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Socioeconomic Effects of Oil Drilling: The Case of Ecuador

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Abstract

In 1964, oil companies starting drilling in Ecuador. From 1985 to 2001, the Ecuadorian government sold 32 different "oil blocks" around the country, most of them in the Amazon area. This paper focuses on the question: How does nearby oil drilling change locals' employment, infrastructure, health, and education? Using individual-level census data from 1982 onwards, and maps delimiting the areas sold for oil exploitation, I explore the effects that oil has on people living in the surrounding area. Because oil companies rarely hire locals, the analysis is divided between locals and migrants. The analysis shows that migrants to oil areas are more likely to be positively affected by oil: they are more likely to be self-employed and have better homes, while there are no effects to their health. Locals are disproportionally harmed: oil reduces their likelihood of having skilled jobs and good health. However, locals benefit from better infrastructure, to some extent, and more education (level of literacy and years of schooling). The more educated migrate to the rest of the country, though, where they are not as successful as the locals or migrants from other areas.

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Contents

List of Figures

List of Tables

1 Introduction

While the effects of a natural resource boom in a country are widely studied, the socioeconomic effects on those living by the oil-drilling sites are often disregarded. Many authors have discussed the resource curse—or Dutch disease—that affects countries rich in natural resources, but there is little discussion about the lives of the individuals around the extraction sites besides that pertaining to environmental repercussions of deforestation and pollution. There are many channels through which oil exploration and extraction can affect the human capital of its neighbors, particularly through the creation of infrastructure. When corporations find oil in remote areas, both they and governments might invest in roads for transportation, accommodation of the influx of immigrant workers, and development of local human capital through healthcare centers or schools. Estimating the real effects on people living near oil exploration would allow a comprehensive evaluation of the oil business that is not restricted to health and environmental issues. While those are relevant, the analysis presented here will add a new dimension to the already highly controversial assessment of corporate crude extraction. Using the case of the Ecuadorian Oriente, this paper focuses on the question: *How does nearby oil drilling change locals' employment, access to infrastructure, health, and education?* Though the main focus of this paper is the effects of oil in the education on the locals surrounding the area, other results also contribute to analyzing the effects of economic enterprises in undeveloped areas more generally.

The case of oil exploration in Ecuador provides an important context to study the effects of oil exploitation on local communities. Oil exploration started in 1964, and since then, the state has granted rights of operation to many national and international companies at different times through selling access to precisely delimited areas called "oil blocks." Most of the oil has been discovered and exploited on the eastern side of the Andes Mountains—in the middle of the Amazon basin, also known as Oriente. Previously untouched by modern civilization, the rainforest was suddenly the focus of infrastructure development and corporate presence. While some of Ecuador's indigenous groups lived in the proximity of oil drilling sites, many more migrants came to the region for various reasons, including jobs, but also accessibility due to roads. The most famous example of this situation is that of Lago Agrio ("sour lake" in Spanish), in Nueva Loja, which was developed to serve as local headquarters for Texaco (Krahenbuhl, 2011). This interaction resulted on a class action lawsuit against Chevron (who bought Texaco) for the pollution of the area, a lawsuit that has been brought to four different countries' Supreme Courts and remains unsettled (Hong and Mackrael 2015). I use data from Ecuadorian censuses, from 1990 to 2010, to explore the socioeconomic effects of oil exposure, to contribute to the discussion of this and other cases of corporate engagement in remote, less-developed areas.

The data used in this paper is not perfect: though census data from the Oriente and maps delimiting the oil blocks are available online, the geographic variable of the census observations is rather imprecise. I contacted the Ecuadorian National Institute of Statistics and Census and obtained aggregate data for more precisely-defined regions of the Oriente—110 in total. By mapping each of these to oil blocks in the map, and to the geographic information of the census, I was able to classify areas into three categories: control, low oil areas, and high oil areas. I use Linear Probability Models for discrete outcomes (e.g. being employed or not), and Ordinary Least Squares for continuous variables (e.g. years of schooling). The results are divided into thematic sections—employment, health, infrastructure, and schooling—and also emphasize the differences between locals and migrants, given that immigration into the area is widespread.

The results of this paper illustrate some of the locals' benefits from and struggles of being in contact with oil companies in Ecuador, particularly in contrast to the immigrants' experience. In terms of job creation, oil exposure does not increase the likelihood of being employed, thought immigrants are more likely to start their own businesses in high oil areas. However, exposure to drilling alters the types of jobs that locals work on: they are more likely to be employed in unskilled positions when in contact with oil. These differences between immigrants in locals continue for health and infrastructure. Locals in high oil areas are more likely to have a lower offspring survival rate; oil does not produce such effect for immigrants. In low oil areas, both immigrants and locals have better access to infrastructure, with the exception of phones. High oil exposure benefits immigrants—for locals, it significantly reduces access to electricity, sewage, and phones. Though locals tend to be negatively affected by oil exposure, it is not the case in terms of education. Exposure to oil is associated with an increase in literacy levels both for immigrants and locals, though the effect is higher for immigrants. For years of schooling, low oil exposure produces a positive and significant effect for both immigrants and locals; the effect of high oil exposure was only positive and significant for locals. A placebo regression suggests that these results are not a reflection of pre-existing differences, though it might be the case that results are biased downward because the more educated leave for the cities and other areas in Ecuador, where they are less likely to be employed in skilled positions, despite being as educated as locals.

2 Literature Review

Oil extraction in Ecuador started in 1967 in the northern region of the Oriente, and shortly after joining the OPEC in 1973, the country became completely reliant on its oil revenues (Sawyer 2004). The discovery and exploitation of oil radically increased income per capita: from US$290 in 1972, it rose to US$1200 in 2000 (San Sebastián et al. 2004). Oil exploitation accounts for 40% of the nation's exports and governmental budget (San Sebastián et al. 2004). The Ecuadorian government has established certain areas for oil exploration, "blocks," whose rights are lent to companies in "bidding rounds" starting in 1985. Oil companies are currently drilling on fourteen blocks in the Oriente, with over 300 functioning wells and 29 production camps (San Sebastián et al. 2004). According to National Geographic, many communities live inside the perimeter of those blocks, while some live just outside, as shown in the map below (Education Blog 2013).

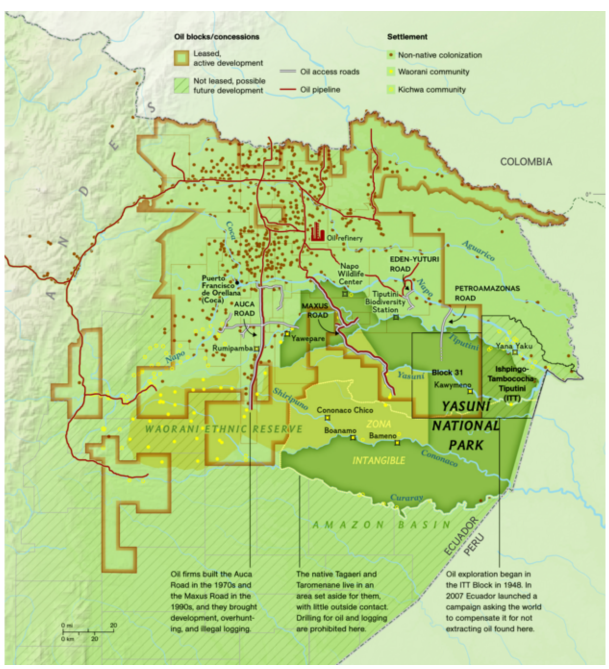


Figure 1: Oil blocks and demographics

2.1 Oil: A Resource Curse?

Literature on the "resource curse," or Dutch Disease—the idea that a country's natural resources do not contribute to growth—is vast. On a macro level, income from oil revenues and other natural resources can induce economic growth, although the effects are context-dependent. Bravo-Ortega and Gregorio (2005) conclude that the natural resource industry has a negative effect on economic growth, even though it increases income. With a macroeconomic model of growth and trade, the authors affirm that natural resources attract skilled workers from other sectors that could foster growth: thus, the country specializes in a sector with low productivity. Black, McKinnish and Sanders (2005) show that the coal boom in some regions of the US had negative net impacts. Because of elevated job creation, only sectors producing nationally traded goods benefited from the boom; the society as a whole, however, suffered its negative effects. Due to the cyclic nature of both the coal and the oil business, one can expect similar spillover effects from both—by affecting other sectors, oil drilling might produce indirect consequences in the local peoples' lives. The three most common effects of the Dutch Disease, Levy argues, are the deterioration of particular sectors, a higher real exchange rate, and increase in poverty and inequality (2006).

But some authors argue that it is possible to beat the resource course through governmental actions. Torres, Afonso and Soares (2012) find that the main problem in natural-resource wealthy countries is the poor quality of their fiscal institutions. Only with significant governmental involvement and good quality policies it is possible to beat the downturns of natural resource wealth (Torres et al. 2012). Levy (2006), in her paper "Public Investment to Reverse the Dutch Disease: Case of Chad," presents simulations of the ways governments can spend oil revenues—

particularly, in roads or irrigation systems. She predicts that through roads, isolated people can integrate to markets and access water supply, and argues that governments can prevent the so-called resource curse. If oil production increases income, at least momentarily, a country could implement policies that use the wealth to positively develop physical infrastructure, and thereby, human capital.

2.2 Growth and Welfare through Infrastructure

It might be the case that investing in infrastructure not only offsets the resource curse, but also produces long-term development. Agénor (2006) contends that public infrastructure can fuel long-run growth, given that a country has good governance and the investments are efficient. This happens through an increase in labor productivity and a decrease in time preference, resulting in a high growth steady state (Agénor 2006). Several empirical papers support this theory, many of which refer to roads. According to Gachassin et al. (2010), it is well established that roads provide access to input and output markets, labor opportunities, and education and health services. Ulimwengu et al. find that access to cities and ports is important for agricultural production in the context of the Democratic Republic of Congo, as measured by travel time: being closer to the market increased wealth (2009). Jalan and Ravallion (1998) find similar results when studying rural population in China. Gachassin et al. (2010) explain that easier access to roads—measured both in time and distance—changes labor activities and produces positive net effects. Jacoby (1998) models a hypothetical road in Nepal, and argues that poor people would benefit, though there would be no change in income inequality. Sapkota (2014) finds that road density in a country is a strong predicator for income, while electricity and water access predict education and health. Finally, both Mu and Van de Walle

(2007) and Khandker et al. (2006) find increased education levels in Vietnam and Bangladesh after significant investments in roads.

At a local and individual level, literature shows that new roads can affect both the behavior and the health of communities. According to Pucha Cofrep (2005) most of the indigenous communities in Ecuador subsist on agriculture and hunting, and only a small part of the excess production is taken to local markets. These markets are often small, and mostly dedicated to artisanal goods (Pucha Cofrep 2005). Espinosa et al. (2014) argue that roads and market proximity have an effect on the types of animals that indigenous in Ecuador hunt, and also, the geographical extent in which they do so. The construction of roads decreases the cost of hunting, because it increases unprotected areas for people to capture animals. Building a road next to an indigenous community doubled the number of animals that indigenous people hunted, producing an income effect. It can reduce the opportunity cost of schooling: as hunting becomes easier, it requires fewer members of the household to participate to sustain the family. But individuals can also choose to participate more in hunting—a substitution effect into low skill labor—because hunting does not require much education. Research by Liebert et al. (2013) indicates that the distance from the market not only modifies indigenous people's hunting habits, but also their health. Studying the Shuar community, Liebert et al. show a significant relationship between how close people live to town and their cholesterol and blood pressure. Indigenous people that are more integrated with the market have higher cholesterol, which could be a result of the increased access to different foods and consumer products (Liebert et al. 2013).

More specifically to the Ecuadorian context, roads impact the environment, but also facilitate migration. A World Bank publication by Bilsborrow shows that, between the censuses of 1972 and 1985, about 10 percent of national migrants moved to rural areas in the Oriente, given the ease of access to the region due to roads "constructed by oil companies" (Hicks et al. 1990; Kimmerling 1991 in Bilsborrow 1992). A newspaper article in *The Guardian* from June 2014 defines roads in the Ecuadorian Oriente as a "high-impact alternative to using only helicopters and rivers" for transportation of materials; "'No roads' has been best practice for years" adds the author (Hill 2014). Finer et al. (2014) use high-resolution imaging to expose a new road built by an oil company into one of the oil production areas. The authors find cars and trucks in WorldView-2 images (from the Satellite Imaging Corporation), concluding that roads were being used for oil extraction (Finer et al. 2014). Activist websites and writers are quick to point out the relationship between roads and migration, with one claiming that "once the roads were built, pipelines laid, Indians sedated (or dead) and oil flowing, people streamed in" (Krahenbuhl 2011).

2.3 The (Non) Opportunity Cost of Schooling

But besides affecting infrastructure, increased revenues from oil can directly influence investment in human capital. Gylfason (2001) finds a negative relationship between natural resource wealth and education expenditure, female years of schooling, and high school enrollment. "Natural capital," he argues, "appears to crowd out human capital, thereby slowing down the pace of economic development" (Gylfason 2001, p. 847). Other authors find similar results: Birdsall, Pinckney, and Sabot (2000) show less investment in education in developing countries that are rich in natural resources, and Davis and Tilton (2005) highlight the wasted opportunities of countries with natural commodities. Behbudi et al. (2010) make a distinction between major petroleum exporters and other petroleum exporting countries. In the major petroleum exporters, human capital has a negative relationship with oil wealth—for the rest of the countries, the relationship is positive. Authors argue that this is a consequence of natural-resource wealthy countries' disregard of the necessary development of human resources (Behbudi et al. 2010). Stijns (2001) shows the possible outcomes of strategic investments with revenues from natural resources. He argues that oil production is sometimes associated with an increase in education expenditure and female human capital accumulation. Using World Bank data for all the countries included, he presents evidence that life expectancy can increase by twelve years, female education by four years, and literacy can reduce by 32% with income from natural resources (Stijns 2001). Emery, Ferrer, and Green (2012) suggest that oil booms are associated with a change of timing of schooling, but not a decrease in the accumulation of human capital. The different settings in which oil companies interact with communities—mostly, the type of jobs they create—and the governmental response to the oil industry will determine its net effect on people.

Theoretically, new local low skill jobs in oil drilling would increase the opportunity cost of education and thereby reduce schooling, although this is contingent on the situation. Two contrary pressures affect students: the possibility of earning money (a higher opportunity cost of schooling), and the prospects of earning more after education if jobs are still available (a higher return to schooling). Le Brun et al. (2009) study the impacts of new Maquiladoras in Mexico: while education improves for young children, teenagers were negatively impacted. Atkin (2012) estimates that for every twenty jobs created, one person dropped out of school three years earlier than they would have otherwise. Controlling for the job characteristics—in Atkin's example, low-skill and high paying—neutralizes the effect on schooling; thus, the consequences of job creation are highly dependent on the characteristics of those jobs

(Atkin 2012). Federman and Levine (2005) sample different regions in Indonesia, where both lower and higher skill jobs were created. They find that adding industrialized jobs to an economy increases school enrollment and decreases the number of teens in the workforce. They attribute these effects to increased industrialization, school density, quality of roads, and higher household consumption. Duflo (2001) is consistent with Federman and Levine (2005): in both papers, urbanization and construction of schools and roads in Indonesia had a positive effect on education and earnings, because they reduced the cost of education. Jensen (2010) argues that perceived returns (not necessarily real returns) to education matter in schooling choices, so the impact of job creation could depend more on how these jobs are perceived in the community than on their real characteristics. For example, whether people believe they belong to the job candidate pool or not.

Besides depending on the type of job created, the effects on schooling will also be contingent on who can get hired—and oil companies do not always hire locals in the Ecuadorian Amazon. In her analysis of indigenous communities in the oil-producing Ecuadorian province of Pastaza, Korovkin (2003) argues that oil businesses rarely hired native people. If they did, it was often as guides for the corporate workers, or to complete reforestation plans—two low-skill jobs. Most of the local inhabitants in the Oriente live in indigenous communities (more than 94% of the population was either mestizo or indigenous in the 2010 census, see Table 1 on page 24). I reviewed 21 articles and books on the indigenous people in the Amazon for this essay: not a single one mentioned indigenous people working in the oil industry (Amazon Watch, Ávalos 2012, Cortina 2013, Espinosa et al. 2014, Gay et al. 2010, Geoyasuni, Haley 2004, Hicks et al. 1990, Hong et al. 2015, Kimerling 1990 and 2013, Korovkin 2003, Laurian et al. 1997, Liebert et al. 2013, Moolgavkar 2014, National Geographic 2013, Ponce et al. 2003, San Sebastián 2001, San Sebastián et al. 2004, Sawyer 2004, Vogliano 2009, and Wasserstromg 2014). According to Korovkin (2003), indigenous individuals often complain about the unwillingness of companies to hire them. Thus, there are reasons to believe that oil companies bring in both skilled and unskilled labor from nearby locations or cities. Even though the creation of jobs could increase the opportunity cost of schooling, the substitution effect does not apply in this case: indigenous people do not have incentives (or the choice) to abandon school over a job. A caveat to this statement is that other indirect effects of oil exploration might result in new jobs: increased exposure to cities brought by the roads, or new jobs to serve those who migrate.

Even if the opportunity cost of schooling is inexistent, the possibly harmful health effects of oil exploitation could prevent inhabitants from obtaining education. Pollution from oil drilling can affect people's wellbeing and mental stability. Kimerling affirms that Texaco was generating "more than 3.2 million gallons of toxic wastewaters every day [in 1990], all of which was dumped into the environment via unlined, open-air earthen waste pits, without treatment or monitoring," although that same process had been banned in the US for over a decade (2013, p. 60). Texaco's carelessness over its time in the Amazon contributed to a spill double the size of the well-known Exxon Valdez disaster, except that Texaco did not contribute with any cleaning efforts before abandoning the area in 1992 (Kimerling, 2013). And although Moolgavkar et al. (2004) estimate that contamination had no effect in cancer mortality of the indigenous living in oil-producing cantons, coming into contact with chemicals causes other less severe health issues, like spontaneous abortions and skin diseases (San Sebastián 2001). Contamination might also reduce sources of clean water (Gay et al. 2010). But toxic waste can also produce psychological negative externalities. Psychological side effects seem to be ever-present in populations near oil drilling and contamination sites (Gay et al. 2010). According to Palinkas et al. (1992 and 2004), different ethnicities are harmed psychologically in different ways. They examing ethnic differences in coping mechanisms and post-traumatic stress between Native-Americans and Euro-Americans in Alaska, after the 1989 Exxon Valdez spill. The authors discover that Natives had higher exposure to the spill, although the levels of post-traumatic stress disorder were similar in both groups (1992 and 2004). Alaskan Natives were much more likely to report damages to property and land, and participate in cleaning efforts; those who reported damages were also more likely to have post-traumatic stress disorders than those who did not (1992). Using the example of Ecuador can help estimate the consequences that oil drilling has on individuals, which can lead to a better analysis of the complex relationships that develop between communities and oil around the world.

In order to placate local protesters in local communities, oil corporations often enhance access to social services by building schools and hospitals around the crude extraction site (Sawyers 2004). Atlantic Richfield Corporation's yearly $500,000 fund for social projects in the Ecuadorian Oriente, established in 1992, included basic health, transportation, communication and education, and provides an example of such an initiative (Haley 2004). In a fight with the Huaorani, an oil company agreed to "sponsor education, health, and small-scale development projects" for the community, although the projects were not as extensive, and served only to "legitimize the company's presence in the Huaorani territory" (Korovkin 2003, p. 7). In Canada there is a scholarship for indigenous people living around the Imperial Oil well ("Sahtu Aboriginal Scholarship Program," 2013). Although these initiatives vary with the oil company and the situation, it will be important to consider these additional efforts when measuring the effects of oil drilling in general.

3 Hypothesis

Various opposing forces might affect the schooling of locals in oil drilling areas. On the one hand, oil businesses reduce the cost of schooling by decreasing transportation time. Depending on the fiscal investment in the area and the oil company's actions, oil production can also incentivize the creation of new schools, thereby reducing the distance and thus travel time to such institutions. Furthermore, the roads created could reduce the opportunity cost of education by facilitating access to food, and requiring less people to participate in collecting it. Alternatively, however, hunting can be considered an option for low skilled individuals, who will benefit from the expansion of roads and might opt out of schooling. But because companies do not tend to hire local people, the opportunity cost of schooling will not increase in terms of formal labor. The positive effect on schooling will be enhanced if local people see the returns to schooling rise due to the increased interaction with the market, perhaps in other sectors, like tourism. Health problems, which could counteract these effects, do not seem like a primary concern (Moolgavkar et al. 2004). Additionally, new roads will facilitate indigenous access to healthcare facilities. The effects of oil, however, will be highly dependent on the extent to which oil corporations act on a given area—and variability could be high.

4 Economic Model

In order to provide a theoretical context in which to interpret my empirical results and the mechanisms considered above, I develop the following economic model. Specifically, I extend a standard model of schooling choice to account for the distinctiveness of the Amazon context. There are two period in the model—present and future, or first and second—to account for the increased earnings that could result from schooling. Individuals choose the schooling in the first period, their youth, and benefit from their level of schooling in the second period, their adult life. Individuals choose the amount of skills or schooling that they will acquire, maximizing their lifetime utility, as shows the following equation:

$$\max_{s,w,h,x_1,x_2} U(s, w, h, x_1, x_2; H, A, Z) \tag{1}$$

Where the choice variables to maximize utility are schooling (s), work (w), healthcare (h), and present and future bundles of consumption (x_1 and x_2). Note that work can take the form of formal or informal employment, like hunting. Utility depends on these factors and also on predetermined characteristics: health (H), individual characteristics (A), and household and community characteristics (Z). The difference between H and h is that the former is out of control for the individual—for example, in this case, pollution. h represents those characteristics of health that depend more directly on access to healthcare facilities, like giving birth at a hospital instead of at home. These last variables, H, A, and Z, include both observable and unobservable characteristics—for example, electricity in the house or preference for a cleaner environment.

Each person faces two constraints: money and time, both in the first and second periods. Non-labor income from a period, Y_1 or Y_2, together with labor income, can be spent in consumption, schooling and healthcare. Time, T, is also divided among those activities. In the first period:

$$(x_1 \times p_x) + (s \times p_s) + (h \times p_h) \leq Y_1 + (w \times p_w) \tag{2}$$

$$(x_1 \times t_x) + (s \times t_s) + (h \times t_h) \leq T - (w \times t_w) \tag{3}$$

That is, individuals are constrained to consume what they have plus what they are earning at that period, and can save for the next—which will add to their non-labor income, Y, for that subsequent period (see equation 4). Similarly, they have limited amount of time, T. Time not spent in consumption, schooling, or healthcare activities is leisure time. Because families hunt, gather, or travel to the market to obtain food and goods, there is a time cost to consumption (t_x) as well as a monetary cost (p_x). Schooling also has a both costs associated with it: mostly travel time, but also time spent in a classroom, and the cost of education—captured in p_s and t_s. Health also has a time cost since individuals often seek care far from their land. Thus, the model incorporates the opportunity cost of schooling: time spent other than studying can be spent obtaining health services, working, or in leisure.

According to the model, individuals would choose to be schooled for the utility derived from it—including future consumption, which appears in the budget constraint for the second period:

$$(x_2 \times p_x) + (h \times p_h) \leq Y_2 + (w \times p_w) \tag{4}$$

Which is similar to the present-time budget constraint, excepts that it includes savings from the previous period (included in Y_2, which equals the income from the first period minus the consumption: $Y_1 + (w_1 \times p_w) - x_1)$, and individuals are no longer spending income on their education. However, because wages depend on schooling obtained in the first period ($p_w = f(s)$), schooling can be included in the budget constraint in the following way:

$$(x_2 \times p_x) + (h \times p_h) \leq Y_2 + (w \times f(s)) \tag{4a}$$

The time constraint for the second period is the equal to that of the first period, except that it no longer includes schooling, i.e. the value for s on equation 3 is zero, assuming that adults do not pursue schooling.

Thus, the demand for schooling in the present is determined by various characteristics, which include both present and future consumption. Many variables affect the schooling decision: the cost of consumption, schooling, and health—both in time and monetary cost. The reduced form demand function for schooling implied by the model appears below.

$$s = f(p_s, t_s, H, A, Z) \tag{5}$$

The variables have been explained above. Only the price and time-cost of education are included, given that they are relative to the other prices. The individual characteristics, A, could include gender, parental education, or whether a parent is employed in the formal sector, which can affect schooling allocation. Z will also impact education, as household and community characteristics—tribal organization, presence of tourism, socioeconomic status, among others—will influence an individual's allocation of time. Some of these features will not change over time, but some will: for example, the level of market integration, or size of the community.

There are two ways through which oil drilling will affect individual behavior in this model: newly built infrastructure, and the presence of an oil corporation in the site. I choose to separate these effects into two variables to identify the influence of oil companies not related to road creation. I captures the characteristics of the infrastructure in the area, mainly but not restricted to roads. O is a vector expressing whether there is oil involvement in the area, and up to what extent. O also includes concrete efforts from the oil corporations—the building of schools and hospitals, for example, or the creation of social programs for the community. Together, I and O affect the time travelled to consume goods (t_x), go to school (t_s), and seek care (t_h). Thus, oil exposure could decrease t_s:

$$t_s = f(I, O) \tag{6}$$

Oil has similar effects on health, except that it can affect health characteristics through two mechanisms, not only through the time-cost of seeking care:

$$H = f(O, A, Z) \tag{7}$$

$$t_h = f(I, O) \tag{8}$$

On the one hand, oil companies contaminate the environment, so H depends on the pollution effects of O. Although this has not been a prominent concern, it is included in the model to estimate the possible consequences of more dire pollution. But oil companies' efforts, like the building of hospitals for instance, can reduce the cost of accessing healthcare facilities (h), which is captured in the equation for t_h. I also reduces t_h, in the same way that it reduced t_x and t_s.

Under this specification, the effects of I will be positive—for increased infrastructure will almost definitely increase healthcare availability and procurement. O, however, has two counteracting effects. Significant pollution from oil might impact H negatively, but hospital construction will reduce the time-cost of healthcare. If the reduction in cost is larger than the negative effects, then O will be positive and improve health. Health will also depend on household and community characteristics—consumption patterns, for instance.

Incorporating health equations into the demand for schooling (equation 5), allows for the creation of a simplified form of demand for schooling:

$$s = f(I, O, A, Z) \tag{9}$$

This equation captures the effects of oil companies and infrastructure in the schooling decision made by individuals.The model predicts that, if prices decline through I or O, individuals will choose to increase their time spent in schools and procuring healthcare. These decisions will also depend on vectors of characteristics of their household and community, which affect both health and schooling.

5 Data description

5.1 Individual-level Census Data

Data from Ecuador's individual-level census is distributed by the Integrated Public Use Microdata Series (IPUMS-I) in six samples, of around every ten years from 1962 until 2010. The censuses were conducted by the Instituto Nacional de Estadística y Censos [National Institute of Statistics and Censuses] (INEC). The censuses available online are accompanied by each census' questions and manuals for the people collecting the data. Moreover, a complete analysis of the evolution of the census—the questions asked and the data collection process—is available online at the INEC's website (INEC 2014). Because most of the documented petroleum blocks of the Oriente were sold starting in 1985 (EP Petroecuador 2010), I only exploit the samples of 1982, 1990, 2001 and 2010. Two areas had contact with oil before the rounds started, which I discuss below. In total, there are more than five million observations spread across all of Ecuador. However, I only use data collected from people living in the Oriente, given the significance of geographical differences in Ecuador, which reduces the sample to about 192,000 individuals.

The census data is not too precise geographically, because of both technical and historical reasons. Ecuador is divided into 24 provinces, six of which are located to the East of the Andean mountains, in the Oriente. Each province is composed of two or more *cantons*, and each canton is divided in several *parroquias*. The six provinces of the Oriente include 41 cantons in total, and around 110 parroquias. But because many of these cantons have populations under 20,000 and the identities of its inhabitants must be protected, the IPUMS data shows both real cantons (those with populations over 20,000) and what I choose to call "areas," a group of two or more cantons in the same province. In total, there are 14 areas, six of which are called "Cantons under 20,000"—one for each province—and eight that are actual cantons. I requested more specific data from the National Institute of Statistics and Censuses, but it only provided aggregate information: means for every variable, rather than individual observations, for each of the parroquias in a canton (I use this data to create a different measure for oil, which I explain in the next section).

Figure 2 (on page 21, adapted from Wikimedia Commons) shows a map of the six provinces of the Oriente: Sucumbios, Napo, Orellana, Pastaza, Morona Santiago and Zamora Chinchipe. Each province is divided in cantons by grey lines. As aforementioned, not every canton is identified in the data—only those cantons filled in color within a province are individually specified. The rest of the cantons in that province are grouped into one area, which is not always contiguous. For example, Sucumbíos, includes seven cantons: Sucumbíos, Gonzalo Pizarro, Cascales, Lago Agrio, Putumayo, Cuyabeno, and Shushufindi. Only Lago Agrio and Shushufindi are specified in the data (filled in blue), and the other five are grouped into an area called "Cantons under 20,000 in Orellana" (lightly shaded in blue). Note that this last area includes both the two easternmost and the two westernmost cantons of the province, and the census data treats both geographies as one. Out of the six provinces in the Oriente, four of them are divided into two areas (one real canton, and one group of cantons), and two provinces are divided into three areas (two real cantons, and one group of cantons). See Table A in the Appendix (p. 59) for the list of areas and the number of observations per year.

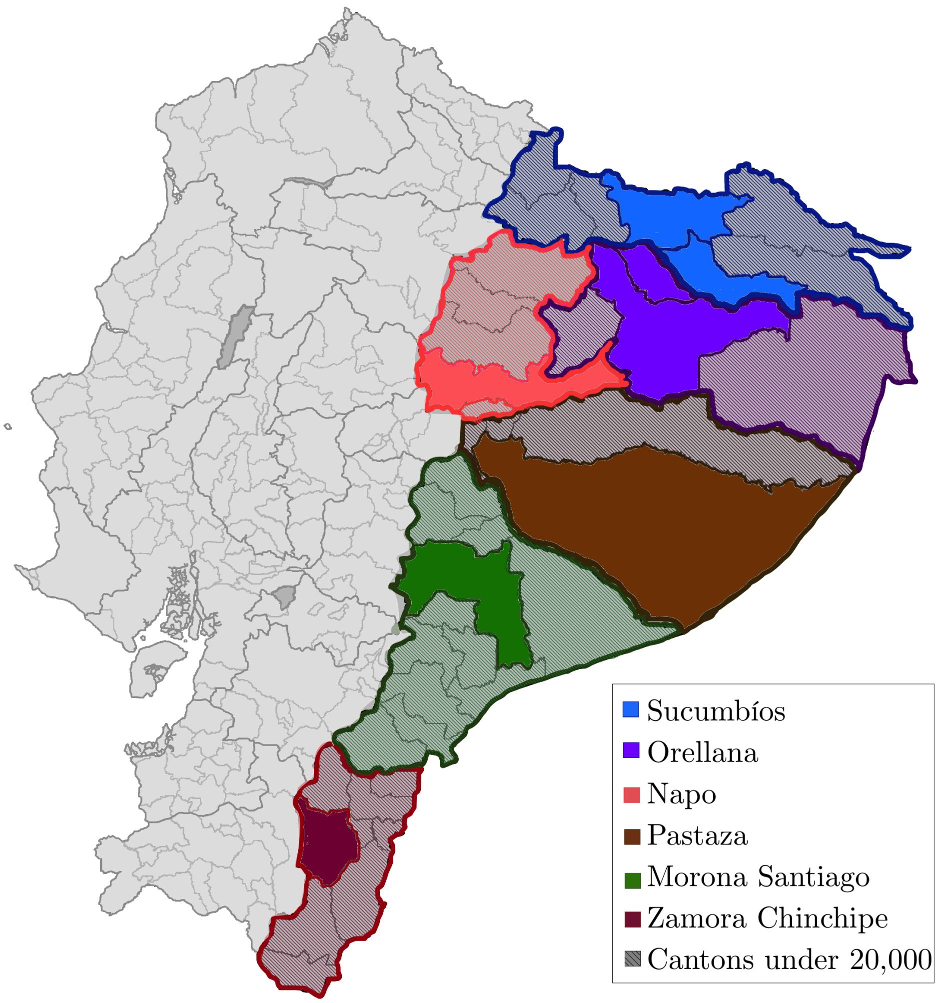


Figure 2: Areas and cantons by province

Besides the lack of geographical precision, another disadvantage to IPUMS' individual-level observations is that some areas only appear on later versions of the census because of geopolitical historical reasons. In 1982, only eight areas of the Oriente had observations—totaling almost 26,400 observations. By 1990, three more areas were included: two cantons, Lago Agrio and Shushufindi, and an group of cantons under 20,000. Not coincidentally, Lago Agrio ("Sour Lake" in Spanish) was only founded in the late 1960s as local base camp for Texaco—based in Sour

Lake, Texas in the United States (Ecuador Explorer). In total, the sample that I use of the census of 1990 had around 37,100 observations. By 2001, all 14 areas of the census had observations in the sample, with over 54,600 observations. In 2010, 74,000 people were included in the sample that I use.

The variables included in the individual-level census data also vary with time, as shown in Table 1 (p. 24). From the first census in 1982 until the last one in 2010, there is complete information about a person's basic demographics including age, gender and marital status. Total children born to female inhabitants and number of children who survived are reported (children are considered to have survived if they are living at the time of the census). Because only some portion of women are old enough to be mothers, the offspring survival rate observations are relatively small. Several schooling-related variables are also included: school attendance, years of schooling, and literacy. Details about a person's employment are also present: whether a person is employed, self-employed, and the type of work that person does, as classified with the International Standard Classification of Occupations from the International Labor Organization (IPUMS). The census of 1982 also includes three measures of household infrastructure: whether a household has electric power, sewage system, running water.

In the census of 1990, three variables of interest were added: whether a person had migrated, was disabled, or lived in a house with a phone. The migration variable also denotes whether a person migrated from abroad, from a different major administrative unit, or within an administrative unit. It is notable that local migration is widespread—in the 2010 census, 76.91% of individuals are migrants from the same province—and thus, I will make a distinction between these and other migrants, i.e. those coming from other provinces or countries (see Table 1). Moreover, this information is particularly helpful in analyzing two groups of people: those who migrate into the area, and those who move out of the oil areas. Though the place of origin is not as specific as the destination (where the responses are recorded), I use this data to trace who has migrated from the Oriente into the cities.

In 2001, both race and language are included in the personal observations. The census employs many different categories for race. For simplicity, I grouped *mestizo* (indigenous and white, around 60%), *montubio* (black and indigenous, around 0.3%), and *mulatto* (black and white, around 1.2%) under the term mestizo ("mixture" in Spanish). It is likely that the variation between year 2001 and 2010 is just a matter of classification. By 2010, cellphone usage was also part of the questions for the census. This information is summarized Table 1.

Table 1: Descriptive statistics

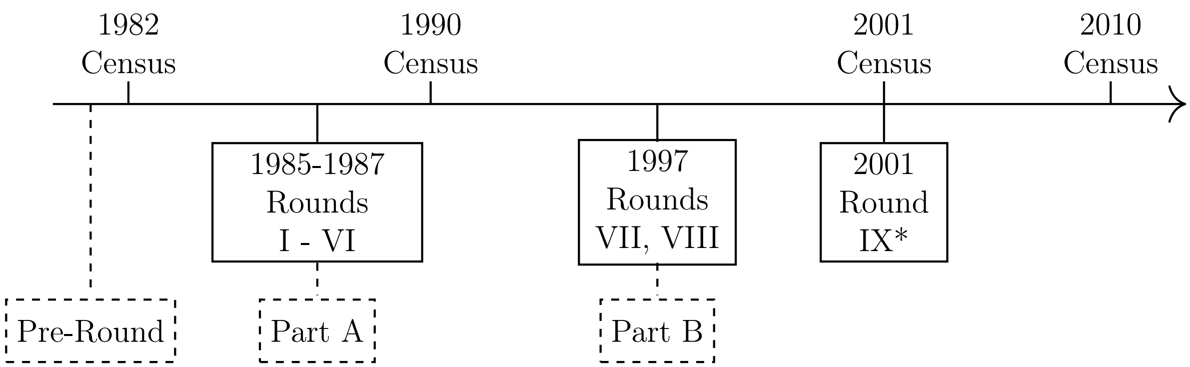
Variable		**1982**	**1990**	**2001**	**2010**
Age	Mean	19.96	20.75	23.49	24.07
	N	26,123	37,114	54,611	74,016
School attendance	Mean	27.7%	27.7%	32.4%	38.2%
	N	25,369	36,247	52,327	74,016
Literacy	Mean	79.7%	86.7%	87.5%	90.6%
	N	20,548	29,722	46,670	61,988
Years of Schooling	Mean	4.114	5.066	5.461	6.994
	N	19,394	28,461	46,104	61,988
Employment	Mean	28.3%	34.9%	36.7%	38.4%
	N	26,392	37,114	54,643	74,016
Offspring survival rate	Mean	87.2%	90.4%	93.7%	95.5%
	N	4,490	6,474	10,632	15,753
Electricity	Mean	27.6%	38.6%	58.5%	80.4%
	N	26,392	37,114	54,643	74,016
Sewage	Mean	11.2%	17.2%	29.4%	35.0%
	N	26,392	37,114	52,827	72,351
Water	Mean	26.4%	38.1%	55.5%	66.3%
	N	25,260	35,942	52,827	72,531
Phone	Mean	-	4.5%	14.3%	21.5%
	N		35,942	52,827	72,531
Immigration	Mean[1]	-	83.8%	85.5%	87.4%
	N		37,114	54,643	74,016
Origin	*Same province*		68.8%	74.2%	76.9%
	Other province		14.6%	10.5%	8.8%
	Abroad		0.4%	0.8%	1.7%
Disability	Mean	-	0.008	0.015	0.017
	N		36,339	54,643	74,016
Race	Mean	-	-	NA	NA
	N			54,643	74,016
	Mestizo			63.6%	61.1%
	Indigenous			29.3%	33.2%
	White			5.9%	3.5%
	Black			1.0%	1.9%
	Other			0.2%	0.3%
Cellphone	Mean	-	-	-	65.8%
	N				72,531

1 Percentage of people who have not lived in the area for more than 5 years

Source: Integrated Public Use Microdata Series, International [IPUMS-I]

5.2 Mapping and Timing of Oil Effects

To classify each of the 14 areas of the census by their exposure to oil drilling, I use publicly available maps that delimit each of the oil blocks and information about the years in which the blocks were sold. Figure 3 below shows a timeline for censuses and oil-bidding rounds:



* Round did not result in sale of rights of any oil block in the Oriente region

Figure 3: Timing of oil-block bidding rounds and censuses

The timing of petroleum block's bidding rounds and censuses allows for different analyses, since different locations have longer exposure to oil than others. With the exception of Round IX in 2001, all the rounds ended with the successful bidding of oil blocks located in the Oriente. Only some areas—Lago Agrio and Shushufindi—were sold before rounds started, and for that reason the pre-rounds appear on the timeline. All the communities affected between 1985 and 1988, in Part A, will be part of the treatment group in the censuses of 1990, 2001 and 2010. The effects of Part B rounds, in which the government sold 8 petroleum, will only appear on the 2001 and 2010 censuses. The more immediate effects of oil exploration from Rounds I through VI (Part A) will show in the 1990 census, and those from Rounds VII and VIII (Part B) in the 2001 census. However, the 2001 and 2010 censuses will also show the effects of oil exposure of the earlier rounds, especially among adults that spent their teenage years in contact with oil, which might have affected their schooling decisions. The timing of oil blocks can also be seen on the following image, where Part A blocks appear in red, and Part B in green (the three darker red blocks were sold first in rounds of Part A, and their contracts were renewed or modified in the rounds Part B).

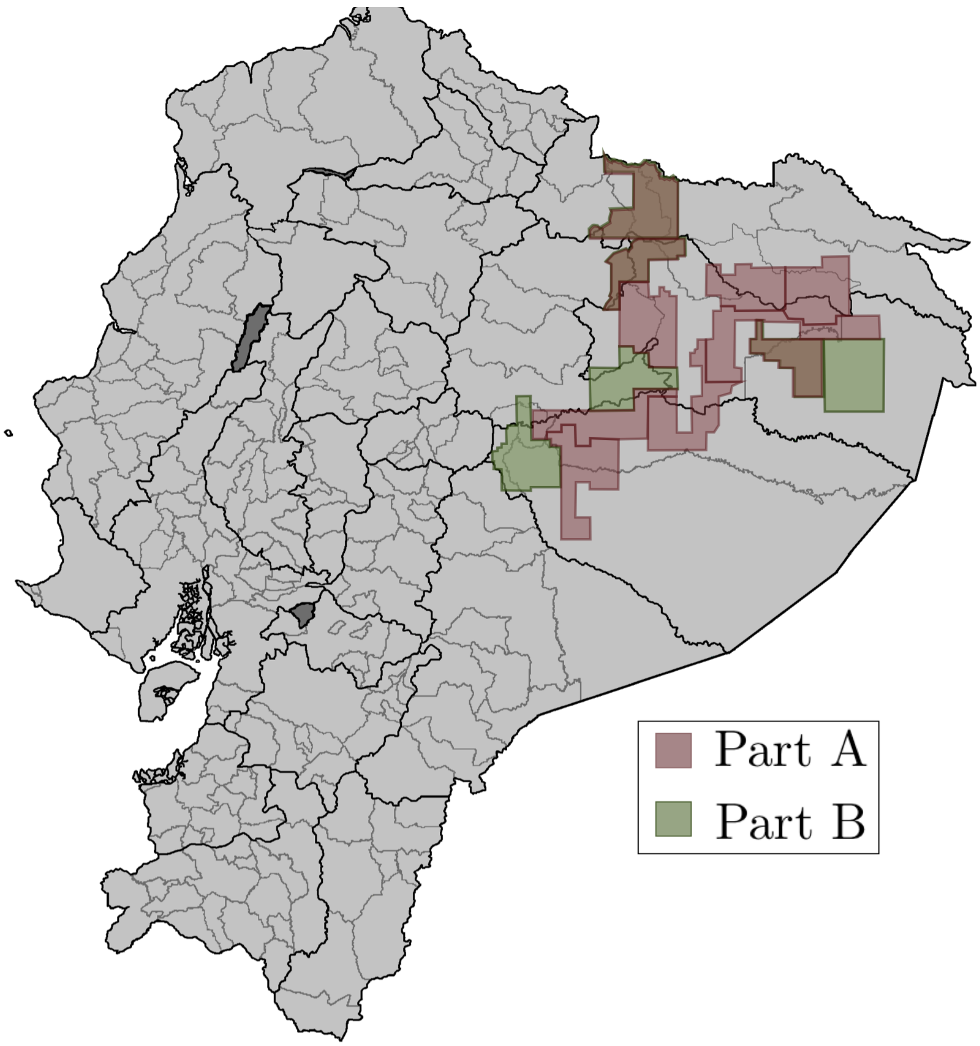


Figure 4: Sale of drilling rights

Figure 4 is also evidence of the challenge of qualifying each area as treatment or control group. Because the oil blocks are delimited independently of political divisions of cantons and areas, it is hard to classify whether an area must be considered part of the oil block for the purposes of this analysis (compare with the map on page 21). In some cases, an oil block covers part of an area—in others, none. For that reason, the classification just between treatment and control is noisy and unreliable. In the example below, of the cantons in Sucumbíos, area (1) has most of its area under an oil block, area (2) only a part of it, and (3) none. In addition—as one can see in the map of page 21—areas (2) and (3) are grouped into the area called "Cantons under 20,000," making the classification even less precise. In total, 10 out of the 14 areas had some contact with oil blocks from 1982 to 2010.

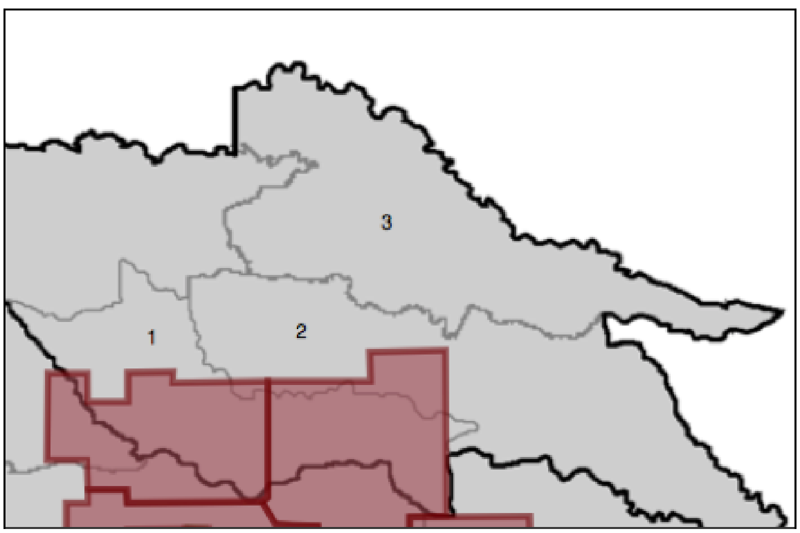


Figure 5: Oil blocks and areas

Due to the lack of precision that a binary classification offers in this context, I create an alternative: a measure for oil exposure that can distinguish between areas of low and high contact. The oil exposure of an area is equal to the percentage of the population that lives inside an oil block. To find it, I use both the aggregate data provided by INEC, and Google Earth Pro—including a map of oil blocks downloaded from Geoyasuni's website in Google Earth format (a KMZ file). First, I estimate the percentage of a population of an area living in each parroquia, for each of the 110 parroquias in the Oriente, with the aggregate data. Then, I search for every parroquia in Google Earth Pro, which was already loaded with the map of oil blocks. The example below shows (Figure 6 on page 29, adapted from Google Earth Pro) an oil block and a parroquia. The light blue lines delimit an oil block, and the red marker is showing Joya de los Sachas, a parroquia in Sucumbíos. Because parroquias are smaller than cantons and areas, their classification as part of the oil or control group is straightforward.

After deciding whether each of the 110 parroquias belonged to the treatment or control group for each of the years in the census, I summed the percentage of population affected by oil on a given area to calculate the oil measure. Even though sometimes the territory under an oil block is relatively large, this measure effectively estimates oil dosage by incorporating the population density of such areas. Moreover, it accounts for additional sale of rights between censuses because it changes over time. Sometimes additional parroquias were exposed to oil between censuses, in which case the dosage increases. Table 2 shows the oil dosage for each area by year (as aforementioned, some areas were only incorporated later: the dashes represent no observations for that location and year).

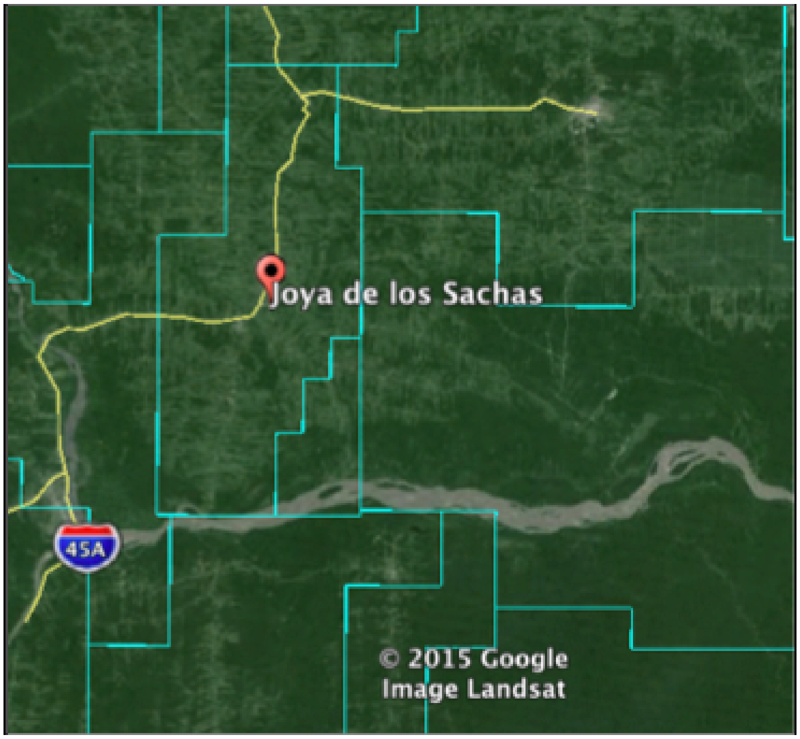


Figure 6: Google Earth map with oil blocks

Table 2: Oil dosage by area and year

Province	**Area**	**1982**	**1990**	**2001**	**2010**
Morona Santiago	Morona	0	0	0	0
	Cantons under 20,000	0	0	0	0
Napo	Tena	0	0	0.11	0.11
	Cantons under 20,000	0	0	0.2	0.2
Pastaza	Pastaza	0	0.004	0.882	0.882
	Cantons under 20,000	0	0.123	0.631	0.631
Zamora	Zamora	0	0	0	0
	Cantons under 20,000	0	0	0	0
Sucumbios	Lago Agrio	-	0.895	0.895	0.895
	Shushufindi	-	0.756	0.756	0.756
	Cantons under 20,000	-	0.428	0.428	0.428
Orellana	Orellana	-	-	0.821	0.821
	La Joya de los Sachas	-	-	0.162	0.162
	Cantons under 20,000	-	-	0.439	0.439

To account for differences among oil measures, I separate the fourteen areas into three categories: control, low oil, and high oil areas. The first is the control group, where the percentage of inhabitants living in an oil block is zero. The are four areas that remain in the control group at all points, in both Morona Santiago and Zamora. The second group is the low oil category, containing all areas with oil dosage under 0.3—all the other areas are considered a high oil category. There are two main reasons why such cutoff makes sense. First, it is the mean of the distribution for exposure. Second, with this limit, Sucumbios is classified as a high oil area, which is reasonable given the history of the area (Sawyer 2004). As a result of this threshold, some areas are considered low oil areas initially, but become high in subsequent censuses. For instance, areas in the province of Pastaza are part of the control group in 1982, become low oil areas in 1990, and high oil areas starting in 2001.

6 Empirical Approach

6.1 Differences between Immigrats and Locals

Because inward migration is widespread in the area, I focus on the differences between immigrants and locals first. Does oil exposure attract immigrants? If so, are they more skilled than locals? Because the outcome of interest is a discrete variable, I estimate the following Linear Probability Model:

$$mig = \beta_0 + \beta_1(oil) + \beta_2(yrsch) + \beta_3(oil \times yrsch) + \beta_4(male) + \varphi_t + \varphi_c + \varphi_a \quad (10)$$

Where *mig* is a dummy variable that takes the value of 1 if the individual has immigrated to the area. *oil* stands for to two dummies—one for low dosage, and one for high, to compare the differences between the three groups: control, low, and high oil exposure. *yrsch* (years of schooling) controls for education and *male* is a dummy that takes the value of 1 if the person is male. The coefficient on the interaction between oil and years of schooling will reveal whether the more skilled migrate to oil areas. Two interaction effects are included: one for low oil areas and years of schooling, and one for high oil areas and years of schooling. If it is true that oil companies hire skilled migrant workers, the coefficient for the interaction term would be positive. Moreover, the coefficient for years of schooling will show the level of education of migrants to other areas not in contact with oil. φ_t, φ_c and φ_a are time, community and age fixed effects. These are included to prevent trends and unobserved differences across communities and age groups from potentially biasing the results. Because the data provides details on the place of origin of the individuals, this regression is run three times, with three dependent variables: immigrated from abroad, immigrated from a different province, and finally, immigrated from the same province.

6.2 Effects of Oil Exposure on Employment, Health, and Access to Infrastructure

Estimating the effects of oil exposure in employment, health and access to infrastructure is relatively similar. I run regressions separately for immigrants and locals. I use different samples: for immigrants, I include those who migrated from abroad or from different countries, and for locals, I include those who have not immigrated and also those who immigrated within each province, since such type of immigration is widespread (see Table 1 on page 24). I control for education and gender, and incorporate time, community and age fixed effects in all of the regressions.

To measure the effects of oil in the local economy, I run regressions estimating the probability that a person is employed—separating self-employment from hires, and skilled from unskilled jobs. The regressions take the following form:

$$emp = \beta_0 + \beta_1(oil) + \beta_2(yrsch) + \beta_3(male) + \varphi_t + \varphi_c + \varphi_a \tag{11}$$

emp stands for any of the aforementioned measures of employment, and the rest of the variables have been explained above. *oil*, again, represents the dummies for each of the two categories. Because time fixed effects are included, general upward trends will not be confounded with the effects of oil. Assuming those who migrate do so to find a job, running these regressions on the migrant population is less likely to reveal effects of oil exposure—it will identify characteristics of the migrants. Still, the differences between self-employment or hired, and skilled or unskilled jobs will reveal important features about the interactions between the oil companies and the societies in which they operate. To measure the skills required by the jobs, I categorize the occupation of people in the census in three groups: skilled, unskilled, and farming—as shows Table 3. Among those skilled positions are legislators, professionals, technical, clerks and plant and machine operators. Unskilled positions are service and craft workers, elementary occupations, and armed forces. Because almost 65% of the observations are unspecified or missing for the profession variable, the regressions for professions have a relatively smaller sample of observations.

Table 3: Professions by category

Profession, ISCO general code	Percentage	Frequency
Skilled		
Legislator, senior officials and managers	0.4%	701
Professionals	2%	3,909
Technicians and associate professionals	0.7%	1,391
Clerks	1.6%	3,067
Plant and machine operators and assembly	1.9%	3,604
Subtotal	6.6%	12,672
Unskilled		
Service workers and shop and market salary workers	3.5%	6,668
Crafts and related trades workers	3.7%	7,104
Elementary occupations	10.2%	19,540
Armed forces	1.1%	2,053
Subtotal	18.4%	35,365
Farming		
Skilled agricultural and fishery worker	10.5%	20,184
Subtotal	10.5%	20,184
Other		
Other, unspecified	0.2%	388
Unknown or missing	62.1%	123,556
Subtotal	64.5%	123,944
Total	100%	192,165
Total, specified	35.5%	68,221

With the purpose of analyzing a more complete picture of the effects of oil companies in the area, I also run these regressions on those who have emigrated from these areas. For that, I select the entire sample of Ecuadorian citizens outside of the region of the Oriente, and classify them among locals, migrants from non-Oriente areas, and migrants from the Oriente. This information reveals the fate of those inhabitants of the Oriente who venture into other areas of Ecuador.

Two measures of welfare—disability and offspring survival rate—are also measured with a Linear Probability Model:

$$dis = \beta_0 + \beta_1(oil) + \beta_2(yrsch) + \beta_3(male) + \varphi_t + \varphi_c + \varphi_a \tag{12}$$

$$osr = \beta_0 + \beta_1(oil) + \beta_2(yrsch) + \beta_3(male) + \beta_4(chborn) + \varphi_t + \varphi_c + \varphi_a \tag{13}$$

Where dis is a dummy variable that has a value of 1 if the person is considered disabled, and osr stands for offspring survival rate, the percentage of children who have are still living at the time of the census, out of those who were born to a female. I exclude women above 50 from the sample, so that different age distributions do not affect the results. I also control for $chborn$, the number of children born. The other control variables have been explained above.

To measure access to infrastructure, I include similar covariates. I estimate the effects of oil presence on four different measures: whether a house has electricity, a sewage system, running water, and wired phone. The equations for these regressions are also a Linear Probability Model, as follows (where inf stands for the aforementioned measures of infrastructure):

$$inf = \beta_0 + \beta_1(oil) + \beta_2(yrsch) + \beta_3(male) + \varphi_t + \varphi_c + \varphi_a \tag{14}$$

6.3 Effects of Oil Exposure on Schooling and Literacy

The regressions in this section will help identify which mechanisms dominate in the economic model proposed in Section 4. As in previous regressions, I separate migrants from locals. The following is an explanation of the empirical methods that are used to estimate the effects of oil exposure in education, in three different measures: school attendance, literacy, and years of schooling. These equations will also be used to explore the educational level of those who emigrate from the oil areas in comparison to migrants from other places. The equations take the following form:

$$educ = \beta_0 + \beta_1(oil) + \beta_2(male) + \varphi_t + \varphi_c + \varphi_a \tag{15}$$

Where *educ* stands for any of the three measures of education—attendance, literacy, and years of schooling—which I discuss below. *oil* represents the two dummies for oil, high and low, and all previous variables have been explained before. The time, community and age fixed effects control for the trend and unobserved heterogeneity across communities, so the coefficient $\hat{\beta}_1$ should be an unbiased estimate of the effects of oil exposure.

The first measure is school attendance. Are children living nearby oil extraction, or roads, more likely to attend school? Because the outcome is binary, a Linear Probability Model is used, following equation 14. The sample used for this regression includes individuals between ages of six and eighteen, to correctly capture those who, potentially, can be in school at the moment.

The second proposed measure of education is literacy. This is not a traditional measure of education; however, the literacy levels among the indigenous population in the Oriente are not high (50.5% of mestizo people are illiterate, compared to

42.7% of indigenous, and only 3.5% of whites, IPUMS). Efforts to educate adults in these areas tend to focus on creating literacy centers (Torres, 2005)—contact with oil and roads might increase their presence and scope. For this regression, the sample used includes all individuals over the age of six, following the assumption that literacy centers serve people of all ages.

The last measure for education is years of schooling, a continuous variable, for which Ordinary Least Squares can be used (see equation 14). Contrary to literacy, where both teenagers and adults can participate, schooling decisions are generally made at some point before 18 years old, and no later. Therefore, in order to correctly compare the populations in the treatment and control groups, I must exclude some of the older population from the sample to run this regression. Moreover, because parents can be influenced by oil involvement to send their children to school, I also include those observations of people above six years old, where students would traditionally start elementary school. To select the samples, I consider the differences in timing between rounds of Part A and B. The following table shows the samples that I use for each of the censuses:

Table 4: Sample included in estimations for years of schooling

	1990 Census	2001 Census	2010 Census
Control and Part A	6 to 21	6 to 32	6 to 41
Part B (1997)		6 to 20	6 to 29

In the 1990 census, only those individuals between six and 21 years old are included, to exclude those who turned 18 by the end of the rounds of Part A. I also select the same observations from the control group to prevent differences in age distribution from tampering the results. The same individuals are excluded from the subsequent census, except that they are 32 years old in 2001: this sample includes individuals whose age ranges from six to 32. But because Part B of the oil bidding rounds (from 1997) is more recent, some individuals who did not live in oil areas during their teenage years must be excluded from the sample, because they should not belong to the treatment group. If living in an oil block sold in Part B, people above the age of 20 are excluded. For the census of 2010, individuals above 41 are excluded (keeping everyone from six to 41 years old), as in previous censuses, because of the rounds of Part A. Also, those under 29 are excluded if they live in an oil block sold in Part B, as explained above.

To confirm that the results are not driven by unobserved individual differences correlated with oil exposure, I run placebo regressions with the population that was not young enough to be affected by the action of oil companies. I only include observations of individuals over 18 by the time an oil company was in town. If the results of the placebo regressions are significantly positive or negative, then the regressions from previous sections are likely to be, at least partially, due to unobserved differences and not completely attributable to oil exposure. If the oil treatment was not random, the methods described previously are not adequate. On the other hand, non-significant effects will provide some validation of the previous results.

7 Results and Discussion

7.1 Differences between Immigrants and Locals

The estimation results presented in Table 5 (p. 40) show the differences among foreigners, immigrants from other provinces, and immigrants from the same province. The sample used for each of the models of Table 5 is the same: all those observations that indicate migration status. Individuals who were born abroad are the smallest proportion of immigrants, as shown in Table 1 (p. 24). Out of the 12 areas in the census, migrants from abroad overwhelmingly settle in Lago Agrio: on average, more than 30% of foreign immigrants on a given census year move to Lago Agrio (IPUMS-I). This is not surprising given that the city was established to host Texaco, a US company. When estimating the likelihood of foreign migrants moving because of oil, the coefficient is negative and significant both for areas with low and high oil. Moreover, those foreign migrants that do establish in high oil areas are not high-skilled workers, per the interaction term between those two. Thus, it does not seem the case that oil companies are bringing foreign workers to work: the marginal effect (calculated at six years of schooling) for both types of oil areas is negative and significant.

Rather, oil companies seem to be bringing skilled workers from other provinces, and keeping local migrants away. In estimating the importance of oil in the likelihood that a migrant from a different major administrative unit, the result is positive and significant, both for low and high oil areas. As expected, the effect is almost a 60% higher for high oil areas than low oil areas. Around 20% of these migrants come from Pichincha (IPUMS-I), the province where Quito—the capital and main city—is located. More interestingly, the interaction term between oil and years of schooling is positive: the migrants from different administrative units that move to oil sectors have more education than those who move to other places. The marginal effect of oil is positive and significant in both cases.

But while migrants from the cities are trickling into oil sites, local migrants—from the same province—seem to be avoiding them. Oil makes it less likely that a local migrant immigrates into both low and high oil areas, with high areas having almost double the negative effect than low oil areas. These migrants are also significantly less educated. These migration results confirm that one should distinguish between migrants and locals when estimating general welfare, employment and education effects, to avoid the influx of skilled workers from tilting the effects in a positive direction. As aforementioned, because of the large quantity of migrants from the same province (see Table 1 on page 24), in subsequent analyses, "immigrants" refers to immigrants from abroad and from other provinces, not local migrants.

Albeit less relevant to the scope of study of this paper, it is interesting to note that while being male increases the likelihood of immigrating from other provinces, it is not significant for foreign immigrants and significantly negative for local immigrants. The oil industry is predominantly male-dominated, and thus it is not a surprise that the coefficient for immigrants from different provinces is positive. Local migration for women might be due to domestic work or pursuit for education (Laurian et al. 1997). Emigration, as explored by Bilsborrow et al. (1987) and Dudley (2013), could also present an alternative to marriage, where women seek for independence from their parents through changing residences, rather than civil status.

Table 5: Determinants of immigration status

	From abroad	From other province	From same province
Low oil	-0.0105***	0.0283***	-0.0178**
	(-4.70)	(4.48)	(-2.70)
High oil	-0.00955**	0.0445***	-0.0350***
	(-2.74)	(4.49)	(-3.38)
Education, yrs.	0.000497***	0.00608***	-0.00658***
	(4.05)	(17.46)	(-18.10)
Low oil × Education	0.000311	-0.000860	0.000549
	(1.59)	(-1.55)	(0.95)
High oil × Education	-0.000729***	0.00263***	-0.00190***
	(-4.75)	(6.04)	(-4.19)
*Low oil marginal effect**	-0.0086208***	0.023176***	-0.0145552***
	(-4.61)	(4.36)	(-2.62)
*High oil marginal effect**	-0.139224***	0.0602991***	-0.0463767***
	(-4.14)	(6.32)	(-4.66)
Male	0.000761	0.0341***	-0.0349***
	(1.25)	(19.64)	(-19.24)
2001	0.00501***	-0.0702***	0.0652***
	(4.73)	(-23.36)	(20.79)
2010	0.0156***	-0.105***	0.0893***
	(14.94)	(-35.39)	(28.87)
Intercept	0.00248	0.0873***	0.910***
	(0.61)	(7.61)	(76.04)
N	137732	137732	137732

t statistics in parentheses

* Marginal effects of oil exposure at 6 years of schooling

Place and age fixed effects not shown

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

7.2 Effects of Oil Exposure on Employment

As explained before, it is imperative to separate immigrants from locals in the analysis of employment, health, and access to infrastructure. Table 6 below shows the effect of oil in employment, and the likelihood of being self-employed or hired. The samples for self-employment and hire differ in number for those who are employed, since the higher level of specificity (i.e. self-employed or hired) is only present in some observations. For migrants, oil does not seem to have a positive effect on likelihood of employment. Taking into account the fact that those who immigrate do so looking for a job, this is not a particularly surprising result. It is likely that migrants might find other jobs irrespective of them settling in oil areas. The results are more interesting in terms of self-employment and hired jobs. The effect of oil on self-employment is significantly positive for high oil areas, whereas significantly negative on hired jobs, both in high and low oil areas.

The results are very different for locals and immigrants. The effects of oil exposure on locals, both in low and high oil areas, are not significant for any of the employment categories. Locals are not more or less likely to be employed by a company, or to start their own business—they remain marginal. A possible explanation of this result is that immigrants may have better access to funds that allow them to start their own businesses. They are also likely to be displaced in search of a job, and thus might try harder to create one. To some extent, this can be a result of the fact that oil areas are likely to attract different kinds of people.

A similar, but more significant phenomenon takes place with respect to the professions of employed local and migrants (see Table 3 on page 33 for a description of skilled and unskilled professions). For migrants, the presence of oil, regardless of its scale, does not alter the likelihood of working in a skilled, unskilled, or farming

Table 6: Effects of oil exposure on employment

	Immigrants			Locals		
	Employed	Self-Employed	Hired	Employed	Self-Employed	Hired
Low oil	-0.0148	0.0268	-0.0403*	-0.00310	0.00148	-0.00703
	(-0.85)	(1.54)	(-2.08)	(-0.45)	(0.22)	(-1.10)
High oil	-0.0342	0.0739**	-0.0969**	-0.00546	0.0120	-0.0152
	(-1.24)	(2.66)	(-3.13)	(-0.44)	(0.99)	(-1.30)
Male	0.399***	0.0952***	0.309***	0.281***	0.159***	0.124***
	(72.63)	(17.24)	(50.31)	(126.10)	(73.45)	(59.52)
Educ., yrs.	0.0100***	-0.0123***	0.0227***	0.00664***	-0.0131***	0.0202***
	(15.18)	(-18.47)	(30.59)	(21.27)	(-43.13)	(69.09)
2001	-0.00112	-0.00735	-0.00309	-0.00181	0.00293	-0.00957**
	(-0.13)	(-0.85)	(-0.32)	(-0.46)	(0.77)	(-2.60)
2010	-0.0138	-0.0426***	0.0256**	-0.00400	0.000388	-0.00658
	(-1.64)	(-5.01)	(2.70)	(-1.03)	(0.10)	(-1.81)
Intercept	-0.0699	-0.0729	-0.00408	-0.0677***	-0.0152	-0.0562***
	(-1.83)	(-1.90)	(-0.10)	(-4.66)	(-1.08)	(-4.15)
N	18892	18419	18419	118840	116134	116134

t statistics in parentheses

Place and age fixed effects not shown

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

position, as shows Table 7 (p. 43). However, oil causes significant alterations in local's career opportunities. Both low and high oil areas cause locals to focus on unskilled jobs, making them significantly less likely to obtain skilled jobs. The effect is more than double in magnitude for the high oil areas than the low ones, except in the case for farming—which also happens to be on an upward trend, per the positive coefficients in the dummies for 2001 and 2010. Not surprisingly, when an area has high oil intensity, farming activities decline. These results suggest that oil areas were not different before the rights to the land were sold; there are significant changes over time when oil drilling starts, relative to other areas.

Though the effect of education is equal for immigrants and locals, gender has differing effects. Immigrant males are less likely to be working in a skilled position, and more likely to be employed in an unskilled one. Local males are altogether less likely to be employed in both skilled and unskilled positions than women, but more likely to be working in farming. And since such occupations in oil areas are in decline, they are significantly more affected than females.

Table 7: Effects of oil exposure on professions

	Immigrants			Locals		
	Skilled	Unskilled	Farming	Skilled	Unskilled	Farming
Low oil	0.00981	0.0268	-0.0366	-0.0336***	0.0404**	-0.00676
	(0.42)	(0.94)	(-1.84)	(-3.86)	(3.25)	(-0.60)
High oil	-0.00157	0.0415	-0.0399	-0.0709***	0.154***	-0.0827***
	(-0.04)	(0.91)	(-1.26)	(-4.38)	(6.67)	(-3.95)
Male	-0.0331***	0.0324**	0.000710	-0.0133***	-0.0245***	0.0378***
	(-3.74)	(3.01)	(0.09)	(-4.23)	(-5.46)	(9.27)
Educ., yrs.	0.0411***	-0.0238***	-0.0173***	0.0458***	-0.0114***	-0.0344***
	(50.04)	(-23.86)	(-24.71)	(127.36)	(-22.23)	(-73.91)
2001	0.00252	-0.0314*	0.0289**	-0.0206***	-0.0486***	0.0691***
	(0.22)	(-2.22)	(2.92)	(-4.05)	(-6.71)	(10.51)
2010	-0.00671	-0.0109	0.0176	-0.0310***	-0.0993***	0.130***
	(-0.59)	(-0.78)	(1.80)	(-6.07)	(-13.63)	(19.67)
Intercept	-0.00440	0.971**	0.0333	0.0666	0.821***	0.113
	(-0.02)	(3.03)	(0.15)	(0.85)	(7.38)	(1.11)
N	10581	10581	10581	49490	49490	49490

t statistics in parentheses

Place and age fixed effects not shown

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

7.3 Effects of Oil Exposure on Health

The disproportionally negative effects of locals relative to immigrants continues in the case of health, as shows Table 8 (p. 45). The two measures for health—disability and offspring survival rate—are not significantly affected by oil in the case of migrants. High oil areas seem to increase the mortality rate among locals, even when controlling for education (years of schooling) and number of children born. Given that locals are more involved in low-skill jobs when there is presence of oil, these results are not surprising: locals are more exposed to dangerous jobs. Another evidence of the exposure to more dangerous positions is the positive coefficient for the male dummy in locals, who are more likely to become disabled. It is important to note that these results also depend on the socioeconomic level of the individuals. By virtue of having better jobs and being more educated, migrants are more likely to get better medical services. These results are not conclusive evidence that oil companies are damaging the environment and thus generating birth defects and diseases, though they are consistent with such a claim.

Table 8: Effects of oil exposure on health

	Immigrants		Locals	
	Disability	Offspring survival rate	Disability	Offspring survival rate
Low oil	-0.00190	-0.00525	0.00185	-0.00186
	(-0.43)	(-0.40)	(0.83)	(-0.36)
High oil	-0.00865	0.00429	-0.00413	-0.0207*
	(-1.21)	(0.20)	(-1.01)	(-2.24)
Male	-0.000418		0.00415***	
	(-0.29)		(5.65)	
Educ., yrs.	-0.00135***	0.00113*	-0.00245***	0.000431*
	(-7.91)	(2.18)	(-23.86)	(2.01)
2001	0.00624**	0.0306***	0.00651***	0.0280***
	(2.79)	(4.55)	(5.02)	(9.59)
2010	0.00665**	0.0258***	0.00974***	0.0350***
	(3.04)	(3.92)	(7.64)	(12.11)
Nº child born		-0.0142***		-0.0129***
		(-11.37)		(-31.15)
Intercept	0.0187	0.967***	0.00620	1.000***
	(1.86)	(10.85)	(1.25)	(19.80)
N	18572	3582	115513	22007

t statistics in parentheses

Place and age fixed effects not shown

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

7.4 Effects of Oil Exposure on Access to Infrastructure

The infrastructure results on Table 9 provide justification for differentiating between low and high oil areas. In low oil areas, the effect of the oil treatment is mostly positive and significant. For immigrants, every single measure is positively related to oil exposure: individuals exposed to oil drilling are more likely to have electricity, sewage, running water, and land phones. But locals are not as fortunate, both because the coefficients are smaller in scale—indicating more likelihood of having better infrastructure than in the control areas, but not as much as immigrants—and because the effect of oil is negative in the case of phones. The rise of cellphones could be an explanation.[1] The results paint a less favorable picture for high oil areas. Immigrants, as in previous cases, have either significantly positive effects of oil, or positive, but non-significant effects. Locals have mostly negative effects, with one clear exception: running water (though the magnitude is not nearly as close to the immigrant's one). Locals are less likely to have electricity, sewage, and phones when living in a high oil area. As with health results, these can be a consequence of socioeconomic status: perhaps immigrants to the oil areas are wealthier than immigrants to other areas, and therefore, more likely to invest in their homes. The infrastructure results also speak to a general problem with privatized, corporation-led development: it might not reach everyone, but rather, those who can pay.

A caveat of these analyses is the possibility of selection bias. If it were the case that high oil areas were selected by the government because there is poor infrastructure—and, possibly, less opportunity cost to building roads and pipes in such land—then these do not reflect a consequence of oil, but rather, a cause. Although the government cannot choose where the oil is located, it could choose to

[1] The aggregate data provided by INEC that I used to create the oil dosage reveals that oil areas are more likely to have more cellphone users.

search for oil in those areas with less developed infrastructure, so that current inhabitants are not disturbed and existing buildings are not damaged. Alternatively, the government could allow drilling to a higher extent in those less-developed areas.

Even though there is no evidence that the government can choose which areas to exploit, I analyze the possibility that the areas are not randomly selected through the robustness check used for the education model (see Table 10 on page 50). I run a placebo regression for education, which indicates that it is likely that oil-block selection and selling of rights is random—at least, in terms of the initial level of schooling of the inhabitants. The level of schooling can be highly correlated to the quality of infrastructure, and thus, the results on the next section support the validity of the infrastructure results shown here.

Table 9: Effects of oil exposure on access to infrastructure

	Immigrants				Locals			
	Electricity	Sewage	Water	Phone	Electricity	Sewage	Water	Phone
Low oil	0.141***	0.149***	0.265***	0.0514**	0.0974***	0.0207**	0.164***	-0.0605***
	(6.99)	(6.61)	(12.30)	(3.03)	(12.79)	(2.70)	(20.30)	(-9.67)
High oil	0.0349	0.0503	0.155***	0.0699*	-0.0585***	-0.0736***	0.0452**	-0.0583***
	(1.06)	(1.37)	(4.39)	(2.52)	(-4.19)	(-5.23)	(3.05)	(-5.09)
Male	-0.0281***	-0.0187**	-0.0180**	-0.0112*	-0.0216***	-0.0235***	-0.0228***	-0.0173***
	(-4.43)	(-2.66)	(-2.66)	(-2.11)	(-8.69)	(-9.37)	(-8.65)	(-8.47)
Educ.	0.0182***	0.0232***	0.0199***	0.0161***	0.0253***	0.0281***	0.0253***	0.0235***
	(22.57)	(25.85)	(23.11)	(23.81)	(72.40)	(79.54)	(68.29)	(81.62)
2001	0.225***	0.262***	0.212***	0.104***	0.186***	0.123***	0.163***	0.117***
	(22.15)	(23.19)	(19.52)	(12.16)	(42.43)	(27.80)	(35.06)	(32.50)
2010	0.358***	0.321***	0.339***	0.135***	0.369***	0.141***	0.239***	0.163***
	(35.85)	(28.85)	(31.79)	(16.09)	(85.03)	(32.16)	(51.90)	(45.67)
Intercept	0.342***	-0.00873	0.189***	-0.125***	0.239***	0.0237	-0.00708	-0.0722***
	(7.59)	(-0.17)	(3.94)	(-3.33)	(14.74)	(1.45)	(-0.41)	(-5.42)
N	15879	15879	15879	15879	117564	117564	117564	117564

t statistics in parentheses

Place and age fixed effects not shown

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

7.5 Effects of Oil Exposure on Schooling and Literacy

The effects of oil on education are mostly positive, though they vary in significance—results appear on Table 10 on page 50. The results of oil exposure on immigrants are interesting, particularly in low oil areas, because they suggest that oil exposure can increase their education, not only attract the most educated. Table 5 (p. 40) showed that immigrants into high oil areas were more likely to have higher education; the same did not occur in low oil areas. Oil exposure is positively related with immigrants' education, both in years of schooling (in low oil areas) and literacy (both in high and low oil areas). As expected, the effects are not significant for attendance, which indicates that people are not migrating into oil areas to attend school. The coefficient for low oil in years of schooling is significant, and also the highest among the oil coefficients: 0.768, which is almost a year of extra schooling. This could reflect selection bias, however. Not surprisingly, males are more likely to be literate and have more years of schooling.

For locals, the outcome is almost as good, representing a sharp difference from previous results of employment, health, and infrastructure. Attendance does not change, which is surprising given that it could have increased in the short-term, at least, with the creation of schools and roads in the area. In the case of literacy, both high and low oil areas have positive and significant effects, which could indicate the growth of literacy centers started in the Oriente. Interestingly, the two highest of the oil coefficients in locals are for years of schooling (0.284, for low oil, and 0.441 for high oil—see Table 10), although it is arguably the hardest to boost: attendance could increase in the short-term, and literacy centers are cheaper to start and maintain than schools. Moreover, the effect in years of schooling is a 55% higher in high oil areas, indicating that a higher exposure to oil has a higher impact on education.

Table 10: Schooling

	Immigrants			Locals			Placebo
	Attendance	Literacy	Years of schooling	Attendance	Literacy	Years of schooling	Years of schooling
Low	0.00288	0.0515***	0.768**	0.00762	0.0157***	0.284***	0.0401
	(0.08)	(5.04)	(3.08)	(0.75)	(3.36)	(3.64)	(0.36)
High	-0.0352	0.0616***	0.556	-0.0185	0.0442***	0.441**	-0.0416
	(-0.61)	(3.77)	(1.47)	(-0.98)	(5.17)	(3.10)	(-0.21)
Male	-0.00864	0.0288***	0.202**	0.00286	0.0332***	-0.0107	0.921***
	(-0.74)	(8.84)	(2.97)	(0.83)	(21.61)	(-0.46)	(22.79)
2001	0.0716***	0.0145**	-0.230	0.0395***	0.0299***	0.119**	1.578***
	(3.83)	(2.83)	(-1.89)	(6.73)	(11.17)	(2.66)	(23.29)
2010	0.201***	0.0374***	1.196***	0.160***	0.0598***	1.375***	3.281***
	(11.01)	(7.59)	(9.75)	(28.11)	(23.03)	(31.22)	(44.87)
Intercept	0.755***	0.745***	0.430	0.809***	0.701***	-0.0457	5.051***
	(11.48)	(36.10)	(0.98)	(40.39)	(73.18)	(-0.30)	(18.27)
N	4350	18416	11068	41049	113610	69748	41004

t statistics in parentheses
Place and age fixed effects not shown
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Finally, the placebo regressions (in the far right column of Table 10) can suggest that the results are not evidence of selection bias. Using a sample of local inhabitants that was not young enough to be affected, the coefficients for oil are not significant and small. Only the regression for years of schooling is compelling in this case: older individuals are no longer attending school, and literacy centers serve all the population. This shows that there were no differences in the change across time between oil and non-oil areas when oil-drilling started: a significant coefficient for any of the oil dummies would have presented selection bias. Thus, oil treatment can be adequately estimated with the methods used by previous regressions.

7.6 Emmigration from the Oriente

Though many immigrate into the Oriente, many leave the region to settle in the cities. This section is dedicated to analyzing who might migrate away from the Oriente. As previously mentioned, the data is not specific enough to know whether the emigrants left the oil areas particularly; however, one can identify who left the Oriente as a whole. It is likely that many are displaced by oil companies, given the literature review (Kimerling 1900), and thus, the following results add to the analysis of oil exposure in the Oriente. Table 11 below compares the means in literacy levels and years of schooling, for the population over 18 years old that stays back in the Oriente, and for emigrants that leave such area. It is clear that the population that leaves is more educated, though the differences in 2010 are not as stark as those in 1990, particularly in literacy levels. The immediate consequence of this result is that previous estimations of the level of education are biased down. If the most educated leave, and those surveyed are the ones that stayed back, the sample of local citizens is not a correct depiction of the actual effects of oil.

Table 11: Mean education in Oriente locals and emigrants

	Literacy			Years of Schooling		
	1990	2001	2010	1990	2001	2010
Oriente locals*	83.7%	88.7%	92.1%	5.36	6.18	7.90
Emigrants from Oriente	96.5%	95.0%	97.1%	8.26	8.27	9.92

* Does not include immigrants to the area

Another worthy comparison is that among emigrants from the Oriente, emigrants from other places, and locals to other parts of Ecuador. Table 12—which uses a larger sample, because it includes observations from all the areas of Ecuador outside the Oriente—shows such differences. The results show that, compared to locals and emigrants from other provinces, emigrants from the Oriente are more likely to be literate. They have the same years of schooling compared to locals, and both the locals and the people from the Oriente have more years of schooling than emigrants from other areas. Thus, the highly educated leave the Oriente, and not to pursue schooling, necessarily (per the negative coefficient on attendance).

Table 12: Education of emigrants in other parts of Ecuador

	Attendance	Literacy	Years of schooling
from other provinces	-0.0992***	-0.00632***	-0.273***
	(-53.30)	(-9.48)	(-25.63)
from Oriente	-0.0501***	0.0126***	-0.00950
	(-7.03)	(4.68)	(-0.22)
Male	-0.00267***	0.0165***	0.160***
	(-3.60)	(61.70)	(35.47)
2001	-0.000957	0.0275***	0.512***
	(-1.01)	(78.39)	(85.70)
2010	0.126***	0.0574***	1.775***
	(136.36)	(168.79)	(305.25)
Intercept	0.810***	-0.0209***	-0.593***
	(333.35)	(-17.51)	(-27.42)
N	920372	3460506	3001562

t statistics in parentheses
Place and age fixed effects not shown
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

But these relatively highly educated individuals do not succeed in the job market place. As the following results of Table 13 show, emigrants from the Oriente are less likely to be employed than locals and emigrants from other provinces. This would not be a problem if it were not for the fact that previous results established that people from the Oriente are actually more highly educated than emigrants from other provinces. Emigrants, from the Oriente and elsewhere, are more likely to be hired by companies than self-employed. There is an interesting contrast with the results of the same model used for immigrants into oil areas. As Table 6 (p. 42) shows, immigrants were more likely to start their own businesses when moving into the Oriente. It was mentioned earlier that this could be evidence of positive selection, as people who migrate tend to have certain characteristics that make them more likely to become entrepreneurs, for they have faced the hardship of migrating. This does not seem the case for migrants that leave the Oriente.

Moreover, as shows the right side of Table 13, emigrants from the Oriente are less likely to be employed in skilled positions and more likely to be employed in unskilled positions, in comparison to emigrants from other provinces. Even though they are virtually as educated (in years of schooling) as locals, they are still much more likely to end up with poorly-paid, unskilled positions. The farming results are expected: generally, these individuals are emigrating to cities, and will not work in farms. An interesting point of these regressions is also that men are more likely to either be employed in skilled or farming positions, whereas women are confined to the lower skilled positions. This is different than in previous results of the Oriente, as shown in Table 7 (p. 43). A possible reason can be found in Dudley (2013): women migrate to the cities for domestic work, which is not a skilled position—men tend not to work in such capacity.

Table 13: Employment and professions of emigrants in other parts of Ecuador

	Employment			Professions		
	Employment	Self-Employed	Hired	Skilled	Unskilled	Farming
from other provinces	-0.000717	-0.0180***	0.0681***	-0.0398***	0.0705***	-0.0299***
	(-0.97)	(-18.26)	(36.59)	(-27.37)	(39.46)	(-24.70)
from Oriente	-0.00731*	-0.0444***	0.102***	-0.0628***	0.0986***	-0.0346***
	(-2.39)	(-11.26)	(13.29)	(-10.45)	(13.37)	(-6.94)
Male	0.00509***	0.148***	0.0113***	0.00515***	-0.0394***	0.0312***
	(13.88)	(355.22)	(12.25)	(7.18)	(-44.73)	(52.39)
Educ., yrs.	-0.0000697	-0.00494***	0.0143***	0.0451***	-0.0337***	-0.0126***
	(-1.85)	(-92.31)	(151.46)	(607.82)	(-370.07)	(-203.69)
2001	0.00110*	-0.00332***	-0.00489***	-0.0448***	0.0827***	0.000116
	(2.42)	(-5.98)	(-4.27)	(-51.26)	(77.04)	(0.16)
2010	-0.0269***	-0.0640***	0.158***	-0.0556***	0.103***	-0.00746***
	(-60.87)	(-117.36)	(141.52)	(-63.78)	(96.67)	(-10.30)
Intercept	0.980***	-0.0253***	0.455***	0.0789**	1.060***	-0.174***
	(83.46)	(-12.80)	(9.12)	(2.80)	(30.70)	(-7.42)
N	1319424	2915546	1201518	1256758	1256758	1256758

t statistics in parentheses
Place and age fixed effects not shown
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

There are a couple of plausible explanations for the discrepancy between level of education and jobs. On the one hand, it could be a problem with the quality of education in the Oriente. Perhaps the high school and college degrees are not well regarded in the cities, or just not recognized by the employers in the cities. This could also be an issue with language: many of the inhabitants of the Oriente speak Spanish as a second language (with ethnic language as their first), or maybe they do not speak Spanish at all and are learning in the city. Finally, this could be evidence of discrimination in the workplace against indigenous people, or people from the interior provinces of Ecuador in general. Race only appears on the censuses of 2001 and 2010, and would considerably reduce the sample. Given the correlation between socioeconomic status and race—evident in literature—this result is not entirely surprising.

8 Conclusion

This paper finds that, for locals in the Oriente in Ecuador during the 1990 to 2010 period, oil exposure was associated with an increase in education, but a decrease in job prospects—oil exposure also negatively affected local's health and infrastructure, at least in high oil areas. Oil companies are likely to attract skilled migrants, and this seems to crowd out locals and push them into more unskilled jobs. Oil exposure did not affect the health of immigrants, but was related to a decrease in the offspring survival rate of locals. Immigrants also benefitted from oil-linked infrastructure improvements; for locals, only low oil areas had such benefit, whereas exposure to high oil areas decreased the likelihood of access to electricity and sewage system (access to water did increase, however). The results are more positive in terms of education: oil exposure was connected to an increase of education, both for migrants and locals—affecting locals to a greater extent in high oil areas. Surprisingly, this effect was particularly evident in terms of years of schooling: locals were more likely to spend almost an extra half-year in school. It is likely that these results are biased downwards, however, because the most educated are more likely to leave for the city. Finally, when these migrants leave the Oriente, they have higher literacy levels than locals in other parts of Ecuador and migrants from other areas, and the same years of schooling as locals—but they are disproportionally more likely to be employed in unskilled positions.

There are a few possible explanations for these results. Because oil companies tend not to hire locals, locals do not have the option to be employed in a skilled job, so the opportunity cost of schooling is not too high. It is not clear whether the secondary markets that support the oil drilling firms are too large, but they certainly cause a shift in the labor market towards unskilled jobs. The creation of roads (or even schools and literacy centers) in the area can also decrease the time-cost of obtaining education. However, oil exposure did not affect school attendance for individuals on schooling age; it increased the likelihood of being literate and the number of years in school. In a way, literacy levels are easier to improve because they require less time and resources; however, the effects of oil exposure were higher for years of schooling. The placebo regressions show that these differences are not likely to be attributed to pre-existing differences in the populations. But even though it could be this very lack of opportunity cost of schooling (i.e. the lack of skilled jobs, and new low skilled jobs) that increased people's likelihood of staying in school, not providing skilled positions to these people forces them to emigrate—or stay, under less than optimal conditions, with poor quality of infrastructure and declining health.

Besides contributing to the discussion of the effects of oil companies' interactions with locals, this paper also lays the ground for questioning the government's policies with respect to oil drilling. Perhaps governments could negotiate the extent to which companies are allowed to interrupt local markets. If a company is developing infrastructure, a possible requirement could be that it focuses some of these efforts in benefiting the community. For instance, if a company brings electricity to their land, households around the area could be guaranteed connection, or if it builds a new road, it could try to allow the largest number of people to gain access, rather than just making the shortest, most convenient way. Furthermore, the government could investigate and work towards solving the inequalities in job opportunities in the Oriente, and elsewhere in the country.

Though this paper conveys these issues qualitatively and quantitatively, it has some limitations. More information about the nature of the oil block bidding and exploiting could have determined whether this is truly a random treatment. A detailed account of the government's rationale to delimit and sell the blocks would have provided such insight. Knowing how quickly or slowly the oil companies start to act in the area after it was sold, and what type of constructions are actually built could help paint a more accurate picture of the interactions between companies and locals. For instance, mapping the newly built roads would have provided a clear perspective on how communities that gain access to them are affected differently than those where the oil company is actually based. More specific geographical data for each of the individual-level observations (i.e. by parroquia, instead of canton) would have produced better results. Many observations under the "low" and "high" oil categories in this paper could have been more accurately categorized as part of the control group, because their geographical position was simply not close to the actual area of treatment.

Further research should focus on correcting these limitations by obtaining better data, and also by finding best practices for corporate engagement in undeveloped areas. Comparing several cases of oil companies' involvement in similar settings could reveal what measures are less disruptive to the local market. Particularly, analyzing whether the creation of jobs would offset the incentives to obtain more education could illuminate the intricacies of corporate involvement in remote areas. In terms of infrastructure, a possible approach would involve the comparison between private and state-owned companies, to contrast the differences in investment and impact. Else, developing a system of incentives for private companies to invest in local areas—rather than merely depleting their natural resources—could help other communities around the world.

Appendix

Table A: Number of observations by area and year

Province	**Area**	**1982**	**1990**	**2001**	**2010**
Morona Santiago	Morona	2,381	2,998	3,058	4,116
	Cantons under 20,000 [11]	4,574	5,306	8,153	10,609
Napo	Tena	2,593	3,564	4,693	6,172
	Cantons under 20,000 [4]	8,980	6,908	3,332	4,221
Pastaza	Pastaza	2,746	3,540	4,602	6,174
	Cantons under 20,000 [3]	390	580	1,591	2,164
Zamora	Zamora	2,097	2,770	2,125	2,595
	Cantons under 20,000 [8]	2,631	3,806	5,434	6,642
Sucumbios	Lago Agrio	-	4,155	6,701	9,065
	Shushufindi	-	1,896	3,210	4,402
	Cantons under 20,000 [5]	-	1,591	3,113	4,114
Orellana	Orellana	-	-	4,349	7,307
	La Joya de los Sachas	-	-	2,502	3,813
	Cantons under 20,000 [2]	-	-	1,780	2,619
N		26,392	37,114	54,643	74,016

Number in brackets represents the number of cantons in an area

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