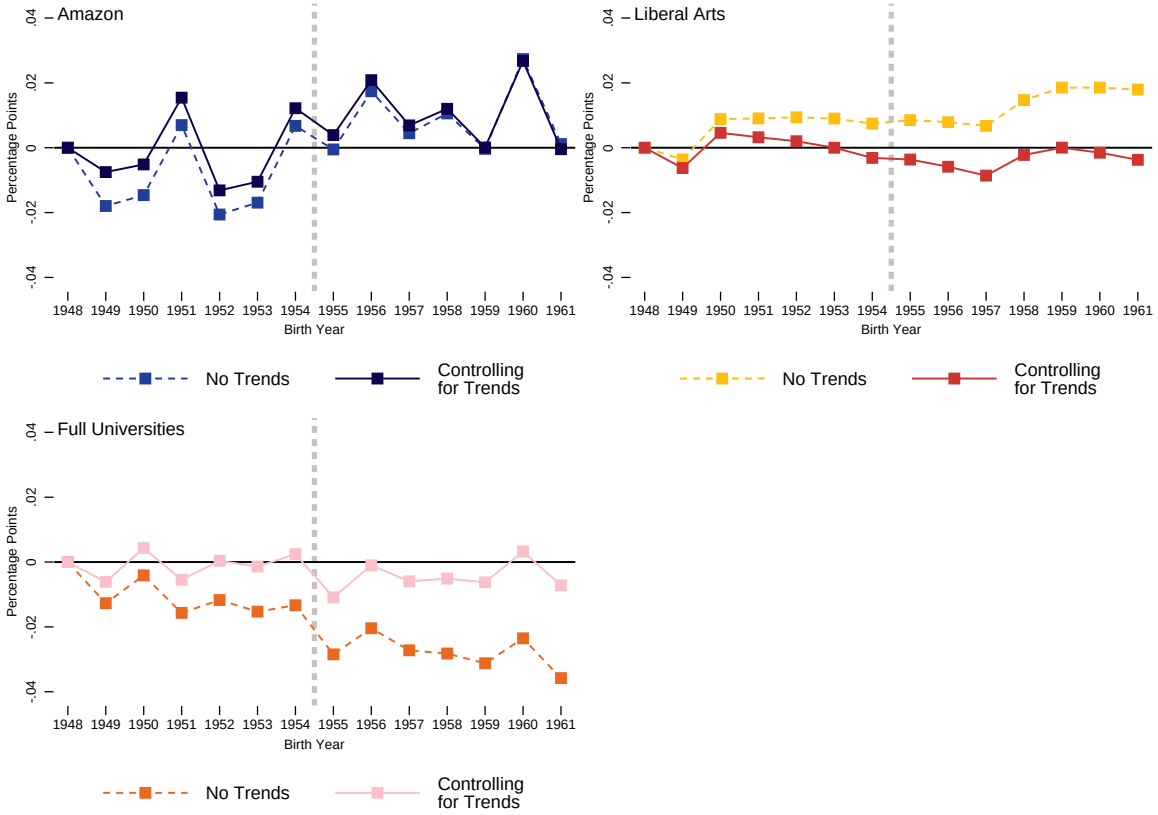
A.5 Additional Graphs on the Effect of the Oil Boom on Wealth

Figure A.7: Population Owning a Home with more than two Rooms in 2010 by Birth Cohort



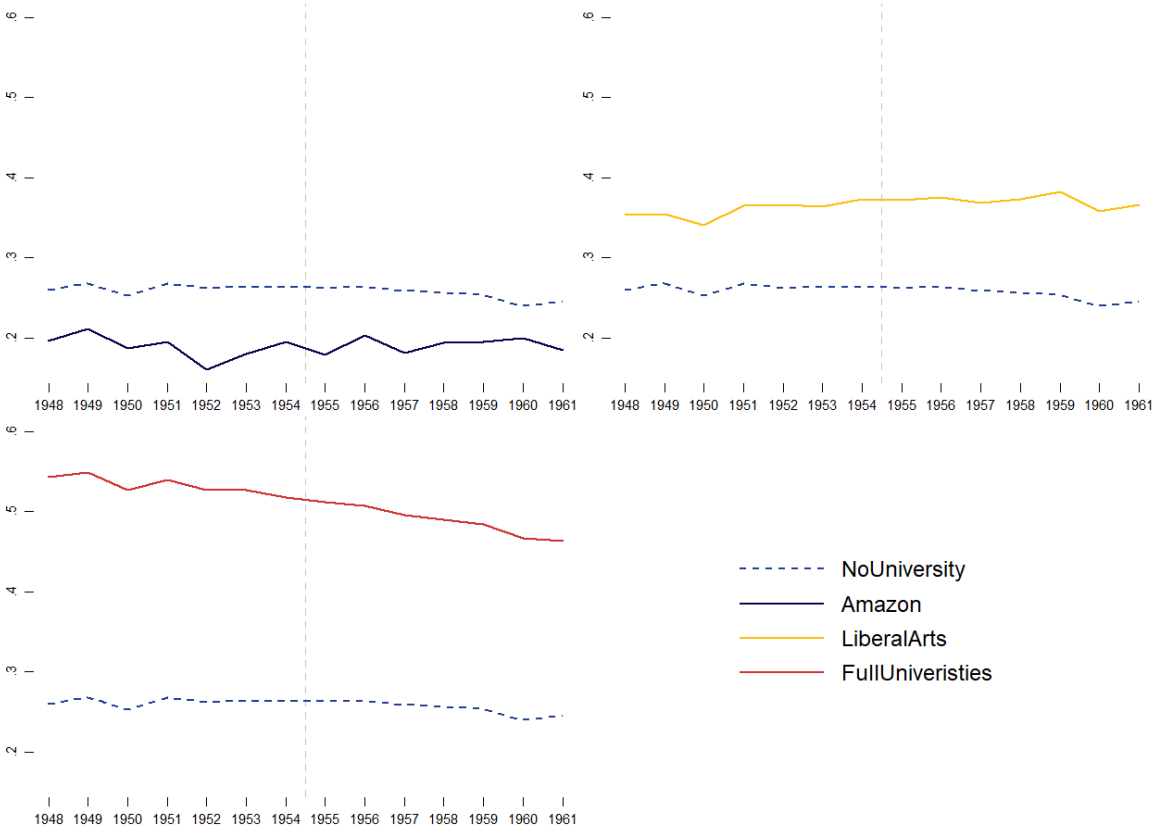
Notes: This Figure presents the evolution of the proportion of the population who owns a home with more than two rooms in Ecuador for the cohorts born between 1948 and 1961. The data correspond to 2010. The horizontal axis plots the year of birth. The country is divided into four regions depending on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

Figure A.8: Effects of Exposure to the Oil Boom Before Turning 18 on the Probability of Owning a Home with more than two Rooms



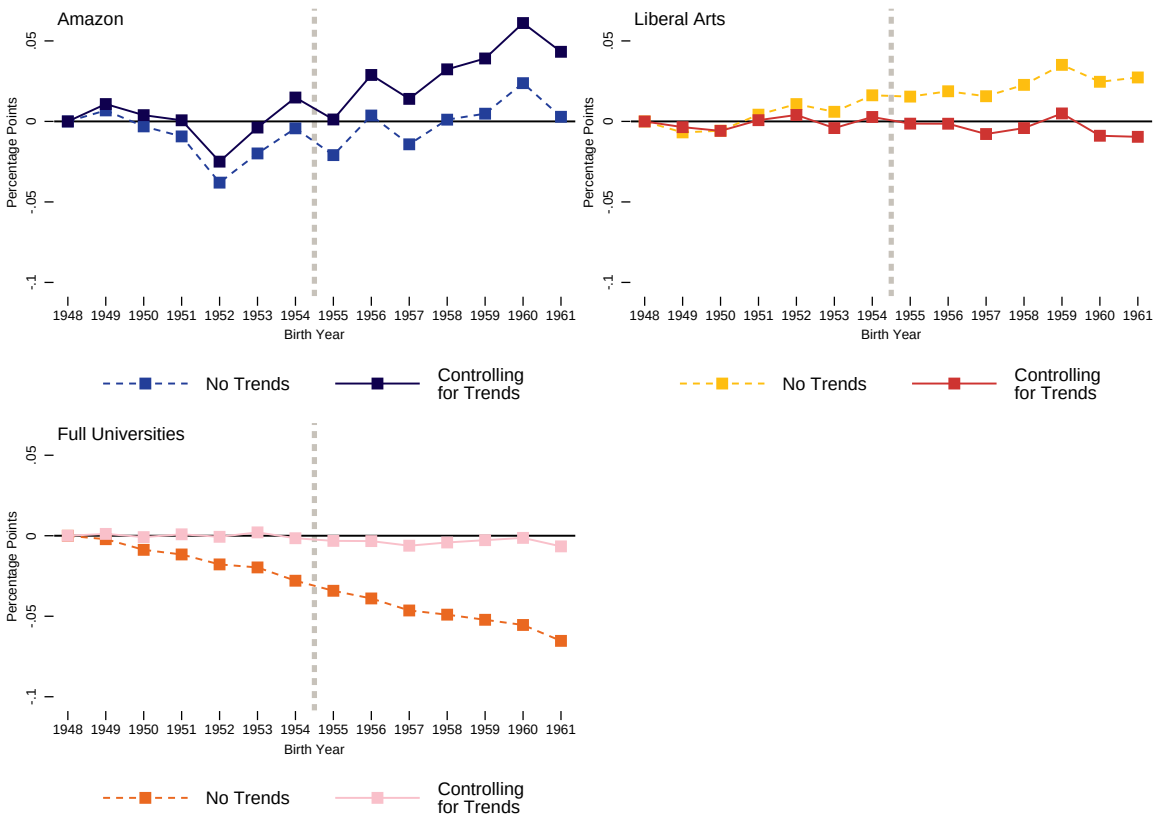
Notes: This Figure presents dynamic difference in difference estimates of the the effect of exposure to the oil boom before turning 18 on the probability of owning a home with more than two rooms in 2010. Dashed lines present conventional difference in difference estimates, and solid lines control for differential trends. These estimates take the the region without universities as the base region.

Figure A.9: Population Owning a Home of Quality above the Median in 2010 by Birth Cohort



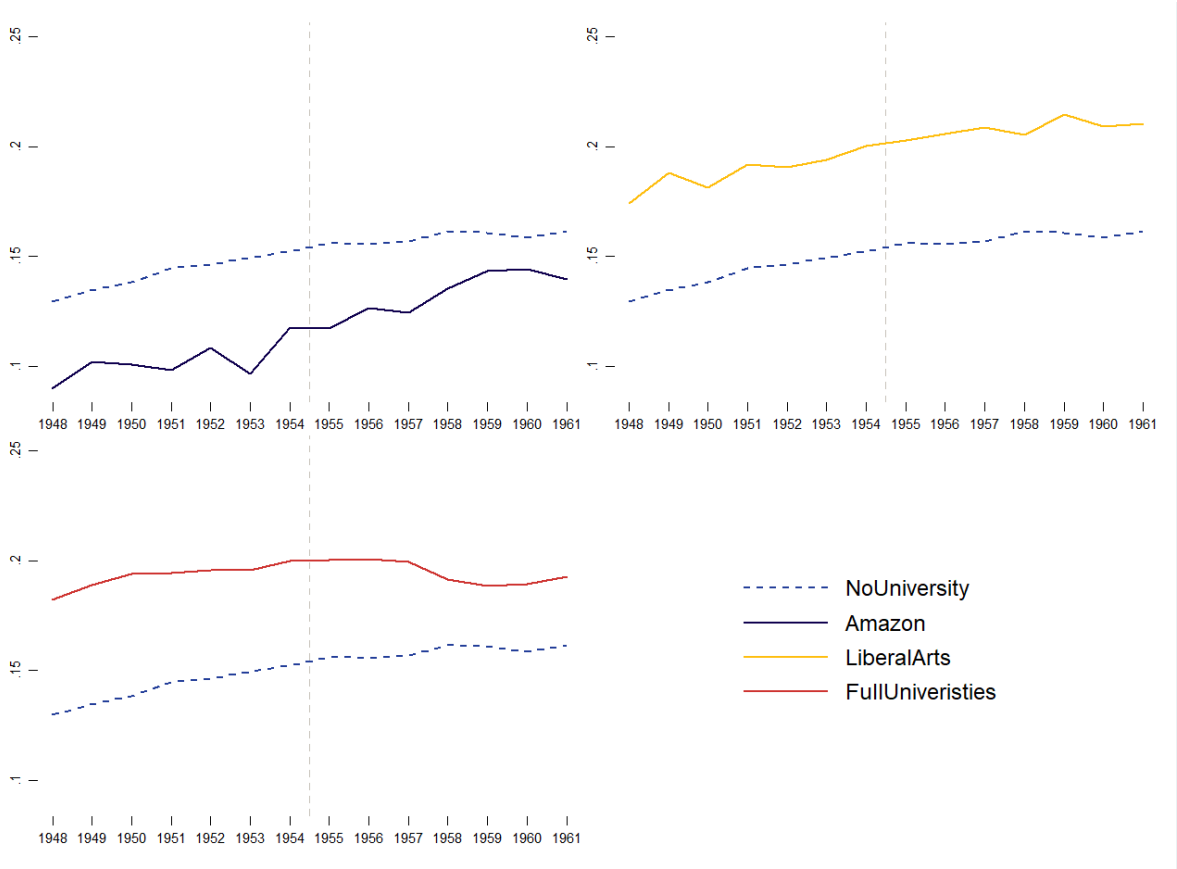
Notes: This Figure presents the evolution of the proportion of the population who owns a home of quality above the median of the quality index in Ecuador for the cohorts born between 1948 and 1961. The data correspond to 2010. The horizontal axis plots the year of birth. The country is divided into four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

Figure A.10: Effects of Exposure to the Oil Boom Before Turning 18 on the Probability of Owning a Home of Quality above the Median



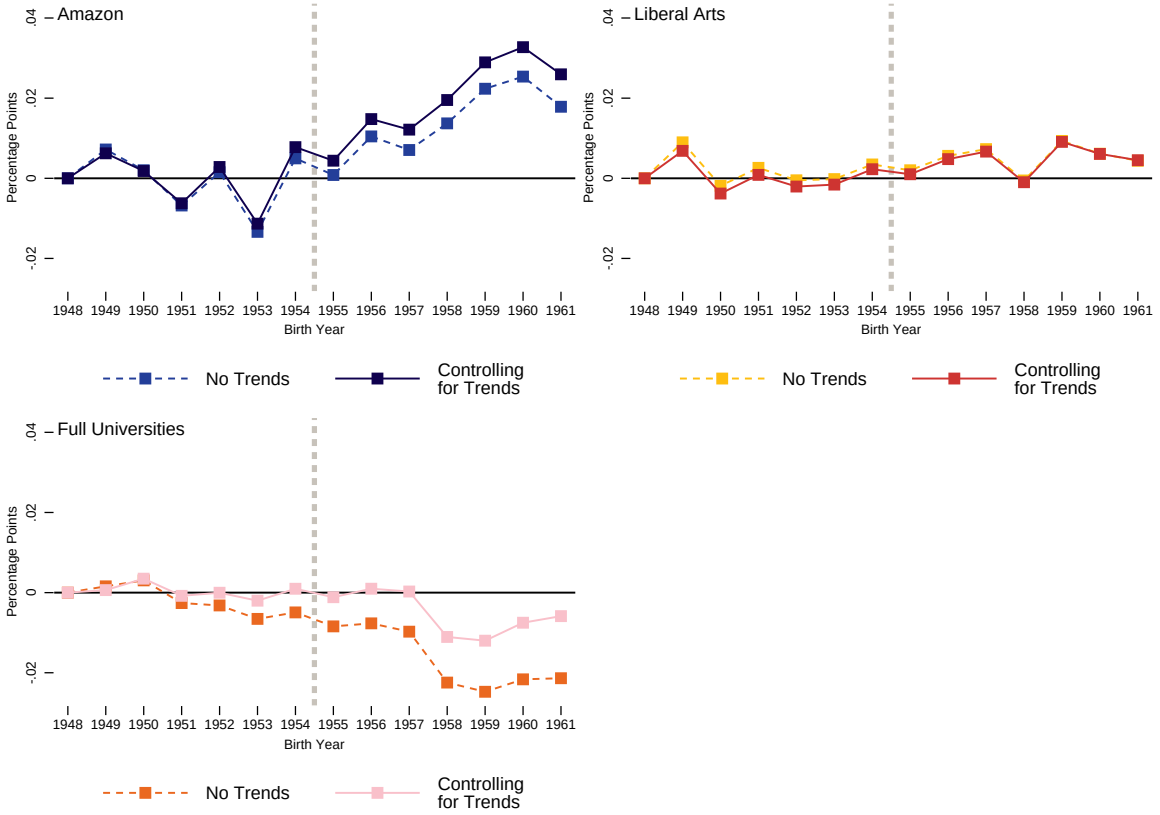
Notes: This Figure presents dynamic difference in difference estimates of the the effect of exposure to the oil boom before turning 18 on the probability of owning a home of quality above the median of the quality index in 2010. Dashed lines present conventional difference in difference estimates, and solid lines control for differential trends. These estimates take the the region without universities as the base region.

Figure A.11: 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 between 1948 and 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 between were exposed to the oil boom before turning 18 years old.

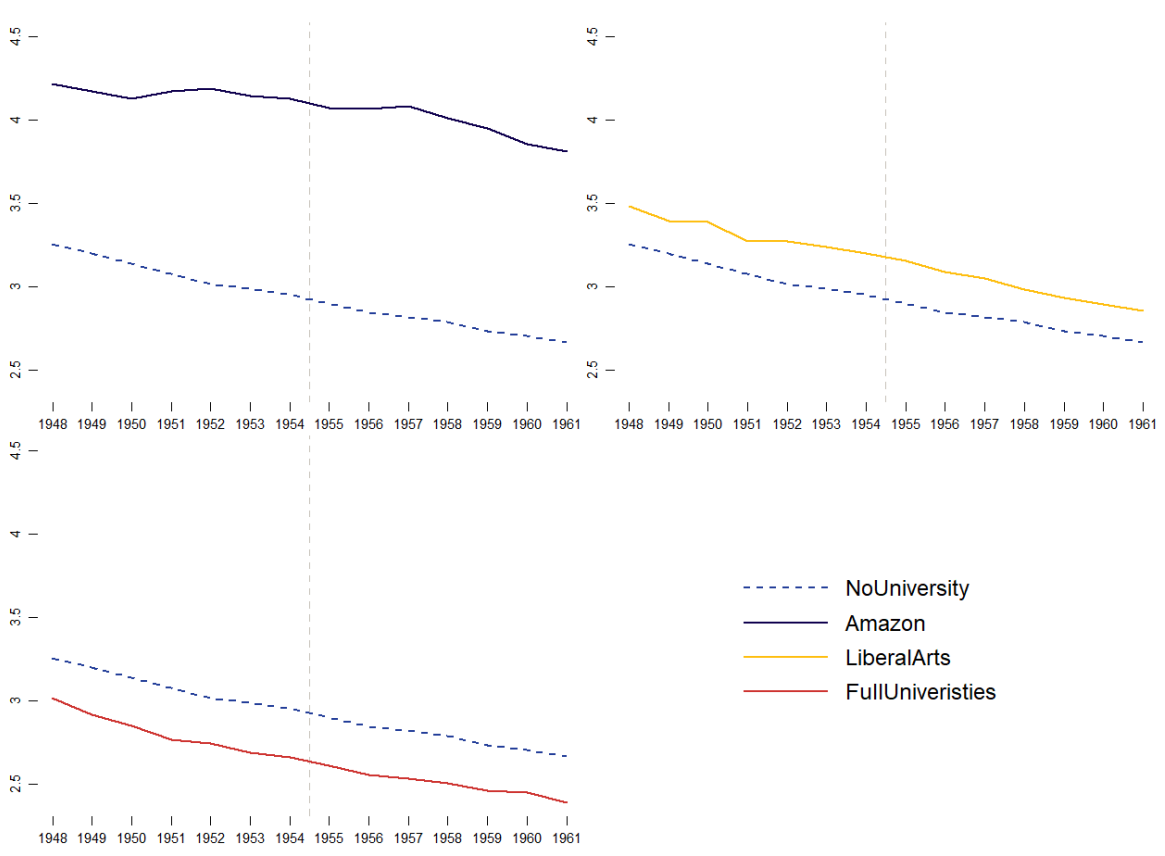
Figure A.12: Effects of Exposure to the Oil Boom Before Turning 18 on the Probability of Owning a Vehicle



Notes: This Figure presents dynamic difference in difference estimates of the 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 differential trends. These estimates take the the region without universities as the base region.

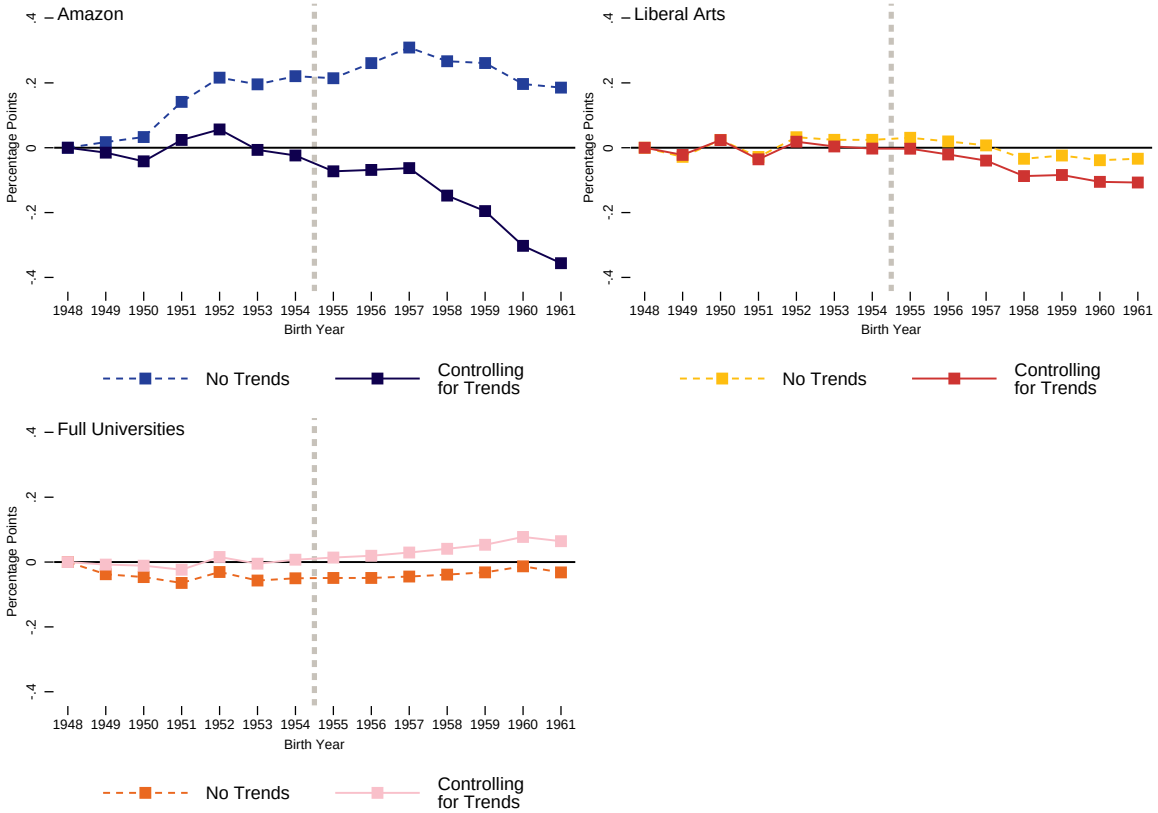
A.6 Effect of the Oil Boom on Fertility

Figure A.13: Number of Children by Birth Cohort



Notes: This Figure presents the evolution of the number of children for the cohorts born between 1948 and 1961. The data correspond to 2014. 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 between were exposed to the oil boom before turning 18 years old.

Figure A.14: Effects of Exposure to the Oil Boom Before Turning 18 on the Number of Children



Notes: This Figure presents dynamic difference in difference estimates of the the effect of exposure to the oil boom before turning 18 on the number of children in 2014. Dashed lines present conventional difference in difference estimates, and solid lines control for differential trends. These estimates take the the region without universities as the base region.

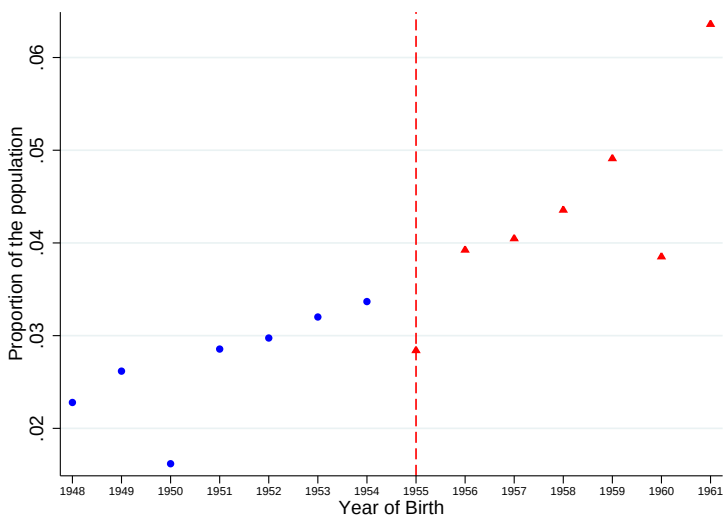
Table A.6: Effects of Exposure to the Oil Boom Before Turning 18 on the Number of Children

	1955	1956	1957	1958	1959	1960	1961	1955-1961
Full Universities	0.0139	0.0195	0.0295	0.0410	0.0533	0.0775	0.0643	0.0446
	(0.0176)	(0.0193)	(0.0214)	(0.0236)	(0.0259)	(0.0285)	(0.0311)	(0.0216)
	(0.0116)	(0.0223)	(0.0213)	(0.0348)	(0.0502)	(0.0447)	(0.0529)	(0.0325)
Liberal Arts	-0.0029	-0.0208	-0.0396	-0.0874	-0.0841	-0.1051	-0.1072	-0.0662
	(0.0211)	(0.0229)	(0.0250)	(0.0277)	(0.0302)	(0.0330)	(0.0359)	(0.0247)
	(0.0194)	(0.0224)	(0.0251)	(0.0333)	(0.0333)	(0.0410)	(0.0432)	(0.0280)
Amazon Region	-0.0726	-0.0684	-0.0628	-0.1475	-0.1954	-0.3025	-0.3560	-0.1854
	(0.0758)	(0.0812)	(0.0898)	(0.0979)	(0.1077)	(0.1167)	(0.1268)	(0.0890)
	(0.0613)	(0.0762)	(0.0805)	(0.1019)	(0.1064)	(0.1255)	(0.1351)	(0.0869)

Notes: This Table presents the effect of exposure to the oil boom on the the number of children per adult for the cohorts born in 1955-1961. The number of children is measured in 2014. The first seven columns present the effect for each cohort. The last column shows the average of these effects across cohorts using 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 with children ($n = 1,366,190$).

A.7 College Completion in Indonesia

Figure A.15: 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 years old during the oil boom in the 1970s. This Figure uses data from a 10 percent random sample of Indonesia's 2010 population census (Minnesota Population Center, 2017). The drops correspond to birth years that are multiples of five. Apparently, individuals with low education round their age/year of birth to the closest multiple of five. I have found evidence of this rounding in self-reported data sets from other developing countries.