Agrarian Reform and Child Stunting: Evidence from Two Land Allocation Strategies

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Abstract

Stunting remains a major development challenge in many countries, including Ecuador. In this paper, I examine whether agrarian reform policies implemented during the 1960s and 1970s help explain long-run patterns of child stunting. The Ecuadorian reform relied on two distinct land allocation strategies: Public land transfers (PLT), designed to promote frontier settlement, and expropriation, aimed at redistributing land from large estates. Combining household survey data with historical maps and administrative records, I estimate the long-run relationship between these policies and child stunting by exploiting historical variation in land allocation across parishes. I find that areas exposed to PLT exhibit significantly lower rates of child stunting, while expropriation shows no robust association. Across specifications, the estimates suggest that PLT is associated with a 3–17 percent reduction in stunting relative to the mean. Cohort evidence further indicates that the relationship is stronger for mothers plausibly exposed to PLT during early childhood. Consistent with this pattern, mothers from more exposed PLT cohorts attained higher levels of education, suggesting that maternal human capital may be one channel linking frontier settlement policies to lower child stunting.

Keywords: Stunting, agrarian reform, Ecuador

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1. Introduction

Agrarian reforms have played a crucial role in the development of many countries. Recent literature has combined historical narratives with new datasets and innovative identification strategies to analyze their impact (Albertus, 2023; Montero, 2020, 2023; Albertus et al., 2020; Galán, 2020). At the same time, extensive research on early childhood well-being highlights the importance of initial conditions for long-term human capital outcomes (Attanasio et al., 2023; Schady et al., 2016). In Ecuador, stunting—the lack of height relative to age for children under five years old—remains a significant public policy challenge (CRISFE, 2023; Gutierrez et al., 2018). While several governments have introduced policy initiatives to address this issue, progress has been limited and reductions in stunting have been modest (CRISFE, 2023). Understanding the historical determinants of child health therefore remains an important question for development policy.

In this paper, I study whether agrarian reform can help explain long-run patterns of child stunting in Ecuador. The Ecuadorian agrarian reform mirrored processes observed in other Latin American countries during the 1960s and 1970s, but it involved two distinct land allocation strategies. The first was public land transfers (PLT), a settlement policy aimed at expanding the agricultural frontier and promoting new rural communities. The second was expropriation, a redistributive policy designed to reduce land inequality and dismantle large estates known as *latifundios* (Albertus, 2015; Barsky, 1984; de Janvry, 1981). These two approaches represented fundamentally different development strategies: one focused on frontier expansion and settlement, while the other emphasized redistribution within existing agricultural structures. This distinction is central to the paper because PLT was also closely linked to internal migration and the formation of new communities, whereas expropriation largely operated within already established agrarian settings.

Figure 1 provides the motivation for this paper. Panel a) and b) display correlations between measures of PLT and expropriation derived from georeferencing historical maps produced by the Ecuadorian Institute of Colonization and Agrarian Reform (IERAC), the main governmental agency responsible for implementing the reform. Panel a) shows a strong negative correlation at the parish level between PLT and stunting rates measured in the 2006 Living Standards Survey[1]. In contrast, Panel b) shows no relationship between expropriations and stunting.[2] These patterns

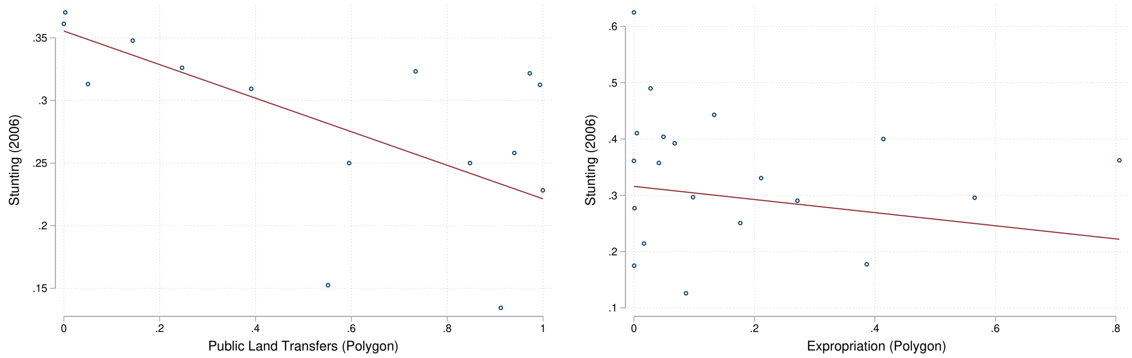
[1] This is the first reliable measure made by the official statistical office of Ecuador. Other measures were performed in 2004 and 1986, but they rely on independent projects associated with certain ministries.

[2] Figure A2 illustrates that the kernel density distribution of height-for-age z-scores for observations in areas that did

raise two natural questions: are these correlations causal, and if so, why would different land reform policies generate such distinct outcomes?

Figure 1: Correlation stunting (2006) and types of agrarian reforms experimented in Ecuador

(a) PLT (b) Expropriation



Note: PLT and expropriation (polygon) refer to the georeferenced polygon area from Figure A1 divided by parish area.

In this research, I present a comprehensive set of results examining the relationship between agrarian reform and child stunting. I combine contemporary household survey data with historical sources including administrative registries and a georeferenced historical map produced by IERAC toward the end of the reform process in 1978. In the first analysis, I estimate ordinary least squares (OLS) regressions where child stunting, measured using comparable Living Standards Surveys, is the dependent variable and the amount of land allocated to PLT or expropriation relative to parish area is the main independent variable using the historical map polygons. In a second analysis, I use archival registry data documenting agrarian reform interventions at the parish level. Because reliable measures of historical parish area are unavailable, I estimate these models using absolute land measures rather than shares.

To partially bridge the gap between the historical reform period and the contemporary survey data, I also present descriptive evidence from the first national survey measuring child stunting in Ecuador, conducted in 1986. Although the dataset does not allow precise geographic matching with current administrative boundaries, it permits a comparison between the Santo Domingo region—primarily affected by PLT—and the highland regions largely exposed to expropriation. The descriptive patterns are consistent with the main findings: stunting rates are lower in areas associated with PLT compared to regions affected by expropriation.

A key empirical challenge is that the registry-based parish measures are likely to be noisy. I therefore complement the registry analysis with an instrumental variables strategy that uses

not receive agrarian reform is skewed to the left, indicating a higher concentration of stunting in those regions.

the georeferenced historical map as an instrument for the registry measure. The two sources capture the same underlying reform process, but through different bureaucratic procedures: one bureaucrat records hectares into a parish in the registries, while another traces reform areas on a map that must later be translated into parish boundaries. In practice, some interventions may be assigned to a neighboring parish in one source but not the other. These discrepancies are more plausibly the result of bureaucratic and cartographic assignment, missing years, and archival survival than of factors related to child stunting decades later. In this sense, the IV strategy helps correct measurement error in the historical reform variable.

Across specifications, I find that PLT is consistently associated with lower rates of child stunting, while expropriation exhibits no statistically significant effect. Conservative estimates suggest that PLT reduced child stunting by approximately 3% to 17% relative to the mean level of stunting in the sample. These results remain robust across alternative measurement strategies and specifications. I also examine internal migration, which is particularly important in this setting because PLT explicitly promoted settlement in new areas. The evidence does not support the view that the PLT results are driven simply by the arrival of parents with systematically higher observable human capital into treated areas. Instead, the migration results are more consistent with interpreting PLT as a settlement policy whose long-run association with child stunting operated through broader place-based changes.

Why would frontier settlement policies reduce child stunting while redistributive expropriations do not? I explore whether these differences are consistent with an intergenerational human capital channel. I find that mothers who were more exposed to the early years of agrarian reform are less likely to have stunted children. In addition, mothers born around the beginning of the reform in regions affected by PLT attained more years of schooling. This pattern does not appear in areas exposed to expropriation. These results suggest that settlement-based land policies may have generated environments conducive to human capital accumulation and improved child health. At the same time, the evidence indicates that maternal education should be interpreted as one possible channel rather than the only mechanism linking PLT to lower stunting.

The discovery and commercialization of oil in the early 1970s is also relevant for interpreting two features of the empirical analysis. First, it helps situate the archival incompleteness in the registries within a broader historical context: as state attention shifted toward the petroleum sector, agrarian reform lost policy centrality, making it less likely that the missing registry years correspond to a period of major expansion in reform interventions. Second, and relatedly, this historical sequence provides a natural explanation for why the long-run effects of PLT are concentrated among earlier maternal cohorts. Settlement-related investments — schools, infrastructure, community formation — were most intensive during the early phase of the reform, before oil revenues redirected fiscal resources away from frontier development. Women born during this initial window were therefore more likely to have been exposed to these place-based investments during childhood, while later cohorts grew up after the reform had lost policy centrality. Both the archival gaps and the cohort gradient thus reflect the same broader shift in Ecuador's development strategy following the oil boom.

This paper contributes to several strands of literature. First, it contributes to the literature on the consequences of agrarian reform (Albertus, 2023; Albertus et al., 2020; Montero, 2020, 2023) by showing that different types of land allocation policies can generate very different long-run development outcomes. Second, it contributes to research examining the determinants of child health and human capital accumulation (Attanasio et al., 2023; Schady et al., 2016; Walker et al., 2007) by highlighting the role of historical institutional policies in shaping nutritional outcomes. Finally, the paper contributes to the debate on whether land reforms promote human capital accumulation. While Galor et al. (2009) argues that land reforms can lead to increased investment in education and Albertus et al. (2020) finds limited evidence for this mechanism in Peru, this paper shows that the impact of agrarian reform on human capital (from a health perspective) depends on the type of policy implemented. In particular, settlement-based reforms such as PLT appear to generate more favorable long-run outcomes when accompanied by public investment and clear purposes (Gachet, 2024).

The remainder of the paper proceeds as follows. Section 2 provides the institutional context of Ecuador's agrarian reform. Section 3 describes the data sources used in the analysis, and Section 4 presents the empirical strategy. Section 5 discusses the main results, while Section 6 explores potential mechanisms. Section 7 concludes.

2. Institutional context

Stunting. Stunting refers to the condition in which children do not reach the height expected for their age according to standardized growth references developed by the United Nations. Beyond reflecting nutritional deprivation, stunting has long-run consequences for cognitive development, educational attainment, and overall human capital accumulation (Walker et al., 2007). While global health indicators have improved in recent decades—including in settings without inclusive political institutions—important disparities in child health persist across regions and socioeconomic groups (Cermeño et al., 2023).

Ecuador has historically exhibited relatively high levels of child stunting relative to other countries in Latin America. By 2018, approximately 25% of children under five were classified as stunted, placing Ecuador among the countries with the highest prevalence of chronic malnutrition in the region (Gutierrez et al., 2018). By 2023, this rate had fallen to approximately 18%, although it remains close to 20% for children under two and exceeds 30% in several provinces. These figures point to gradual improvements in child health, but comparisons over time must be interpreted with caution because survey instruments and measurement procedures have changed. The persistence of large territorial disparities nonetheless suggests that structural determinants of child health—including household resources, maternal human capital, and local economic opportunities—continue to matter.

Ecuador's agrarian reform. Ecuador implemented a major agrarian reform during the 1960s and 1970s. The process formally began in 1964 under a military government and sought to transform rural institutions, reduce extreme land concentration, and expand agricultural production. Two main mechanisms were used to allocate land: PLT and expropriations of large estates. Although both belonged to the broader agrarian reform agenda, they differed substantially in institutional design, geographic reach, and likely implications for local development.

PLT were primarily designed to expand the agricultural frontier by allocating previously unoccupied or publicly owned land to settlers. These programs were especially important in frontier regions, including the Amazon and parts of the coastal lowlands. A central feature of this mechanism was that it explicitly encouraged internal migration and the creation of new agricultural settlements. In practice, PLT did not simply reassign land within already established rural communities; it often brought new families into reform areas and altered the local composition of the population. Beneficiaries were frequently granted flexibility in production decisions and crop choice, so access to land could generate new economic opportunities for rural households and potentially shape long-run investments in human capital. This migration component is therefore not peripheral to the reform: it is one of the main ways through which PLT could have changed local economic and social conditions over time.

Expropriations, in contrast, aimed to redistribute land from large estates to landless peasants and dismantle highly unequal rural labor institutions. These policies were concentrated in the Highland and southern Coastal regions, where large haciendas dominated agricultural production and labor systems such as *huasipungo* remained prevalent. Under this system, indigenous workers were tied to estates through highly unequal labor arrangements that combined wage labor with access to small subsistence plots.[3] Relative to PLT, this mechanism was less directly associated with settlement expansion and frontier migration, and more closely linked to the reorganization of pre-existing agrarian relations.

For approximately two decades, the Colonization and Agrarian Reform Institute (IERAC, in Spanish) managed the main administrative tasks associated with the reform and oversaw the implementation of land allocation policies across the country. The geographic distribution of the two mechanisms varied considerably. Expropriations were particularly vigorous in the Highland and southern Coastal regions, where they targeted large haciendas and sought to eliminate labor arrangements such as *huasipungo*. PLT were more common in frontier regions, especially in the Amazon, although early colonization efforts also took place in selected coastal and highland areas, including Esmeraldas, Santo Domingo, and Quevedo.

The two mechanisms also differed in the degree of political discretion involved in implementation. Expropriations were often shaped by negotiation, administrative constraints, and the characteristics of the estates subject to redistribution. These factors could affect both the selection of properties and the quality of redistributed land. Such dynamics may have been particularly relevant in the Highland region, where ruggedness and land suitability varied substantially. Historical accounts also suggest that some regions were more effective in carrying out expropriations, particularly in the coastal region following the implementation of Decree 1,001 under President Velasco Ibarra (Gachet, 2024; Dávila and Pazmino, 2016).

PLT, by contrast, generally involved greater flexibility in land use and settlement arrangements. Because the objective was often to establish or expand agricultural communities in frontier areas, beneficiaries were commonly granted broader autonomy in production decisions. At the same time, not all PLT programs created entirely new settlements. In some cases, the policy legalized plots for workers whose landlords had abandoned them (Carrasco, 1994). Even in those cases, however, PLT remained closely connected to mobility, frontier incorporation, and the formation of new local economic opportunities.

The implementation of agrarian reform also coincided with a broader transformation of Ecuador's political economy. In the early 1970s, the discovery and commercialization of oil reserves sharply increased government revenues and shifted the strategic priorities of the state. While agrarian re-

[3] Huasipungo was an informal institution in which indigenous peoples were treated as part of the land rather than as an independent labor force.

form had been a central policy objective during the 1960s, the rapid expansion of the petroleum sector gradually reduced the prominence of rural reform within national development policy. As a result, the later stages of agrarian reform unfolded in a context in which administrative attention and fiscal resources were increasingly redirected toward the oil economy. This broader shift is also useful for understanding why the historical administrative record becomes less complete in later years: the weakening policy centrality of agrarian reform coincided with a state increasingly oriented toward oil-led development.

3. Data

The empirical analysis combines household survey data with historical administrative sources and geographic information. The household surveys provide individual- and household-level outcomes, while historical records and maps document the spatial distribution of agrarian reform policies. Geographic data are used to account for underlying land characteristics and spatial constraints. I describe the data sources below.

3.1. Survey data

The main source of child health information comes from the Living Standards Surveys conducted in 2006 and 2014 by the Ecuadorian statistical office, INEC. These surveys form a repeated cross-section dataset designed primarily to measure household consumption and calculate poverty indexes. Both survey waves include modules that collect anthropometric information for children, allowing the construction of standard indicators of nutritional status.

Stunting is measured using height-for-age indicators calculated according to World Health Organization (WHO) growth standards. The Living Standards Surveys report height-for-age z-scores constructed using these standards, following the procedures documented in Gutierrez et al. (2018). These indicators are based on standardized routines developed by the WHO and UNICEF that compare children's observed heights with internationally harmonized growth references. Children with z-scores below minus two standard deviations are classified as stunted. The use of harmonized standards ensures international comparability of children's height relative to their age, and the two Living Standards Surveys are comparable across time (Gutierrez et al., 2018).

In addition to anthropometric outcomes, the surveys provide rich information on individual and household characteristics. These include parish of residence, mother's education, consumption levels as a measure of household welfare, race, birth order, and gender. Maternal characteristics are particularly important for the empirical analysis because they allow linking children's health outcomes to the socioeconomic background and human capital of mothers. Using the age of mothers reported in each survey wave, I reconstruct maternal birth cohorts that make it possible to relate mothers' early-life exposure to agrarian reform policies to health outcomes observed in the next generation. This cohort structure is also useful for studying internal migration, since the survey information allows distinguishing mothers' current place of residence from their migration-related profiles in ways that help assess whether the estimated relationships are driven only by selective population movements into reform areas.

An additional source of information used to provide suggestive evidence on intermediate outcomes comes from the first national survey on child stunting conducted in Ecuador in 1986. These data were originally used in CONADE and MSP (1988) and were kindly shared by Wilma Freire (principal investigator) and Phillipe Belmont. While the survey is nationally representative, it does not provide parish identifiers. To partially overcome this limitation, I apply a backward identification procedure to identify observations from the Santo Domingo municipality, which was largely exposed to PLT, and municipalities from the Midland region which were predominantly exposed to expropriations. These data are used only for descriptive and suggestive evidence.

3.2. Historical sources

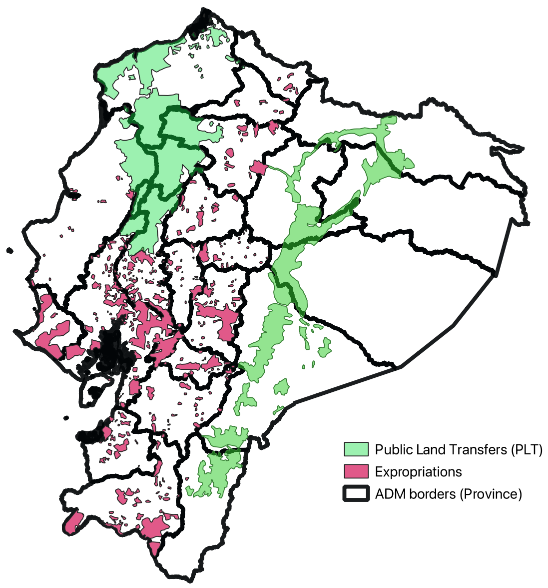
The main historical sources documenting agrarian reform come from the archives of the Colonization and Agrarian Reform Institute (IERAC). These include administrative registries of land allocation as well as historical maps describing the geographic extent of reform areas. Data on PLT and expropriation applications at the parish level were collected from IERAC administrative registries for the years 1964–1970, and 1975 and 1978. These registries document the location and type of land allocation implemented during the agrarian reform period.[4]

In addition to the administrative registries, I use a historical map located in the IERAC archives as well as in the Jesuit library "Aurelio Espinosa Polit". The historical map provides an alternative spatial record of agrarian reform interventions constructed through a different bureaucratic procedure, and is therefore useful precisely because its discrepancies with the registries are more plausibly driven by cartographic and administrative translation than by the original determinants

[4] Expropriation data was originally collected in Baquero-mendez (2023).

of reform placement. To integrate this source into the empirical analysis, I apply Geographic Information System (GIS) techniques to georeference the polygons depicted in the map and overlay them onto modern administrative shapefiles provided by INEC. This procedure allows extracting spatial measures of agrarian reform exposure that can be linked to contemporary parish boundaries (Figure 2).

Figure 2: IERAC historic map: Georeference



Note: Digital version of A1 re-drawn in GIS and geolocated.

The archival records are not available for all years during the 1970s. This gap coincides with a period of major structural change in Ecuador following the discovery and commercialization of oil in the early 1970s. The emergence of the petroleum sector rapidly altered the priorities of the central government and redirected administrative attention toward the management of oil revenues and related infrastructure. As a consequence, bureaucratic institutions associated with agrarian reform, including IERAC, likely experienced changes in administrative capacity, policy priority, and record keeping. These broader institutional dynamics help explain why the archival registry data contain gaps for several years even though agrarian reform activities continued during the decade. The historical map described above, which aggregates information on agrarian reform interventions up to 1978, provides a complementary spatial record that, alongside the registries, allows a more complete picture of reform exposure across parishes, and is therefore particularly useful in the empirical strategy.

3.3. Geographic data

The analysis also incorporates geographic characteristics that may influence agricultural productivity and the implementation of agrarian reform policies. These include an agricultural suitability index from the Center for Climatic Research at the University of Wisconsin–Madison, measures of terrain ruggedness from Nunn and Puga (2012), and administrative border shapefiles from INEC. These geographic variables help account for underlying environmental conditions that may affect land allocation patterns, settlement decisions, and local economic opportunities.

3.4. Final data set construction

The final dataset is constructed by merging the different sources at the parish level, except for the 1986 survey data which are used separately for descriptive purposes. Parish identifiers are standardized across sources using administrative codes in order to ensure comparability across datasets. The resulting dataset is organized at the individual child level and combines information on children's health outcomes and household characteristics with parish-level measures of agrarian reform exposure and geographic attributes derived from historical and spatial sources. This merged structure allows the analysis to relate child outcomes not only to place-based exposure to agrarian reform, but also to maternal cohort variation and migration-related dimensions that are important for interpreting the long-run effects of PLT. Descriptive statistics are presented in Tables A14 and A15.

4. Empirical strategy

The empirical analysis proceeds in two steps. I first estimate baseline Ordinary Least Squares (OLS) regressions relating children's health outcomes to exposure to agrarian reform at the parish level. I then implement an instrumental variables (IV) strategy that exploits differences between two historical sources documenting agrarian reform in Ecuador. My preferred specification compares PLT- or expropriation-exposed locations with areas where no agrarian reform was implemented according to the historical map. The first step constitutes the main empirical evidence in the paper. The second step is a complementary exercise whose purpose is narrower: it assesses whether the main contrast between PLT and expropriation survives when reform intensity is measured through a different historical source and when measurement noise in the registry data is partially corrected.

4.1. Baseline specification

The baseline empirical specification takes the following form:

$$Y_{i,p,t} = \alpha + \beta Reform_p + X'_{i,p}\gamma + \delta_m + \tau_t + \varepsilon_{i,p,t} \quad (1)$$

where i denotes individual children under the age of five, p indicates the parish of residence, m denotes the province, and t corresponds to the survey year. The dependent variable $Y_{i,p,t}$ represents two alternative measures of child health outcomes: an indicator variable equal to one if a child is classified as stunted (height-for-age z-score below -2 standard deviations), and the height-for-age z-score itself as a continuous measure of nutritional status.[5]

The key explanatory variable $Reform_p$ measures exposure to agrarian reform at the parish level. I construct this measure using information derived from a georeferenced historical map of agrarian reform interventions (Figure A1). Specifically, I calculate the total amount of land allocated through PLT or expropriations relative to contemporary parish area using INEC shapefiles.

The vector $X_{i,p}$ includes a set of individual, household, and geographic controls. Individual characteristics include gender, birth order, and birth cohort. Household socioeconomic status is proxied by consumption quintiles derived from the Living Standards Surveys. Geographic characteristics include agricultural suitability, terrain ruggedness, and parish population measured using the 2010 census. These controls account for demographic differences, household economic conditions, and environmental factors that may influence child health outcomes. In specifications that speak more directly to mechanisms and interpretation, the empirical analysis also leverages information on mothers' cohorts and migration-related profiles, which is important because PLT were historically linked to internal migration and settlement expansion rather than only to land redistribution within fixed populations.

The controls are chosen to account for two broad sources of confounding. First, geographic characteristics — agricultural suitability, terrain ruggedness, and parish population — are included because both PLT and expropriation were implemented in places with particular environmental and demographic features. PLT was concentrated in frontier areas with specific land characteristics, while expropriation targeted established agricultural regions. Without controlling for these features, the estimated associations could reflect underlying geographic differences rather than the policies themselves. Second, individual and household characteristics — gender, birth order, birth cohort, and consumption quintiles — are included because child stunting is sys-

[5] This variable is widely used in the literature, including Kosec and Shemyakina (2024) and Duflo (2003).

tematically related to household socioeconomic status, child age, and sex. Omitting these would conflate the reform associations with pre-existing household-level differences in child health determinants. Province fixed effects additionally absorb any persistent regional differences across Ecuadorian provinces that are common to all children within a province, regardless of reform exposure.

All regressions include province fixed effects (δ_m) to account for persistent regional differences across Ecuadorian provinces and survey year fixed effects (τ_t) to capture common time trends between the 2006 and 2014 surveys. Standard errors are clustered at the parish level, which corresponds to the level at which agrarian reform exposure is measured.

4.2. Instrumental variables

The OLS specification in equation 1 may be subject to endogeneity concerns. In particular, the spatial distribution of agrarian reform policies may be correlated with unobserved characteristics affecting child health outcomes. To address this issue, I implement an instrumental variables strategy that exploits differences between two historical sources documenting agrarian reform. It is important to note, however, that the IV strategy is not presented as a full solution to the concern of non-random policy placement. Both the map and the registries are downstream of the same broader reform process, and conditioning on observable controls does not fully eliminate placement-related concerns. Rather, the IV exercise is best understood as a second empirical step that addresses measurement error in the registry-based reform variable and examines whether the main qualitative contrast between PLT and expropriation is robust to using an alternative historical source.

Two complementary sources provide information on land interventions during the reform period. The first consists of administrative registries from the Colonization and Agrarian Reform Institute (IERAC), which document land allocation for the years 1964–1970, 1975, and 1978.[6] Because several years in the 1970s are missing from the registries, these records do not provide a complete account of agrarian reform implementation.

The second source is a historical map collected from the IERAC archives (Figure A1). This map aggregates information on agrarian reform interventions up to 1978, the final year in which the reform was implemented. Using Geographic Information System (GIS) techniques, I georeference the map and overlay it onto contemporary administrative boundaries to recover the total

[6] Baquero-mendez (2023) and Gachet (2024) use the same archival sources for expropriations and PLT respectively.

amount of land affected by either PLT or expropriation at the parish level.

The identification strategy exploits the fact that these two sources measure the same underlying reform process through different bureaucratic procedures. The registries record interventions as they were entered administratively into parish units in specific years, while the historical map reflects a cumulative spatial representation of reform areas as later summarized by map makers within the same state apparatus. In practice, discrepancies between both sources can arise because one set of bureaucrats assigned land interventions to parish boundaries in the registries, while another translated reform areas into cartographic space in the historical map. Neither source should be understood as more accurate than the other in an absolute sense. Both the map and the registries are partial records of the same underlying reform process, constructed through different bureaucratic and cartographic procedures, each subject to its own form of incompleteness and recording error. Additional differences may also reflect incomplete archival survival and missing years in the registries. Under this interpretation, the map-based measure is useful because it is strongly related to underlying reform exposure, but its remaining discrepancy with the registry-based measure is more plausibly driven by bureaucratic and cartographic assignment differences than by determinants of child stunting observed decades later. This is the sense in which the exclusion restriction is plausible in this setting: conditional on controls, the measurement differences generated by registry-entry bureaucrats and map-making bureaucrats are arguably orthogonal with respect to later child health outcomes[7].

The coexistence of these two sources should also be understood in the broader institutional context in which agrarian reform unfolded. During the early 1970s, Ecuador experienced a major economic transition following the discovery and commercialization of oil, which shifted government priorities toward the emerging petroleum sector. While this does not by itself explain the missing registry years, it provides historical context for why agrarian reform may have lost administrative centrality during part of the decade. The historical map used in this paper aggregates the cumulative extent of agrarian reform interventions up to 1978 and therefore may capture policy implementation more comprehensively than the surviving annual registries. This broader context further motivates the use of the map-based measure as an instrument for the archival registry data and as a way to reduce bias from measurement problems in the historical reform variable.

[7] IERAC operated as a centralized institution based in the capital Quito with very few local offices. Discrepancies between the two sources are therefore less likely to reflect local state capacity differences and more plausibly arise from the administrative and cartographic translation of the same centrally managed process.

At the same time, this strategy is especially relevant in the case of PLT, where reform exposure was closely tied to frontier settlement and internal migration. In that setting, the map is informative not only because it summarizes cumulative intervention, but also because it better captures the territorial scope of the policy than the surviving yearly registries alone. This is useful for an empirical design that later examines whether long-run child health differences are consistent with migration-based and intergenerational channels rather than only with static place-based redistribution.

The IV specification is given by

$$Y_{i,p,t} = \alpha + \beta \widehat{Reform}_p + X'_{i,p}\gamma + \delta_m + \tau_t + \varepsilon_{i,p,t} \tag{2}$$

where $\widehat{Reform}_p$ denotes the predicted value of agrarian reform exposure obtained from the first-stage regression.

The first stage takes the following form:

$$Reform_p = \pi_0 + \pi_1 MapReform_p + X'_{i,p}\rho + \delta_m + u_p \tag{3}$$

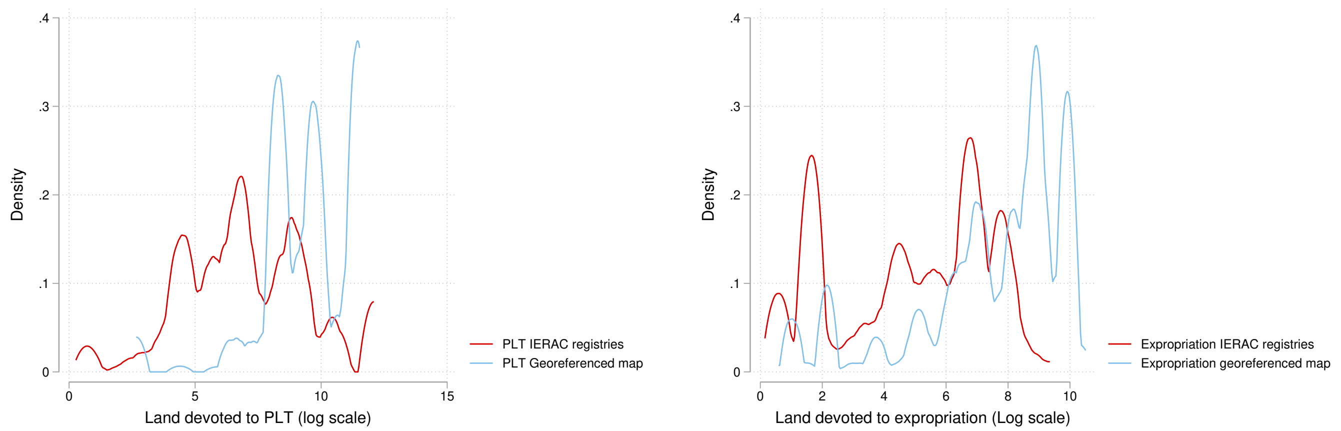
where $MapReform_p$ measures the amount of land affected by agrarian reform derived from the georeferenced historical map. The vector $X'_{i,p}$ represents the same control variables used throughout this paper.

4.2.1. Comparing sources

Figure 3 presents kernel density distributions for the main independent variables used in the econometric models: the amount of land devoted to PLT and expropriations (in logs). As expected, the data derived from the historical map show larger land areas because the map aggregates information across all years of reform implementation, whereas the administrative registries contain incomplete records for several years. While the map aggregates across more years, this does not imply it provides a more accurate parish-level measure of reform intensity - both sources are subject to different forms of recording imprecision, and their relationship is informative precisely because of that complementarity.

Figure 3: Differences between registries and georeferenced map

(a) PLT (b) Expropriation

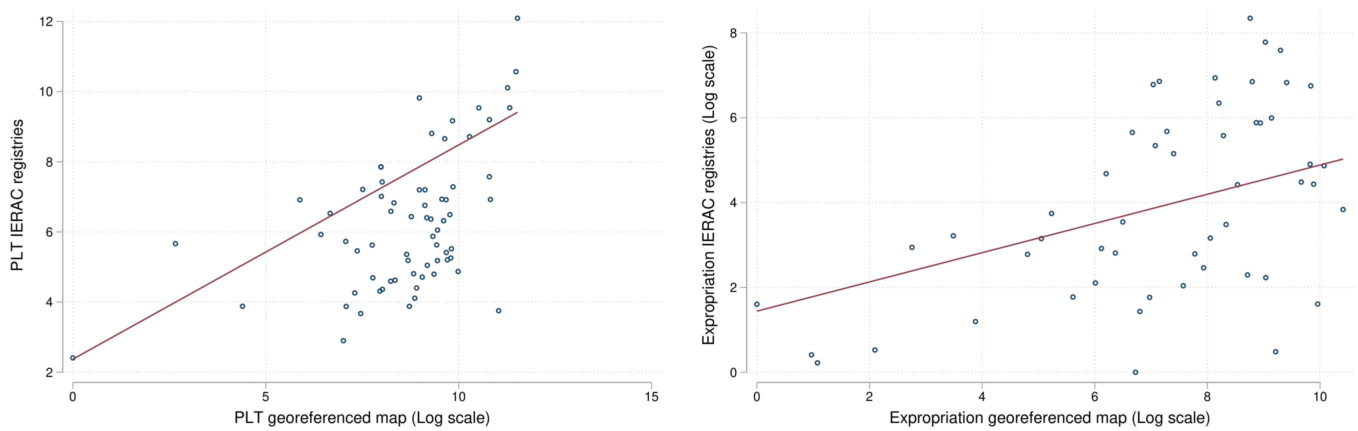


Note: Figure plots kernel densities by the absolute amount land (in log scale) devoted to PLT (Panel a) or expropriations (Panel b).

Figure 4 presents the correlation analysis corresponding to the previous figure. Both regressions display a positive relationship between the two measures of agrarian reform. For PLT, where the policy was implemented more uniformly and over broader settlement areas, the alignment between the registries and the historical map is relatively strong. In contrast, expropriation displays greater dispersion, reflecting the more heterogeneous implementation of this policy across estates and regions. Nonetheless, both figures confirm a systematic relationship between the two data sources.

Figure 4: Correlation between registries and georeferenced map

(a) PLT (b) Expropriation



Note: Binscatter plot between the two sources of measures for agrarian reform. Panel (a) shows the correlation between PLT measured in the historic map A1 using GIS and available IERAC registries. The correlation coefficient is 0.63. For expropriation (Panel b) the correlation coefficient is 0.45.

5. Results

5.1. PLT and expropriation relative to parish area

This section first presents baseline estimates relating exposure to agrarian reform to child stunting. The main specification compares parishes affected by agrarian reform with those that did not experience any form of intervention. Exposure is measured using the share of parish land affected by each policy based on the georeferenced historical map.

Table 1 presents the OLS estimates for PLT . Column 1 reports results where the dependent variable is an indicator equal to one if a child under five is classified as stunted. Column 2 uses the continuous height-for-age z-score. Across both specifications, PLT exposure is associated with meaningful improvements in child nutritional outcomes.

In the binary specification, a one-unit increase in PLT relative to parish area is associated with a reduction in stunting of approximately 0.05. This corresponds to roughly 17 percent of the sample mean of the outcome variable. A similar pattern appears in the intensive margin: the height-for-age z-score increases by approximately 0.17 standard deviations. Taken together, these estimates suggest that children living in areas exposed to PLT exhibit better nutritional outcomes than children in areas unaffected by agrarian reform.

Table 1: OLS estimates – PLT (georeferenced)

	(1) Stunting(0-1)	(2) height for age z-score
PLT(GEO)/area	-0.050	0.167
	(0.022)**	(0.064)***
Observations	6843	6843
Controls	Yes	Yes
Province FE	Yes	Yes
Mean Dep.Var	0.30	-1.35

Cluster standard errors in parentheses
$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$

Note: PLT(GEO)/area: PLT polygon area (in hectares) calculated in GIS from the historical map A1 over parish area (in hectares). Stunting (0-1): Indicator variable equal to one if a child is suffering from stunting. Height-for-age z-score: Continuous measure of children's height relative to international growth standards. Controls include agricultural suitability, ruggedness, population (Census 2010), race, survey year fixed effects, consumption quintile fixed effects, gender, child order fixed effects, and year of birth fixed effects. Standard errors are clustered at the parish level.

Table 2 reports the corresponding estimates using expropriation exposure measured relative to parish area. In contrast to the results for PLT, the coefficients are small and statistically insignificant for both the binary and continuous measures of child stunting. These estimates indicate that areas affected by expropriations do not display systematic improvements in child nutritional outcomes relative to areas without agrarian reform.

Overall, the baseline results reveal a clear contrast between the two agrarian reform strate-

Table 2: OLS estimates – Expropriation (georeferenced)

	(1) Stunting(0-1)	(2) height for age z-score
Expropriation(GEO)/area	-0.010	0.097
	(0.034)	(0.099)
Observations	11135	11135
Controls	Yes	Yes
Province FE	Yes	Yes
Mean Dep.Var	0.29	-1.31

Cluster standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Expropriation(GEO)/area: Expropriation polygon area calculated in GIS from the historical map A1 over parish area. Stunting (0-1): Indicator equal to one if a child is suffering from stunting. Height-for-age z-score: Continuous measure standardized using international growth references. Controls and clustering follow the same specification as in Table 1.

gies. While PLT is associated with significant reductions in child stunting, expropriation does not appear to generate measurable improvements in child health outcomes. This contrast is consistent with the broader interpretation developed in the paper: PLT was not only a land policy, but also a frontier-settlement process that may have altered local economic opportunities and the composition of the population through internal migration.

Additional results are presented in Table A12, where I include each type of agrarian reform as categorical variables and examine their extensive margin jointly. It is interesting to note that, at this margin, any type of reform is associated with statistically significant reductions in child stunting. This suggests that agrarian reform in general may have been beneficial relative to no reform at all. However, the main results of the paper indicate that it is the intensity and mode of land allocation that ultimately drive the differences across policies. Expropriation was more spatially fragmented and heterogeneous, whereas PLT was implemented more uniformly. Taken together, these findings suggest that agrarian reform may have generated broad benefits, but that the scale and form of intervention were crucial in shaping its long-run effects.

5.2. Instrumental variables estimates

The OLS results above may be affected by potential endogeneity in the spatial distribution of agrarian reform. To address this concern, I implement the instrumental variables strategy described in Section 4, which exploits differences between agrarian reform measures derived from IERAC registries and those obtained from the georeferenced historical map. As previously discussed, the IV exercise is presented as a complementary step to the baseline map-based results rather than as a resolution of the broader placement concern. Its purpose is to examine whether the main contrast between PLT and expropriation survives when reform intensity is measured through the registry data and when measurement noise in that source is partially corrected.

Tables 3 and 4 present the IV results for PLT and expropriation respectively. Each table reports reduced-form, OLS, and IV estimates for comparison. In these specifications the agrarian reform variables are measured in absolute terms.

For PLT, the IV estimates confirm the pattern observed in the baseline regressions. Panel A in Table 3 presents the reduced-form relationship between the georeferenced map measure and child stunting outcomes. Panels B and C report the OLS and IV estimates using the registry-based measure instrumented by the map measure. The IV coefficients remain statistically significant and indicate that larger PLT allocations are associated with reductions in child stunting. In the specification using height-for-age z-scores, the magnitude of the effect corresponds to approximately 0.03 standard deviations.

Table 3: IV model – PLT

	(1) Stunting(0-1)	(2) height for age z-score
Panel A: Reduced form		
PLT area GEO(Log)	-0.006	0.019
	(0.003)*	(0.010)*
Panel B: OLS estimates		
PLT area IERAC(Log)	-0.006	0.021
	(0.003)**	(0.008)***
Panel C: IV Estimates		
PLT area IERAC(Log)	-0.011	0.033
	(0.006)*	(0.018)*
Observations	6843	6843
Controls	Yes	Yes
Province FE	Yes	Yes
K-P F-stat	82.85	82.85
Mean Dep.Var	0.30	-1.35

Cluster standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: PLT area GEO (log): PLT polygon area calculated from the georeferenced historical map. PLT area IERAC (log): land allocations recorded in IERAC registries. Stunting (0-1) and height-for-age z-score follow the same definitions as in previous tables. Controls include agricultural suitability, ruggedness, population (Census 2010), race, parish area, survey year fixed effects, consumption quintile fixed effects, gender, child order fixed effects, and year of birth fixed effects. Standard errors are clustered at the parish level.

In contrast, the IV estimates for expropriation presented in Table 4 remain statistically insignificant across specifications. While some coefficients approach conventional significance levels, the overall pattern across OLS and IV estimates indicates that expropriation policies did not produce systematic improvements in child nutritional outcomes.

Because historical parish boundaries changed over time, the main IV specifications rely on absolute measures of land allocation. Share-based measures constructed using contemporary parish area are presented as robustness checks in the appendix.

As an additional robustness check, I control for the discrepancy between the polygon/map

Table 4: IV model – Expropriation

	(1) Stunting(0-1)	(2) height for age z-score
Panel A: Reduced form		
Expropriation area GEO(Log)	-0.002	0.009
	(0.002)	(0.005)*
Panel B: OLS estimates		
Expropriation area IERAC(Log)	0.001	-0.005
	(0.002)	(0.006)
Panel C: IV Estimates		
Expropriation area IERAC(Log)	-0.005	0.025
	(0.005)	(0.015)*
Observations	11135	11135
Controls	Yes	Yes
Province FE	Yes	Yes
K-P F-stat	45.91	45.91
Mean Dep.Var	0.29	-1.31

Cluster standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Expropriation area GEO (log): Expropriation polygon area calculated from the historical map. Expropriation area IERAC (log): land allocations recorded in IERAC registries. Controls and clustering follow the same specification as in Table 3.

measure and the registry measure to assess whether the main results are driven by disagreement across historical land sources. This difference captures the gap between the two measures and helps account for the possibility that missing information in the registries follows a systematic pattern across parishes. I estimate this specification in an OLS framework, reported in Tables A10 and A11. The goal of this exercise is not to claim exogeneity, but to show that the main patterns are not mechanically generated by inconsistencies between the two underlying sources.

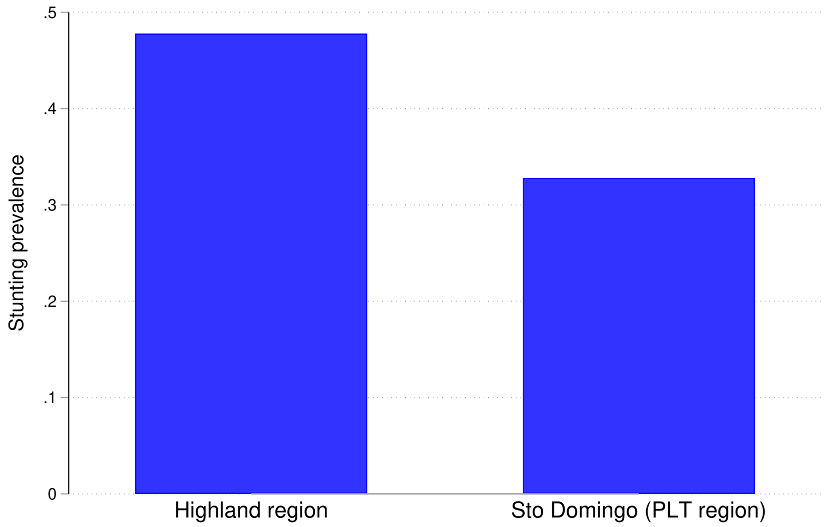
Taken together, the IV results reinforce the main empirical contrast in the paper. The PLT results remain present when the analysis uses variation coming from the historical relationship between registries and the cumulative map measure, whereas expropriation remains imprecise and generally null. This pattern is consistent with the idea that the two reform mechanisms generated different long-run local trajectories.

5.3. Descriptive evidence from the 1986 survey

Additional descriptive evidence can be obtained from the first national survey measuring child anthropometrics in Ecuador, conducted in 1986. Although the raw microdata cannot be fully matched to current administrative units, the survey allows comparisons across broad regions identified in the companion report CONADE and MSP (1988).

Figure 5 compares stunting prevalence in Santo Domingo—a region that emerged largely as a result of PLT interventions (Barsky, 1984)—with the highland region, where expropriations were more prevalent. The figure shows that stunting rates in Santo Domingo are substantially lower than those observed in the highland region. Similar patterns appear when Santo Domingo is compared with other areas predominantly affected by expropriation or not exposed to agrarian reform.

Figure 5: Stunting prevalence: Highlands region vs Santo Domingo (PLT region), DANS 1986



Note: Stunting rate in Santo Domingo, a region largely shaped by PLT settlements, compared with the highlands region where expropriations were more prevalent.

Although these comparisons should be interpreted cautiously given the limitations of the historical data, the evidence suggests that the relationship between PLT exposure and lower stunting rates is not limited to the survey years used in the main analysis. In that sense, the 1986 evidence is useful because it points in the same direction as the later repeated cross sections and is consistent with the idea that the PLT-stunting relationship has deeper historical roots.

5.4. Robustness and additional results

5.4.1. Robustness using alternative specifications

I present additional robustness checks to assess whether the main patterns depend on sample definition or measurement choices. The baseline comparisons frame PLT and expropriation relative to locations not affected by agrarian reform. Tables A4 and A5 report estimates using the full sample, including all observations rather than restricting comparisons to non-reform areas. In this specification, the PLT coefficients become less precise, remaining significant at the 15% level for the binary stunting measure and at the 10% level for the height-for-age z-score, but the qualitative conclusions remain unchanged. By contrast, expropriation continues to show no statistically significant relationship with child stunting.

I also examine the sensitivity of the results to alternative ways of scaling reform exposure. Because there is no georeferenced information on parish size before the twenty-first century, constructing historical shares using IERAC registry data may be misleading. For this reason, the main IV analysis relies on absolute land measures, while shares are used only with the georeferenced map data. Tables A1, A6, and A7 report OLS and IV estimates when registry-based reform measures are normalized by current parish area. These coefficients are large in magnitude, likely reflecting changes in parish boundaries over time, but the sign, direction, and substantive interpretation remain the same. Finally, Tables A8 and A9 show that excluding parish area as an explicit control from the IV specifications does not alter the results.

As a further robustness check, I control for the gap between the polygon/map measure and the IERAC registry measure of reform intensity. This discrepancy may reflect omitted years in the registries or other differences in historical reporting across parishes. The purpose of this exercise is not to provide a new source of identification, but to verify that the main results are not mechanically driven by disagreement across land sources. Tables A10 and A11 show that the qualitative conclusions remain the same: PLT continues to be negatively associated with child stunting, whereas expropriation does not show a robust relationship.

Table A12 reports the extensive-margin specification, where parishes are classified according to whether they experienced PLT, expropriation, or both, relative to areas not affected by agrarian reform. At this margin, both PLT and expropriation are associated with lower child stunting, and the estimated magnitudes are fairly similar across the two policies. This result is not necessarily problematic, but it should be interpreted with caution. The extensive margin captures only whether a parish was ever intervened, without distinguishing differences in the scale or intensity of reform exposure. For that reason, it provides a coarse contrast between reform and non-reform areas, but is less informative about the mechanisms through which distinct land policies may have shaped long-run outcomes. This is why the paper places greater weight on the intensive-margin results. Once variation in the amount of land transferred is taken into account, PLT remains more consistently associated with lower stunting, whereas expropriation becomes imprecise or statistically null. In this sense, the extensive-margin estimates suggest that any type of agrarian intervention may be associated with lower stunting relative to untreated areas, but the intensive margin is more informative for distinguishing the long-run relationship between frontier settlement policies and child stunting.

Internal migration. Internal migration is an important consideration in this setting because PLT explicitly promoted settlement in new areas. A natural concern is therefore that migrants may differ systematically from non-migrants, which could complicate the interpretation of the main results. The household surveys record whether the parent was born in the parish of current residence, which makes it possible to identify internal migrants and compare them with the rest of the sample[8]. I examine differences across several relevant dimensions: mother's education, father's education, ethnic group, child sex, agricultural suitability at the parish level, and terrain ruggedness at the parish level. It is important to note that this measure has limitations. I only observe the parish of birth and the parish of current residence, so I cannot reconstruct a fuller migration profile. In addition, I define the relevant internal migrant as the mother in the household.

Tables 5 and 6 report two balance exercises. First, I estimate specifications comparing internal migrants with the rest of the sample along the characteristics listed above. Second, I repeat the same exercise restricting the sample to residents of PLT areas only. This second comparison is particularly relevant because PLT was designed to encourage internal migration and frontier settlement, so any interpretation of the main results should take seriously the possibility of selective sorting into those areas.

The results point to two main patterns. First, internal migrants are less likely to be indigenous, both in the full sample and within PLT areas. Second, and importantly, there are no statistically meaningful differences in mother's or father's education within PLT areas. In the full sample, migrants are also not significantly different in parental education, although they are associated with less rugged locations. By contrast, within PLT areas there is no significant difference in either agricultural suitability or ruggedness, suggesting that migrants in PLT locations were not systematically sorting into observably better land within the treated sample.

These findings matter for the interpretation of the paper. They do not support the view that the main PLT results are driven simply by the arrival of parents with systematically higher observable human capital into PLT areas. At the same time, the evidence does point to some compositional differences, particularly in ethnicity, so the results should not be interpreted as effects on a fixed population that remained spatially constant over time. Rather, they are more consistent with long-run place-based effects operating in a context where internal migration was itself

[8] It is important to note that the parish-of-birth variable is reported primarily for individuals who answer this question with a parish different from their current residence. The remaining observations are classified as missing. In this exercise, I assume that this missingness largely reflects cases in which the parish of birth coincides with the parish of current residence; otherwise, the internal migration dichotomous variable would contain no zeros.

part of the policy process. This distinction is important because it helps reconcile the historical nature of PLT as a settlement policy with the empirical evidence presented in the paper.

Table 5: Balance internal migration sample

	(1)	(2)	(3)	(4)	(5)	(6)
	Mother educ.	Father educ.	Indigenous	Child sex	Ag suitability	Ruggedness
	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
Internal migrant	0.103	0.092	-0.113***	0.007	0.006	-22590.540***
	(0.186)	(0.144)	(0.021)	(0.008)	(0.011)	(6150.327)
Observations	16363	13069	16932	16932	15976	16932

Note: This table presents the results of regressions in which the internal migrant indicator takes the value of 1 if the parish of birth of the mother of a surveyed child differs from her parish of current residence, and 0 otherwise. It is important to note that 0 includes both non-internal migrants and missing values; thus, the comparison is between internal migrants and the rest of the sample. Column 1 reports mothers' education, column 2 fathers' education, column 3 whether the surveyed individual identifies as indigenous, column 4 the sex of the mother's child, column 5 the agricultural suitability index, and column 6 the ruggedness index.

Table 6: Balance internal migration within PLT

	(1)	(2)	(3)	(4)	(5)	(6)
	Mother educ.	Father educ.	Indigenous	Child sex	Ag suitability	Ruggedness
	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
Internal migrant in PLT	-0.159	-0.171	-0.179***	0.006	0.029	11248.225
	(0.240)	(0.176)	(0.038)	(0.013)	(0.020)	(8946.520)
Observations	4646	3769	4828	4828	4828	4828

Note: This table presents the results of regressions in which the internal migrant indicator takes the value of 1 if the parish of birth of the mother of a surveyed child differs from her parish of current residence, and 0 otherwise. This is restricted to the sample of observations that currently lives in the PLT area at the time of being surveyed. It is important to note that 0 includes both non-internal migrants and missing values; thus, the comparison is between internal migrants and the rest of the sample. Column 1 reports mothers' education, column 2 fathers' education, column 3 whether the surveyed individual identifies as indigenous, column 4 the sex of the mother's child, column 5 the agricultural suitability index, and column 6 the ruggedness index.

For this reason, the migration results do more than alleviate a selection concern. They also support the broader interpretation that PLT may have shaped child health through long-run changes in local economic conditions and intergenerational human capital accumulation in places transformed by settlement. The next section explores these mechanisms more directly.

Overall, the results consistently indicate that PLT interventions are associated with substantial improvements in child nutritional outcomes, whereas expropriation policies exhibit no statistically meaningful effects.

6. Mechanisms

6.1. Frontier development and human capital

Why did PLT reduce child stunting while expropriation policies did not produce similar effects? One possible explanation lies in the distinct local dynamics generated by these two land reform strategies.

PLT policies were designed to expand Ecuador's agricultural frontier and promote the establishment of new settlements for the internal population. In practice, these programs often involved the creation of new villages and infrastructure in previously underdeveloped areas. According to the legislation governing PLT programs, settlements were expected to include basic public investments that would make the new locations attractive for settlers. Historical accounts describe processes of this type as "oriented colonization," in which the state actively promoted settlement through infrastructure and public services in frontier regions (Barsky, 1984). Examples of such initiatives can be found in several provinces including Esmeraldas, Guayas, Imbabura, Manabí, Morona, Napo, and Zamora. Similar dynamics have been documented in other historical contexts where frontier settlement policies were accompanied by investments in local infrastructure and public goods (see Albertus (2023)).

These frontier settlements were also explicitly linked to internal migration. This point is important for the interpretation of the paper because PLT was not simply reallocating land within stable local populations; it was fostering the arrival of new families, the formation of communities, and the gradual transformation of local economies. As these communities expanded, new infrastructure and public services—including schools—may have facilitated human capital accumulation among the local population. In turn, improvements in parental human capital could translate into better child care, greater knowledge about health and nutrition, and better long-run child outcomes.

The empirical analysis below explores whether cohort exposure to agrarian reform is consistent with this mechanism. The goal is not to claim that schooling is the only channel linking PLT to lower stunting, but to assess whether the data are consistent with a broader process of frontier development, migration, and intergenerational human capital accumulation.

6.2. Cohort exposure and child health

The first piece of evidence examines whether mothers who were more exposed to agrarian reform during early life exhibit different child health outcomes. Using the birth cohorts of mothers observed in the household surveys, I construct measures of exposure relative to the start of agrarian reform.

Figure 6 presents estimates from a model where the dependent variable is a binary indicator of child stunting and the key explanatory variables interact mothers' birth cohorts with exposure to agrarian reform. The specification includes the same set of controls used in the baseline regressions.

Figure 6: Reduction in stunting by cohort exposure to the agrarian reform

Note: The figure plots interaction coefficients between mothers' birth cohorts and their children's stunting outcomes. Estimates are relative to the 1984–1988 cohort.

The results suggest that children of mothers belonging to cohorts exposed to the early years of agrarian reform exhibit lower rates of stunting relative to later cohorts. This pattern is particularly pronounced for cohorts born around the beginning of the reform period. These mothers were not necessarily of school age when the reform began, so the cohort evidence should be interpreted more broadly as early-life exposure to places transformed by the reform rather than as exposure to schooling reforms alone. While these estimates should be interpreted with caution given sample size limitations for individual cohorts, the overall pattern is consistent with the idea that exposure to the early stages of PLT may have influenced long-run human capital accumulation and child health outcomes.

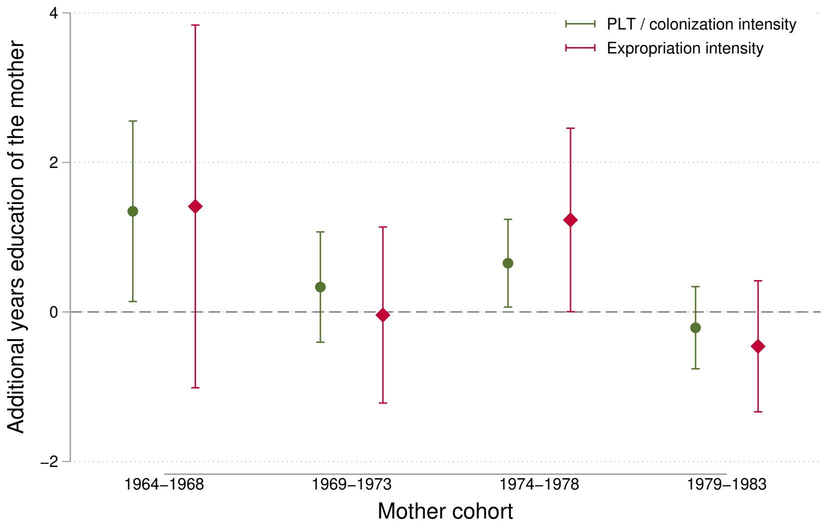
A key reason why effects are concentrated in earlier cohorts is historical. Agrarian reform began in 1964, but the discovery and commercialization of oil after 1973 shifted state attention and fiscal resources away from frontier settlement toward the petroleum sector. Settlement-related investments — schools, infrastructure, community formation — were therefore most intensive during the early phase of the reform. Later cohorts grew up after the reform had lost policy centrality, which explains why the cohort gradient slopes downward rather than reflecting a permanent advantage applying uniformly to all cohorts born in PLT areas.

6.3. Human capital accumulation

One possible channel through which these improvements in child health may occur is through parental human capital. In particular, if frontier settlement programs expanded access to schooling or created environments more conducive to education, cohorts exposed to PLT during childhood or early life might exhibit higher educational attainment later in life.

Figures 7 present estimates of the relationship between cohort exposure and maternal education, measured in years of schooling. The results are shown separately for areas exposed to PLT and those affected by expropriation.

Figure 7: Exposure to agrarian reform and maternal education



Note: The figure plots interaction coefficients between mothers' birth cohorts and exposure to agrarian reform. The outcome variable is mothers' years of schooling.

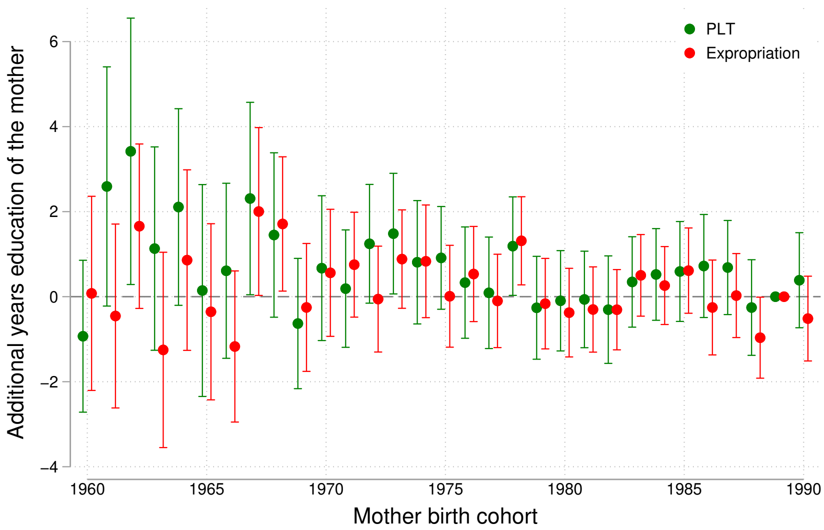
The estimates indicate that cohorts exposed to PLT during the early stages of reform tend to exhibit higher levels of educational attainment relative to later cohorts. In contrast, the corresponding estimates for expropriation areas are generally small and statistically insignificant. These patterns are consistent with the hypothesis that frontier settlement policies may have generated environments conducive to human capital accumulation.

At the same time, the magnitude of these educational differences suggests that schooling alone is unlikely to fully explain the improvements in child nutritional outcomes documented in the previous section. This result should not be read as evidence against the mechanism. Rather, it suggests that maternal human capital is one relevant channel among several long-run changes associated with PLT. Frontier expansion may also have altered household income opportunities, access to public services, market integration, and the local returns to investing in children. The empirical evidence here is therefore best interpreted as suggestive of one plausible mechanism rather than as a complete mediation account.

6.4. Transparency across cohorts

To provide additional transparency, Figure 8 presents estimates for all individual birth cohorts interacting with exposure to each type of agrarian reform. These estimates allow a more detailed view of the cohort patterns underlying the previous figures.

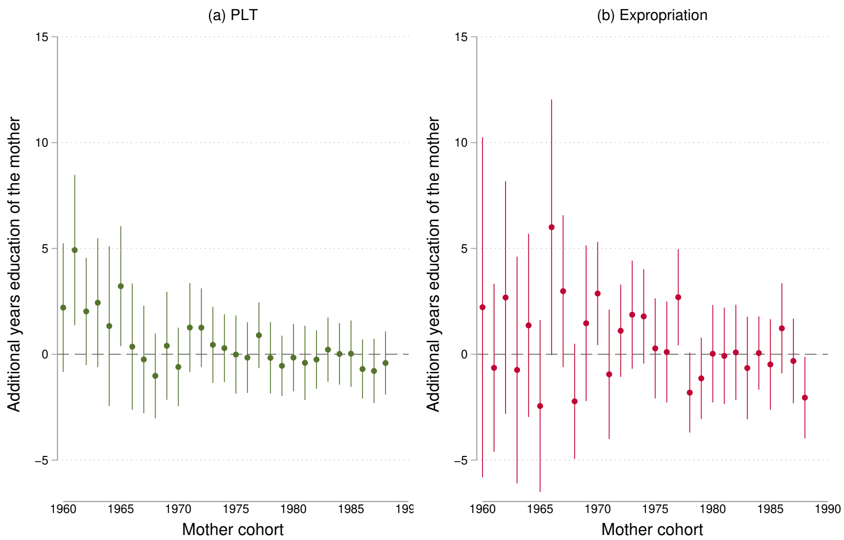
Figure 8: Exposure to agrarian reform and maternal education (extensive margin): all cohorts



Note: The figure plots interaction coefficients between individual maternal birth cohorts and exposure to agrarian reform. Estimates are relative to the 1989 cohort.

While the estimates display some variability across individual cohorts, the overall pattern remains consistent with the previous results. Cohorts exposed to PLT around the beginning of the reform period tend to display higher levels of educational attainment, whereas no systematic pattern emerges in expropriation areas. Taken together, these findings suggest that frontier settlement policies may have contributed to improvements in human capital accumulation, which in turn could have influenced child health outcomes.

Figure 9: Exposure to agrarian reform and maternal education (intensive margin): all cohorts



Note: The figure shows cohort effects for individual birth cohorts rather than grouped cohorts. Estimates are relative to the 1989 cohort.

More broadly, these results are consistent with a mechanism in which frontier development generated new economic opportunities, attracted internal migration, and facilitated the formation of new communities with greater access to infrastructure and schooling. Such dynamics may have improved household conditions and parental investments in children, ultimately contributing to lower stunting rates. Similar arguments regarding the role of infrastructure and local economic conditions in shaping development outcomes have been proposed in other contexts (Banerjee et al., 2020).

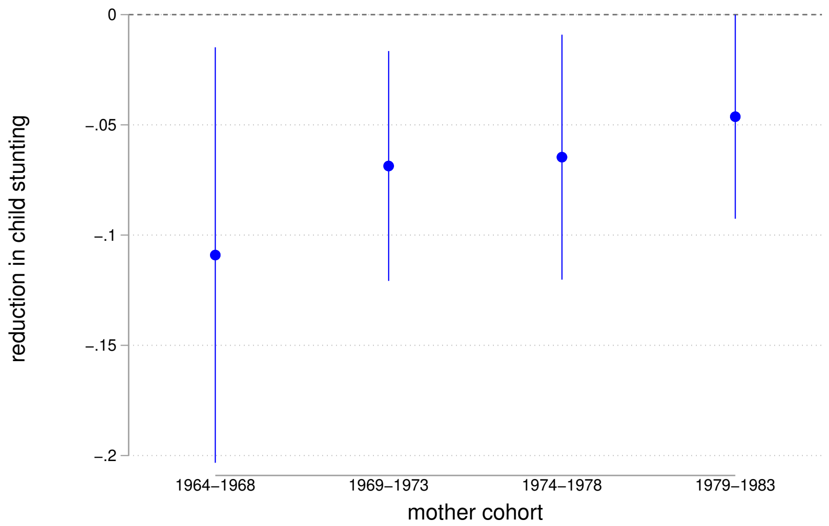
6.4.1. Internal migration

I next examine whether internal migration could account for the observed patterns. Using information on mothers' birthplace reported in the surveys, I restrict the sample to households in which the mother is classified as an internal migrant[9]. This is a demanding exercise because PLT explicitly promoted settlement and movement into frontier areas, so if the main results were driven primarily by migrant selection, they should weaken substantially once the analysis focuses only on this population. Instead, the broad pattern remains in place. Figure 10 shows that, even within the internal migrant sample, earlier maternal cohorts are associated with lower child stunting relative to the omitted 1984–1988 cohort. The magnitude is largest for the earliest cohort and remains negative throughout, which is consistent with the baseline finding that the long-run stunting relationship is concentrated among mothers more plausibly exposed to the reform

[9] I use the same strategy as in the robustness subsection within the results section.

period.

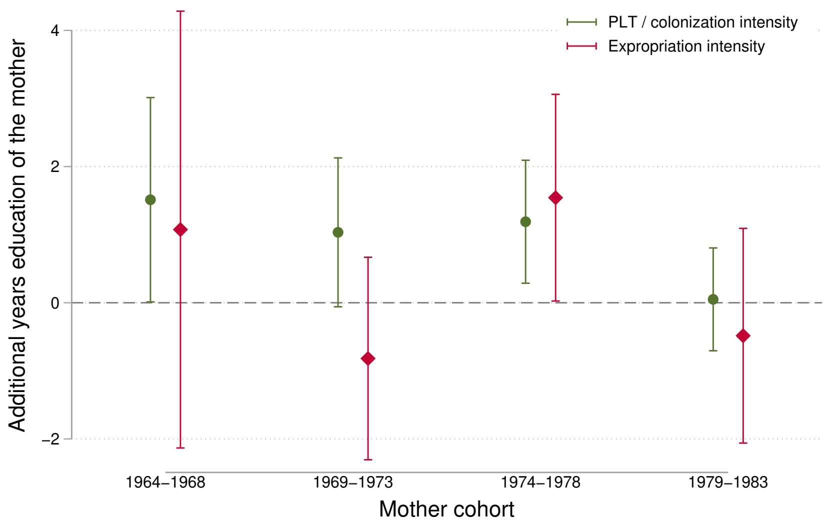
Figure 10: Reduction in stunting by cohort exposure to the agrarian reform within internal migrants(mothers)



Note: The figure plots interaction coefficients between mothers' birth cohorts and their children's stunting outcomes. Estimates are relative to the 1984–1988 cohort. This figure only uses internal migrants sample

Figure 11 provides further evidence on the mechanism. Among internal migrants, PLT exposure continues to be associated with positive cohort-specific differences in mothers' education, whereas expropriation displays a noisier and less coherent pattern. This is important because it suggests that the main contrast between PLT and expropriation does not disappear once attention is restricted to a population for whom migration is an inherent part of the policy environment. In other words, the education pattern linked to PLT is not simply an artifact of comparing migrants with non-migrants.

Figure 11: Exposure to agrarian reform and maternal education within internal migrants(mothers)



Note: The figure plots interaction coefficients between mothers' birth cohorts and exposure to agrarian reform. The outcome variable is mothers' years of schooling. This figure only uses internal migrants sample.

Taken together, the internal migration results are encouraging for the interpretation of the paper. First, they weaken the concern that the main findings are driven purely by selective in-migration of mothers with systematically different observable characteristics, this was discussed in the robustness subsection within the results section. Second, they show that the cohort-specific education and stunting patterns survive even within the migrant population itself. This is consistent with interpreting PLT as a settlement policy whose long-run association with child stunting operated through a broader bundle of place-based changes, including, but not limited to, maternal education. While the evidence presented here is suggestive rather than definitive, it points to maternal human capital as one plausible component of a wider long-run process linking frontier settlement policies to lower child stunting. These results should also be interpreted with caution, since the migrant-based mechanism analysis is more demanding in terms of sample size and statistical power.

Table A13 complements these figures with a simple mediation-style exercise based on common estimation samples. In both the PLT and expropriation specifications, mothers' education is strongly negatively associated with child stunting. However, adding mothers' education leaves the PLT coefficient virtually unchanged and does not alter the null relationship for expropriation. This result should not be read as evidence against the proposed mechanism. Rather, it suggests that maternal human capital is one relevant channel among several long-run changes associated with PLT, rather than a single variable that fully absorbs the estimated association in a regression-control sense. Further research could explore additional mechanisms more directly and assess their relative importance alongside maternal education.

7. Conclusions

This paper studies the long-run relationship between agrarian reform and child stunting in Ecuador. Child stunting remains an important public policy concern in many developing countries, and understanding how historical development policies shape long-run human capital outcomes can provide useful insights for contemporary policy design.

I combine historical and contemporary sources to analyze the effects of the two main land allocation strategies implemented during Ecuador's agrarian reform: PLT and expropriation. The results reveal a clear contrast between these policies. While expropriation exhibits effects that are generally statistically indistinguishable from zero, PLT is consistently associated with lower rates of child stunting. Across different specifications and measurement strategies, the relationship between PLT and improved child nutritional outcomes remains stable.

Using a combination of historical maps and archival registries, I implement an instrumental variables strategy to examine whether the main results are robust to using an alternative historical source and to partially correct for measurement noise in the registry data of agrarian reform intensity. The estimates suggest that PLT reduced child stunting by approximately 3% to 17%, depending on the specification and outcome measure. These estimates should be interpreted with caution given historical limitations in measuring parish land areas and the broader constraints of archival data; however, the qualitative conclusions remain stable across alternative approaches.

The results suggest that the design and implementation of land reform policies can generate very different long-run development trajectories. In Ecuador, PLT functioned primarily as a frontier settlement policy aimed at expanding the agricultural frontier and promoting the formation of new rural communities. In contrast, expropriation was largely focused on redistributing land within existing agricultural areas. The findings of this paper indicate that these two policy approaches were associated with distinct long-term trajectories, with frontier settlement policies appearing to generate more favorable outcomes in terms of child health.

The historical context of the reform is also important for interpreting these results. During the early 1970s Ecuador experienced a major economic transformation following the discovery and commercialization of oil reserves. The expansion of the petroleum sector shifted government priorities and reduced the centrality of agrarian reform within national development policy. This broader shift also helps explain why the archival record becomes less complete in part of the decade. As a consequence, many of the settlements created during the earlier phase of the reform continued to evolve through local economic dynamics, internal migration, and community formation rather than through sustained state attention. This historical sequence helps explain why the long-run patterns documented in this paper appear more consistent with localized development processes in frontier settlements than with the large-scale redistributive objectives associated with expropriation.

To explore potential mechanisms, I analyze cohort exposure to agrarian reform among mothers observed in the household surveys. The results suggest that cohorts exposed to PLT during early life exhibit both higher educational attainment and lower stunting rates among their children. In contrast, similar patterns do not emerge in areas affected by expropriation. These findings are consistent with the possibility that frontier settlement policies facilitated improvements in local infrastructure, schooling, and economic opportunities, which may have contributed to human capital accumulation and improved child health outcomes. At the same time, the magnitude of these educational patterns suggests that maternal human capital should be interpreted as one possible channel rather than the sole mechanism through which PLT influenced nutritional outcomes. The migration-based evidence points in a similar direction: internal migration does not appear to overturn the main results and is more consistent with interpreting PLT as a settlement policy whose long-run association with child stunting operated through a broader bundle of place-based changes.

Overall, the results highlight the importance of distinguishing between different types of agrarian reform policies. While redistributive land reforms have often been evaluated in terms of land inequality and agricultural productivity, this paper shows that settlement-based reforms may also generate long-run human development effects through the creation of new economic opportunities, local infrastructure, and intergenerational changes in human capital. More broadly, these findings contribute to a growing literature examining the long-run consequences of historical policies and suggest that frontier development strategies may have lasting impacts on health and human capital, even if the precise mechanisms deserve further study.

Declaration of generative AI and AI-assisted technologies in the manuscript preparation process

During the preparation of this work, the author(s) used ChatGPT and Claude in order to correct spelling and grammar. Claude Code assisted in preparing a replication package for this

paper. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the published article.

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Appendix

Figure A1: IERAC historic map: Original

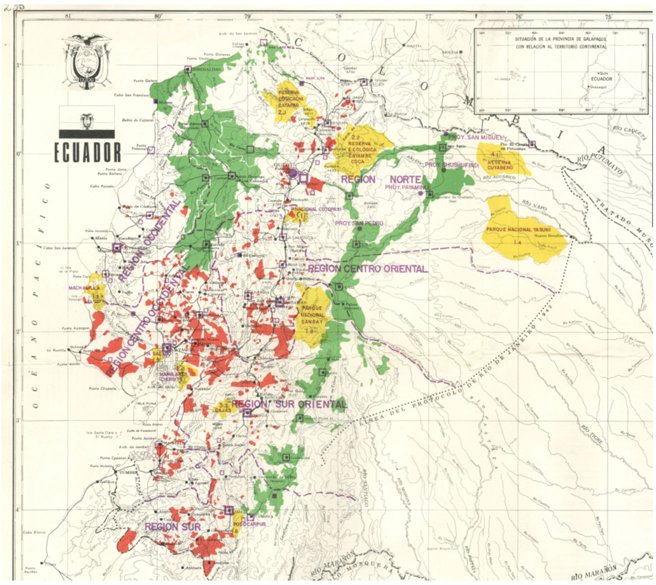


Figure A2: Density z scores

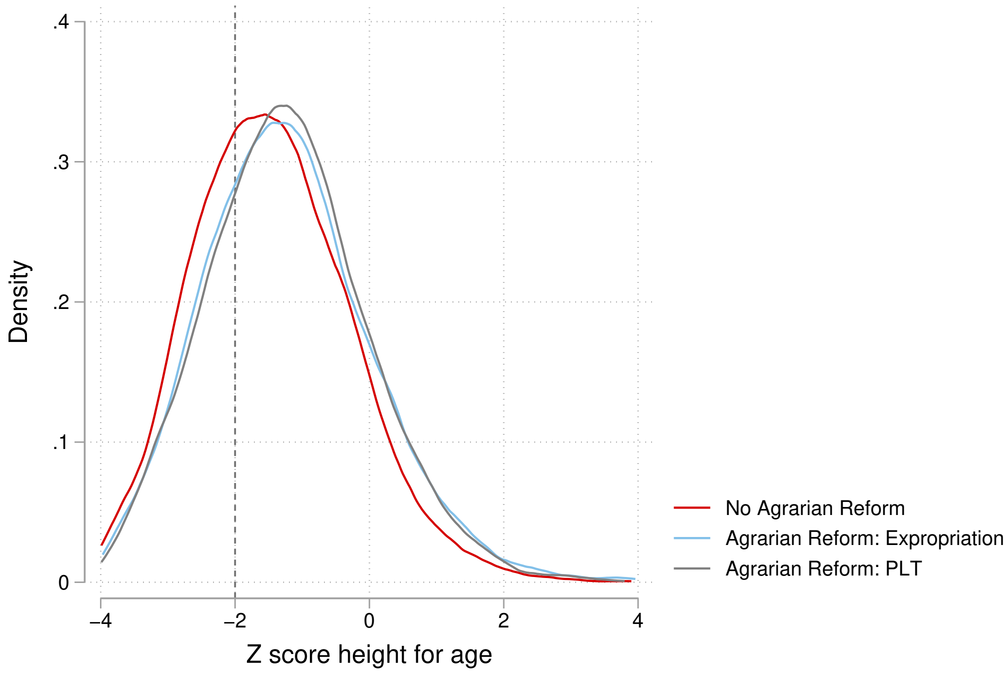


Table A1: OLS estimates- PLT as a share of contemporary parish area-

	(1) Stunting(0-1)	(2) height for age z-score
PLT(IERAC)/area	-0.284	0.455
	(0.080)***	(0.201)**
Observations	6843	6843
Controls	Yes	Yes
Province FE	Yes	Yes
Mean Dep.Var	0.30	-1.35

Cluster standard errors in parentheses
$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$

Note: PLT(IERAC)/area: Amount of land (in hectares) devoted to PLT according to IERAC registries over parish area (in hectares). Stunting (0-1): Indicator variable that takes the value of 1 if a child is suffering from stunting and 0 otherwise. Height-for-age z-score: Continuous variable that standardizes children's height to international tables; this is calculated using WHO's igrowup package for Stata. Controls include: Agricultural suitability, ruggedness, population (Census 2010), race, year of the survey fixed effect (FE), consumption quantile FE, gender, child order FE, year of birth FE. Cluster is at the parish level:366 total (118 PLT, 248 no agrarian reform)

Table A2: OLS estimates- PLT original GEO sample-

	(1) Stunting(0-1)	(2) height for age z-score
PLT(GEO)/area	-0.065	0.214
	(0.020)***	(0.061)***
Observations	8352	8352
Controls	Yes	Yes
Province FE	Yes	Yes
Mean Dep.Var	0.31	-1.35

Cluster standard errors in parentheses
$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$

Note: PLT(GEO)/area: PLT Polygon area (in hectares) calculated in GIS from the historical map A1 over parish area (in hectares). Stunting (0-1): Indicator variable that takes the value of 1 if a child is suffering from stunting and 0 otherwise. Height-for-age z-score: Continuous variable that standardizes children's height to international tables; this is calculated using WHO's igrowup package for Stata. Controls include: Agricultural suitability, ruggedness, population (Census 2010), race, year of the survey fixed effect (FE), consumption quantile FE, gender, child order FE, year of birth FE. Cluster is at the parish level:712 total (195 PLT, 517 no agrarian reform or expropriation)

Table A3: OLS estimates- Expropriation original GEO sample-

	(1) Stunting(0-1)	(2) height for age z-score
Expropriation(GEO)/area	0.001	0.065
	(0.031)	(0.092)
Observations	11491	11491
Controls	Yes	Yes
Province FE	Yes	Yes
Mean Dep.Var	0.29	-1.31

Cluster standard errors in parentheses
$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$

Note: Expropriation(GEO)/area: Expropriation polygon area (in hectares) calculated in GIS from the historical map A1 over parish area (in hectares). Stunting (0-1): Indicator variable that takes the value of 1 if a child is suffering from stunting and 0 otherwise. Height-for-age z-score: Continuous variable that standardizes children's height to international tables; this is calculated using WHO's igrowup package for Stata. Controls include: Agricultural suitability, ruggedness, population (Census 2010), race, year of the survey fixed effect (FE), consumption quantile FE, gender, child order FE, year of birth FE. Cluster is at the parish level: 712 total (287 expropriation, 425 no agrarian reform or PLT).

Table A4: OLS estimates- PLT all sample-

	(1) Stunting(0-1)	(2) height for age z-score
PLT(GEO)	-0.027	0.103
	(0.018)$^{+}$	(0.058)*
Observations	15943	15943
Controls	Yes	Yes
Province FE	Yes	Yes
Mean Dep.Var	0.29	-1.29

Cluster standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: PLT(GEO): PLT Polygon area (in hectares) calculated in GIS from the historical map A1. Stunting (0-1): Indicator variable that takes the value of 1 if a child is suffering from stunting and 0 otherwise. Height-for-age z-score: Continuous variable that standardizes children's height to international tables; this is calculated using WHO's igrowup package for Stata. Controls include: Agricultural suitability, ruggedness, population (Census 2010), race, year of the survey fixed effect (FE), consumption quantile FE, gender, child order FE, year of birth FE, and parish area. Cluster is at the parish level:712 total (195 PLT, 517 no agrarian reform or expropriation)

Table A5: OLS estimates- Expropriation all sample-

	(1) Stunting(0-1)	(2) height for age z-score
Expropriation(GEO)	-0.000	0.074
	(0.030)	(0.089)
Observations	15943	15943
Controls	Yes	Yes
Province FE	Yes	Yes
Mean Dep.Var	0.29	-1.29

Cluster standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Expropriation(GEO): Expropriation polygon area (in hectares) calculated in GIS from the historical map A1. Stunting (0-1): Indicator variable that takes the value of 1 if a child is suffering from stunting and 0 otherwise. Height-for-age z-score: Continuous variable that standardizes children's height to international tables; this is calculated using WHO's igrowup package for Stata. Controls include: Agricultural suitability, ruggedness, population (Census 2010), race, year of the survey fixed effect (FE), consumption quantile FE, gender, child order FE, year of birth FE, and parish area. Cluster is at the parish level: 712 total (287 expropriation, 425 no agrarian reform or PLT).

Table A6: IV Results using shares relative to contemporary parish area-PLT

	(1) Stunting(0-1)	(2) height for age z-score
Panel A: Reduced form		
PLT(GEO)/area	-0.050	0.167
	(0.022)**	(0.064)***
Panel B: IV Estimates		
PLT(IERAC)/area	-0.553	1.837
	(0.252)**	(0.810)**
Observations	6843	6843
Controls	Yes	Yes
Province FE	Yes	Yes
K-P F-stat	18.94	18.94
Mean Dep.Var	0.30	-1.35

Cluster standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: PLT(GEO)/area: PLT polygon area (in hectares) calculated in GIS from the historical map A1 over parish area. PLT(IERAC)/area: Amount of land (in hectares) devoted to PLT according to IERAC registries over parish area. Stunting (0-1): Indicator variable that takes the value of 1 if a child is suffering from stunting and 0 otherwise. Height-for-age z-score: Continuous variable that standardizes children's height to international tables; this is calculated using WHO's igrowup package for Stata. Controls include: Agricultural suitability, ruggedness, population (Census 2010), race, year of the survey fixed effect (FE), consumption quantile FE, gender, child order FE, year of birth FE. Cluster is at the parish level:366 total (118 PLT, 248 no agrarian reform)

Table A7: IV Results using shares relative to contemporary parish area-Expropriation

	(1) Stunting(0-1)	(2) height for age z-score
Panel A: Reduced form		
Expropriation(GEO)/area	-0.010	0.097
	(0.034)	(0.099)
Panel B: IV Estimates		
Expropriation(IERAC)/area	-0.145	1.423
	(0.509)	(1.658)
Observations	11135	11135
Controls	Yes	Yes
Province FE	Yes	Yes
K-P F-stat	9.02	9.02
Mean Dep.Var	0.29	-1.31

Cluster standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Expropriation(GEO)/area: Expropriation polygon area (in hectares) calculated in GIS from the historical map A1 over parish area. Expropriation(IERAC)/area: Amount of land (in hectares) devoted to expropriation according to IERAC registries over parish area. Stunting (0-1): Indicator variable that takes the value of 1 if a child is suffering from stunting and 0 otherwise. Height-for-age z-score: Continuous variable that standardizes children's height to international tables; this is calculated using WHO's igrowup package for Stata. Controls include: Agricultural suitability, ruggedness, population (Census 2010), race, year of the survey fixed effect (FE), consumption quantile FE, gender, child order FE, year of birth FE. Cluster is at the parish level:366 total (248 expropriation, 251 no agrarian reform).

Table A8: IV estimates- PLT not including area control

	(1) Stunting(0-1)	(2) height for age z-score
Panel A: Reduced form		
PLT area GEO(Log)	-0.006	0.019
	(0.003)*	(0.010)**
Panel B: OLS estimates		
PLT area IERAC(Log)	-0.006	0.021
	(0.003)**	(0.008)***
Panel C: IV Estimates		
PLT area IERAC(Log)	-0.011	0.034
	(0.006)*	(0.018)*
Observations	6843	6843
Controls	Yes	Yes
Province FE	Yes	Yes
K-P F-stat	79.82	79.82
Mean Dep.Var	0.30	-1.35

Cluster standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: PLT area GEO(Log): PLT polygon area (in hectares) calculated in GIS from the historical map A1 transformed to a log scale. PLT area IERAC(Log): Amount of land (in hectares) devoted to PLT according to IERAC registries transformed to a log scale Stunting (0-1): Indicator variable that takes the value of 1 if a child is suffering from stunting and 0 otherwise. Height-for-age z-score: Continuous variable that standardizes children's height to international tables; this is calculated using WHO's igrowup package for Stata. Controls include: Agricultural suitability, ruggedness, population (Census 2010), race, year of the survey fixed effect (FE), consumption quantile FE, gender, child order FE, year of birth FE. Cluster is at the parish level:366 total (118 PLT, 248 no agrarian reform)

Table A9: IV estimates- Expropriation not including area control

	(1) Stunting(0-1)	(2) height for age z-score
Panel A: Reduced form		
Expropriation area GEO(Log)	-0.002	0.008
	(0.002)	(0.005)*
Panel B: OLS estimates		
Expropriation area IERAC(Log)	0.001	-0.005
	(0.002)	(0.006)
Panel C: IV Estimates		
Expropriation area IERAC(Log)	-0.005	0.023
	(0.005)	(0.015)
Observations	11135	11135
Controls	Yes	Yes
Province FE	Yes	Yes
K-P F-stat	44.44	44.44
Mean Dep.Var	0.29	-1.31

Cluster standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Expropriation area GEO(Log): Expropriation polygon area (in hectares) calculated in GIS from the historical map A1 transformed to a log scale. Expropriation area IERAC(Log): Amount of land (in hectares) devoted to expropriation according to IERAC registries transformed to a log scale Stunting (0-1): Indicator variable that takes the value of 1 if a child is suffering from stunting and 0 otherwise. Height-for-age z-score: Continuous variable that standardizes children's height to international tables; this is calculated using WHO's igrowup package for Stata. Controls include: Agricultural suitability, ruggedness, population (Census 2010), race, year of the survey fixed effect (FE), consumption quantile FE, gender, child order FE, year of birth FE. Cluster is at the parish level:366 total (248 expropriation, 251 no agrarian reform).

Table A10: OLS model – Controlling for sources differences PLT

	(1) Stunting(0-1)	(2) height for age z-score
PLT area IERAC(Log)	-0.008	0.027
	(0.003)**	(0.010)**
GAP (Log)	-0.003	0.009
	(0.004)	(0.011)
Observations	6843	6843
Controls	Yes	Yes
Province FE	Yes	Yes
Mean Dep.Var	0.30	-1.35

Cluster standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: PLT area IERAC (log): land allocations recorded in IERAC registries. GAP (Log): Difference between PLT measured in absolute terms from IERAC registries and the historical map. Stunting (0-1) and height-for-age z-score follow the same definitions as in previous tables. Controls include agricultural suitability, ruggedness, population (Census 2010), race, parish area, survey year fixed effects, consumption quintile fixed effects, gender, child order fixed effects, and year of birth fixed effects. Standard errors are clustered at the parish level.

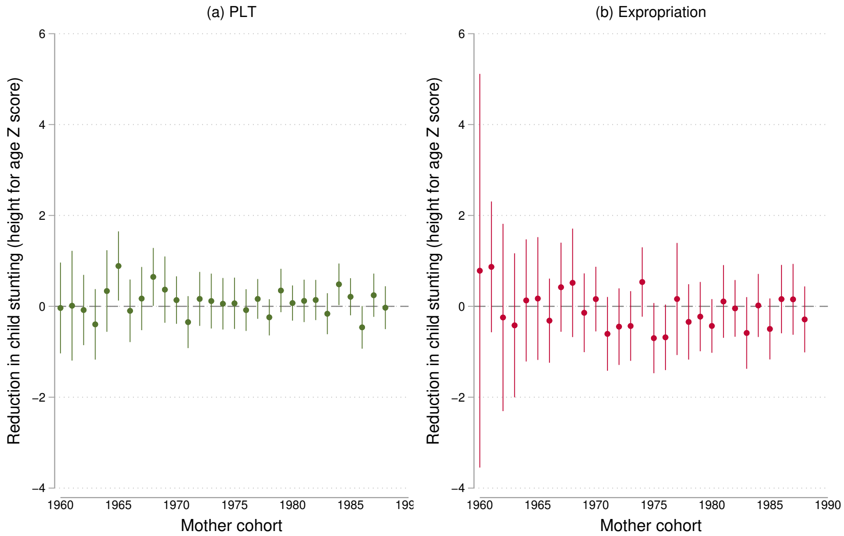
Table A11: OLS model – Controlling for sources differences Expropriation

	(1) Stunting(0-1)	(2) height for age z-score
Expropriation area IERAC(log)	-0.000	0.000
	(0.002)	(0.006)
GAP(log)	-0.002	0.012
	(0.002)	(0.005)**
Observations	11135	11135
Controls	Yes	Yes
Province FE	Yes	Yes
Mean Dep.Var	0.29	-1.31

Cluster standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Expropriation area IERAC (log): land allocations recorded in IERAC registries. GAP (Log): Difference between Expropriation measured in absolute terms from IERAC registries and the historical map. Controls and clustering follow the same specification as in Table A10.

Figure A3: Stunting reduction-All cohorts-



Note: The Figure plots the interaction between mothers' cohorts and the intensive margin of PLT (Panel a)) and expropriation (Panel b)). The outcome is the stunting prevalence of mothers' children. These estimates are relative to 1989 cohort.

Table A12: Stunting and agrarian reform comparison -Extensive margin-

	(1) Stunting(0-1)	(2) height for age z-score
PLT	-0.034	0.144
	(0.017)**	(0.055)***
Expropriation	-0.032	0.115
	(0.013)**	(0.035)***
Both	-0.030	0.106
	(0.025)	(0.071)
Observations	15943	15943
Controls	Yes	Yes
Province FE	Yes	Yes
Mean Dep.Var	0.29	-1.29

Cluster standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: This table reports OLS estimates from an extensive-margin specification in which parishes are classified according to whether they were exposed to Public Land Transfers (PLT), expropriation, or both, relative to parishes with no agrarian reform according to the historical map. The dependent variable in column 1 is an indicator equal to one if a child is suffering from stunting. Column 2 reports the height-for-age z-score, a continuous measure of child nutritional status relative to international growth standards. PLT is a dichotomous variable equal to one if the parish experienced only Public Land Transfers, Expropriation is a dichotomous variable equal to one if the parish experienced only expropriation, and Both is a dichotomous variable equal to one if the parish experienced both types of agrarian reform. Controls include agricultural suitability, ruggedness, population (Census 2010), race, survey year fixed effects, consumption quintile fixed effects, gender, child order fixed effects, and year of birth fixed effects. Province fixed effects are included. Standard errors clustered at the parish level are reported in parentheses.

Table A13: Mediation-style exercise

	(1) PLT: baseline	(2) PLT: + mother's educ.	(3) Expro: baseline	(4) Expro: + mother's educ.
PLT intensity	-0.046**	-0.046**		
	(0.022)	(0.021)		
Expropriation intensity			-0.002	-0.003
			(0.035)	(0.034)
Mother's education		-0.013***		-0.012***
		(0.002)		(0.001)
Observations	6607	6607	10764	10764
Controls	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
Mean Dep.Var	0.30	0.30	0.29	0.29

Cluster standard errors in parentheses
$^{+}$ $p < 0.15$, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: This table reports a mediation-style exercise examining whether mothers' education attenuates the relationship between agrarian reform intensity and child stunting. The dependent variable in all columns is an indicator equal to one if a child is suffering from stunting. Columns 1 and 2 restrict the sample to parishes exposed to Public Land Transfers (PLT), while columns 3 and 4 restrict the sample to parishes exposed to expropriation. PLT intensity and Expropriation intensity measure the share of parish land affected by each type of agrarian reform based on the georeferenced historical map. Columns 1 and 3 report baseline specifications. Columns 2 and 4 add mothers' education, measured in years of schooling. Controls include agricultural suitability, ruggedness, population (Census 2010), race, survey year fixed effects, consumption quintile fixed effects, gender, child order fixed effects, and year of birth fixed effects. Province fixed effects are included. Standard errors clustered at the parish level are reported in parentheses.

Table A14: Descriptive

	(1) No agrarian reform					(2) PLT					(3) Expropriation				
	mean	sd	min	max	count	mean	sd	min	max	count	mean	sd	min	max	count
Stunting indicator(0-1)	0.35	0.48	0.00	1.00	4045	0.29	0.45	0.00	1.00	4463	0.27	0.44	0.00	1.00	8059
Length/height-for-age z-score	-1.51	1.25	-5.92	4.57	4045	-1.25	1.34	-5.88	5.09	4463	-1.25	1.27	-5.97	5.23	8059
Race(1=Indigenous)	0.17	0.37	0.00	1.00	4045	0.30	0.46	0.00	1.00	4463	0.13	0.34	0.00	1.00	8059
Mother education(years)	8.99	4.23	0.00	22.00	3884	8.95	3.89	0.00	21.00	4242	9.64	4.39	0.00	21.00	7742
Gender(1=male)	1.47	0.50	1.00	2.00	4045	1.49	0.50	1.00	2.00	4463	1.48	0.50	1.00	2.00	8059
Consumption quantile	1.69	1.04	1.00	5.00	4036	1.57	0.97	1.00	5.00	4452	1.97	1.16	1.00	5.00	8049
Observations	4045					4463					8059				

Table A15: Descriptive2

	(1) No agrarian reform					(2) PLT					(3) Expropriation				
	mean	sd	min	max	count	mean	sd	min	max	count	mean	sd	min	max	count
PLT(GEO)/area	0.00	0.00	0.00	0.00	283	0.51	0.36	0.00	1.00	177	.	.	.	.	0
PLT(GEO)/area(all sample)	0.00	0.00	0.00	0.00	283	0.51	0.36	0.00	1.00	177	0.00	0.00	0.00	0.00	288
PLT area GEO(Log)	0.00	0.00	0.00	0.00	283	3.69	4.55	0.00	11.52	177	0.00	0.00	0.00	0.00	288
PLT area IERAC(Log)	0.79	1.80	0.00	7.69	283	4.11	3.70	0.00	12.09	177	0.97	2.08	0.00	9.33	288
Expropriation(GEO)/area	0.00	0.00	0.00	0.00	283	.	.	.	.	0	0.22	0.23	0.00	1.00	288
Expropriation(GEO)/area(all sample)	0.00	0.00	0.00	0.00	283	0.00	0.00	0.00	0.00	177	0.22	0.23	0.00	1.00	288
Expropriation area GEO(Log)	0.00	0.00	0.00	0.00	283	0.00	0.00	0.00	0.00	177	7.19	1.84	0.04	10.51	288
Expropriation area IERAC(Log)	1.26	2.03	0.00	8.16	283	0.20	1.13	0.00	8.31	177	3.34	3.16	0.00	9.35	288
Agricultural suitability	0.62	0.26	0.01	0.98	248	0.64	0.22	0.08	0.98	177	0.73	0.18	0.05	0.95	269
Ruggedness	2.0e+05	1.4e+05	638.40	6.0e+05	283	1.0e+05	1.1e+05	1135.24	4.6e+05	177	2.1e+05	1.5e+05	1392.85	5.7e+05	288
Population(2010 Census)	10241.85	21363.13	370.58	2.3e+05	283	11072.03	30334.92	423.20	3.2e+05	177	31854.60	1.7e+05	592.54	2.4e+06	288
Parish area(contemporary boundaries)	19594.45	69741.92	302.46	8.2e+05	283	37411.68	39059.43	2456.11	2.9e+05	177	19069.75	21510.14	978.32	2.4e+05	288
Observations	283					177					288				