The Dark Side of Infrastructure: Roads, Repression, and Land in Authoritarian Paraguay*

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Abstract

Transportation infrastructure is associated with economic development, but it can also be used for social control and to benefit the governing elite. We explore the connection between the construction of road networks, state-led repression, and illegal land allocations in the longest dictatorship in South America: Alfredo Stroessner's military regime in Paraguay. Using novel panel data from the truth and reconciliation commission, we show that proximity to newly constructed roads facilitated state-led repression, illegal allocation of agricultural plots to dictatorship allies, and hindered sustainable economic development in the following decades.

Keywords: roads, repression, land allocations, dictatorship, Paraguay, Alfredo Stroessner.

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1 Introduction

Influential work has consistently shown that dictators choose policies to benefit supporters and remain in power for extended periods (Bueno de Mesquita et al., 2003; Bueno de Mesquita and Smith, 2011). The construction of infrastructure such as a road network, generally treated as a measure of public goods provision (e.g., Acemoglu and Dell 2010), stands out as a multifaceted policy which can generate a positive view of a dictator but also provides benefits for supporters (Burgess et al., 2015), allows control of remote locations, and lowers the cost to repress dissent. This "dark side" of transportation infrastructure has been relatively overlooked and is likely to be detrimental for sustainable economic development.[1] We empirically examine the prevalence of state-led repression and the misallocation of productive resources to supporters, in the context of the construction of the road network in a low-income country under an authoritarian regime.

We study Paraguay, a country which experienced the longest dictatorship in South America (1954-1989) and has nowadays one of the lowest income per capita in the region and the highest levels of land inequality in the world. Led by army officer Alfredo Stroessner, the regime has become famous for its human rights violations and for its endemic corruption. But, Stroessner also engaged in the development of ambitious infrastructure projects. Among these, the construction of a network of paved roads was a prominent strategy to colonize the Eastern part of the country. Using archival documents, we tracked the evolution of Stroessner's road network to investigate how it shaped state-led repression and the misallocation of agricultural land.

To measure state repression and misallocation, we digitize individual-level data on human rights violations in the 1954-1989 period and the illegal allocation of agricultural plots. Following the end of the Stroessner dictatorship in 1989, the discovery of the "Archives of Terror" in 1992 unearthed a massive amount of information documenting its repressive activities. The Truth and Justice Commission was subsequently created and reported how thousands of people were tortured, killed, disappeared, or detained under Stroessner's rule. We structured these data into a panel of 248 districts observed annually during the dictatorship. The Commission also investigated the land allocation process and concluded that a large share was plagued by irregularities, leading to the wrongful reallocation of twenty percent of the country's land. We measure how many plots were illegally allocated by district and year. Importantly, we measure the extent to which the dictatorship allies benefited from the process of illegal allocations of land.

[1] Transportation infrastructure is traditionally associated with development through lower transportation costs and increased economic activity (Hummels, 2007; Redding and Turner, 2015; Roberts et al., 2020). More generally, the "dark side" of states promoting economic development through active investments has been underexplored.

We present three findings. First, Stroessner's road network facilitated state repression. Our empirical strategy exploits the gradual construction of roads over time. We leverage the variation that arises after paved roads were constructed and some districts became easier to access. Doubling the distance to the network decreases repression events by 31 percent. The results are robust to alternative estimation strategies tailored for staggered treatments (Borusyak et al., 2024) and to the use of instrumental variables methods (Banerjee et al., 2020). Second, dictatorship allies were the main beneficiaries of illegal allocations. Moreover, plots were more likely to have been illegally allocated in districts with high potential for cotton production nearby the road network. These results relate to recent research showing that Stroessner selected beneficiaries who were central in local networks to control the local population (Bandiera et al., 2023). Third, districts with more illegal land allocations are nowadays less developed, experience more extractive economic activities, and have more rural conflict. Latin America exhibits the most unequal land distribution in the developing world, and Paraguay displays the second highest land Gini and second lowest income in the region (Gáfaro et al., 2023). We tentatively conclude that by facilitating repression and illegal land allocations, the road network later retarded sustainable development in Paraguay.

We contribute to the literature studying the political economy of infrastructure.[2] Scholars have shown that transport networks are often shaped by political and military reasons, especially in non-democratic contexts (Saiz, 2006; Burgess et al., 2015). In ancient times, the Persian Royal Road, a 2500 km corridor built by King Darius I to connect the Assyrian capital to the Mediterranean, served military and administrative purposes. The primary aim of the Roman roads network was military control over the Empire, although it also facilitated trade and persistently changed economic integration in Europe (Berechman, 2003; Lay, 2009; Dalgaard et al., 2022; Flückiger et al., 2022). The original functions of the road network constructed by the Incas were religious and military (Martincus et al., 2017). When the colonial government of India decided to construct the Indian railroad system in the mid-19th century, it had clear political objectives (Donaldson, 2018). Even democratic governments in the 20th century have to some extent displayed similar motivations. When President Franklin D. Roosevelt launched the planning tasks for a national highway system in 1937, the committee in charge "considered a strategic highway network suggested by the War Department, the location of military establishments, interregional traffic demand, and the distribution of population and economic activity at that time." (Duranton and Turner, 2012).

Previous literature has ignored the potential long-run consequences of large infrastructure

[2] A large literature has documented the impact of transportation infrastructure on economic outcomes (e.g., Fogel 1964; Donaldson 2018; Banerjee et al. 2020), including criminal activity (Agnew 2020; Baires et al. 2020; Calamunci and Lonsky 2022). See Redding and Turner (2015) and Berg et al. (2017) for relatively recent reviews.

projects constructed with political motives and has usually interpreted the construction of roads as a measure for the provision of public goods under both democracy and dictatorship (e.g., Deacon 2009; Acemoglu and Dell 2010). We show that the construction of roads had direct implications for the allocation of productive land in Paraguay, a key economic input for a developing country where the primary sector represented close to 40% of GDP in the 1960s. Thus our results show that roads can diverge from the traditional notion of public goods because they can offer private benefits to supporters of a government. Our results also suggest that even though the primary motives behind a new road can be military or political, it can still generate large-scale economic distortions through the allocation of economic inputs such as land close to the road network.

Recent work has shown how constructing transportation networks can be politically profitable for incumbents. New highways have increased votes for the Nazi party in 1930s Germany (Voigtländer and Voth, 2022) and the incumbent government in Turkey in the 2000s (Akbulut-Yuksel et al., 2024). Related work documents the various ways in which infrastructure projects themselves can be implemented with distortions arising from political incentives (e.g., Cadot et al. 2006; Burgess et al. 2015) and the workings of corruption in large infrastructure projects (Campos et al., 2021). In contrast to existing research, we focus on the impact of roads on state-led repression and the (mis)allocation of agricultural plots to dictatorship allies. The proposed link between infrastructure and state repression has been emphasized by previous work but mostly in the context of military buildings (Dube and Naidu, 2015; Bautista et al., 2023).

We also contribute to the empirical literature documenting how state repression is implemented, particularly during times of an authoritarian regime. The majority of previous research studies the consequences of repression, particularly its effectiveness in quieting dissent (Davenport, 2007). A relatively smaller research agenda attempts to uncover how repression is deployed on the ground. For example, recent work has emphasized how dictatorships can target specific influential individuals (e.g. union leaders) and shows how politically connected firms can be crucial for this process (Klor et al., 2021). In the same vein, large international events covered by the international media can incentivize dictatorships to temporarily refrain from repression (Scharpf et al., 2022). Yet, beyond these contributions and the previously discussed role of military infrastructure, transportation networks have been relatively neglected as an important driver of repression.

2 The Stroessner dictatorship

General Stroessner rose to power in May 1954 through a military coup.[3] Having overthrown Federico Chávez, of his own party, he was confirmed as president of Paraguay by a military board. Stroessner relied on a tripartite alliance between the government, the military, and the Asociación Nacional Republicana (ANR), locally known as the Colorado party. Stroessner was at the helm of this alliance, ensuring a tight grip on every aspect of public life. From the start, his regime suspended all constitutional and civil rights, relying on the military police to quash any attempt at resistance. An extensive network of whistle-blowers quickly reported any opposition (Boccia et al., 1994). Participation in economic and social activities, such as being a public servant or an entrepreneur, was largely conditional on being a member of the Colorado party. The party pervaded all levels of society and was present in every corner of the territory. By centralizing control and distributing favors to all these stakeholders, in the form of jobs, public contracts, or assets such as land, the regime made sure that nobody had incentives to bet against its survival. After modifying the constitution, Stroessner was reelected seven times in fraudulent elections. On February 3rd, 1989, he was deposed in a coup led by his collaborator General Andrés Rodriguez.

General Stroessner relied on repression to suppress dissent. His regime methodically spied on, detained, and tortured opponents to retain control of the Paraguayan society. Many attempted to topple Stroessner, from initial resistance within the Colorado party (Boccia et al., 1994; Boccia, 2014), to the emergence of rural opposition movements and Marxist movements in the 60s and 70s. There were also at least three assassination attempts against him. Most of what we know about state repression during this period was revealed in 1992 when hundreds of thousands of documents were discovered in a locked room in a police station in the country's capital. These documents had been created by the regime's security forces and became popularly known as the "Archives of Terror." Repressive activities restrained freedoms of expression, gatherings, demonstrations, and organization of any opposition group. The "Archives of Terror" was used by the "Truth and Justice Commission," created in the early 2000s to investigate the crimes committed under Stroessner. The final report (Comision de Verdad y Justicia, 2008) revealed the identity of victims and the misappropriation of state assets. The report also uses testimonies from victims and their relatives

[3]Paraguay is a relatively rural, low-income, and unequal country, which researchers attribute to the War of the Triple Alliance in the 1860s and the subsequent political control of a small elite (Lewis, 1980, 1993; Leuchars, 2002; Alix-Garcia et al., 2022). The history of Paraguay since independence in 1811 is characterized by dictatorships, from Dr. Francia, Carlos Antonio López and his son Mariscal Francisco López in the 19th century, to early strongmen such as Franco, Estigarribia, and Moriñigo in the 1930s and 40s, and subsequently Alfredo Stroessner. In the decades before Stroessner, the country experienced a revolution (1936), a civil war (1947), and was politically very unstable.

to establish a list of close to 10,000 persons repressed between 1954 and 1989.

The Truth Commission also analyzed comprehensive data from the country's land allocation agency between 1954 and 2003. Their analysis reveals thousands of irregular appropriations, one of the main ways in which the regime rewarded its collaborators. Out of the 12.2 million hectares reallocated during that period, about two-thirds involved ineligible beneficiaries or plots larger than the legal size, close to 20 percent of the country's total area. After the dictatorship, governments have done little to recover this ill-gotten land. Land concentration has remained high, intensive agriculture has grown, and hundreds of thousands of small farmers have migrated to cities. Land has become one of the biggest sources of conflict in the post-dictatorship period.[4]

At the end of the 1950s, Stroessner launched a colonization process to the East. The border with Brazil was until then ill-exploited, mostly unpopulated, and covered by forest (Nickson, 1981). Maps from the 1920s indicate that this part was inhabited by probably no more than 12,000 inhabitants, 2% percent of the total population. The eastern territory was difficult to access given the lack of paved roads connecting the area with the main cities. Before Stroessner's expansion plan, the paved road network was entirely concentrated around Asunción and had less than 200 kilometers of length.[5] The 1960s became known as the decade of the "March to the East" as the length of the paved road network increased by four. The new corridors connected Asunción to the border with Brazil and to the border with Argentina (Encarnación). The triangle connecting these three points was completed in the 1980s, with the paved network then exceeding 2,000 km. In this context, Paraguay signed a treaty with Brazil, which in 1975 led to the start of the construction of the Itaipú dam, at the time the largest in the world. Large infrastructure projects gave a boost to the economy until the mid-1980s, but contributed to the deepening of the local corruption and rent-seeking system (Straub, 2014).

3 Data construction

Repression. The Truth and Justice Commission documents close to 10,000 victims of repression under Stroessner. We use events of repression, and for each, we observe the name of the vic-

[4]Supporters of the Stroessner regime were also favored through the regular allocation of procurement contracts (Nickson and Lambert, 2002; Auriol et al., 2016; Straub, 2014), a common strategy to extract rents from the state to benefit collaborators (Schoenherr, 2018; Brugués et al., 2023). For example, during the construction of the Itaipú and Yacyretá dams (Straub, 2015), two of the main contractors amassed immense fortunes and subsequently became presidents of the country: Juan-Carlos Wasmosy (1993-1998) and Raúl Cubas Grau (1998-1999).

[5]The only other transportation corridor was a slow train, connecting the capital to Encarnación in the South, across the Paraná river from the Argentinean city of Posadas, where many opposition figures would later find refuge.

tim, date, district, and whether it was a detention, exile, torture, execution, or disappearance. The regime recorded activities in detail and failed to destroy these archives when the 1989 coup happened, suggesting that most repression is covered (Boccia et al., 1994). We digitized and organized these data.[6] Table A.2 indicates that 5 percent of the 7,688 district-year observations in our sample have some event of repression, with a mean of 0.23 and a maximum of 75 events.

Road network. Figure 1 shows the evolution of the paved road network over three decades. As there is no official record of the road network, we reconstruct its evolution based on a host of historical maps and policy documents (see Appendix A.1 and Table A.1). We observe six snapshots of the road network and employ linear interpolations within districts across these years to get the full 1955-1985 panel data. Until 1960, the network was limited to Asunción and nearby areas. In the 1960s, new roads connected Asunción with the Brazilian frontier with support from international donors (including Brazil). The new network helped to colonize the East. Finally, in the 1970s and 80s, additional corridors were completed, connecting Villarrica, and mostly completing the triangle with Encarnación in the South. Figure A.2 shows how localities inside the country became better connected as the road network progressed. Table A.2 reports the average distance of districts to the road, which decreased by more than 50 percent over the 1955-85 period.

Illegal land allocations. The Truth and Justice Commission had access to all land allocations over the period 1954-2003 and to the country's land registry. For each plot, the report presents the location, size, name of beneficiary, and date of allocation. Based on the prevailing legal frameworks throughout the period, the commission established three main reasons why some allocations were illegal: (1) the beneficiary was *not* eligible,[7] (2) the beneficiary received more than one plot, and (3) the beneficiary received a plot larger than the legal size. A total of 4,241 of the 200,705 allocations examined were found to be illegal. These allocations involved 3,336 beneficiaries and covered almost 8 million hectares, almost 20 percent of the country's total area. We observe 3,766 illegal allocations and 2,544 beneficiaries under dictatorship. We digitized the location and size of these illegal allocations, together with the identity of the beneficiary.

We identified beneficiaries linked to the dictatorship by comparing the names of recipients of

[6]Figure A.1 shows repressive activity under Stroessner. Spikes correspond to instances in which the regime geared up the fight against insurgent groups. The main one in 1976 was the crackdown on the clandestine group "Organización Político Militar", which the regime took as a pretext to also strike any persons or organizations it considered hostile. Unfortunately, some events fail to report the district. However, Figure A.1 shows that events with a known location show a similar time variation to all events, which include the ones without district. These patterns suggest that the lack of information on the location of some events is unlikely to cause significant problems in terms of sample selection.

[7]The eligibility criteria was to be a farmer or have the intention to farm. Norms were established in the *Decreto Ley* 120 of 1940, replaced by *Ley* 854/63 in 1963 and later by *Ley* 1963/02 in 2002.

illegal allocations with a list of people connected to the regime. We constructed the list from various sources. From the Commission report, we extracted the names of victimizers, identified from the archives or the testimony of surviving victims. We also hand-collected the list of politicians involved in the successive governments of Stroessner, i.e. ministers or directors of important state agencies. We further complemented the list with all Congress members (deputies and senators) over the 1954-1989 period, recovered from the Library of the Paraguayan Congress. Finally, we collected the names of all graduates from the National College of War (Colegio Nacional de Guerra, subsequently Instituto de Altos Estudios Estratégicos) over the relevant period.[8] Overall, we recovered the names of one thousand five hundred individuals linked to the Stroessner regime.

4 Research design

We estimate the empirical relationship between the evolving road network, state-led repression, and illegal land allocations in Paraguay using the following panel data regression equation:

$$Y_{dt} = \beta R_{dt} + \phi_d + \phi_t + \varepsilon_{dt} \quad (1)$$

where Y_{dt} is an outcome in district d in year t. The main right-hand side variable of interest is R_{dt} and it measures the district-level exposure to the road network. Operationally, we use the logarithm of Euclidean distance (in kilometers) from the district's geometric centroid to the closest road, but the results are robust to alternative definitions. The use of logarithm assumes that, from the point of view of the Stroessner regime, the cost of exerting repression is non-linear on distance to the road network. Below we provide evidence supporting this non-linear relationship. As shown by Figure 1, variation within district over time arises from the construction of roads. Importantly, note that a district might become more exposed to the road network even without construction taking place within its boundaries. We absorb district-level constant heterogeneity and account for idiosyncratic year changes with the use of fixed effects ϕ_d and ϕ_t. To allow for arbitrary correlation in the error term within districts over time, we cluster standard errors ε_{dt} at the district level.

In terms of dependent variables, we focus on two state actions prominently featured in the recent empirical literature examining authoritarian regimes: state-led repression and misallocation of public policies to favor allies. We begin by studying state repression in both its extensive and

[8]The National War College, created in 1968, is the country's highest-level National School of Studies, reporting directly to the President of the National Defense Council. It trains around 30 selected members of the Armed Forces of the Nation, the National Police, and civilian officials of the State and the private sector with the doctrinal and methodological knowledge necessary for the future leaders of Paraguay.

intensive margins. For the former, we use an indicator that takes the value of one in a district-year if we observe at least one event of repression in the Truth and Justice Commission report, and zero otherwise. For the latter, we use the number of state-led repressive events. We show the results are robust to alternative measures. We then examine misallocation driven by favoritism with the use of detailed data on illegal land allocations. For each district, we measure whether any land was illegally allocated in a given year with an indicator variable. Similarly, we measure the total number of hectares illegally allocated and relate it to exposure to the road network. To capture favoritism, we determine whether each allocation was received by an individual who was politically connected to the Stroessner regime. We allow connections to be either political or military, and we construct these by combining (i) the list of high-ranked military officers and politicians (including congresspeople) of the dictatorship, with (ii) the list of beneficiaries of illegal land allocations. Overall, the richness of the data allows us to track misallocation and favoritism within Paraguay over a thirty-year period of dictatorship.

The parameter of interest in equation (1) is β, which measures the empirical relationship between exposure to the evolving road network and the outcomes of interest within districts over time.[9] In order to interpret β as the causal effect of the road network, we need to assume that changes in district-level exposure to the network are uncorrelated with other district-level and time-varying factors that also affect repression and land allocations. Note that exposure to the network in district $d = k$ might increase even in the absence of road construction in that district. Therefore, variables such as local state presence over time, which might affect both road construction and repression locally, are not necessarily confounders because when a road is constructed in $d = k$ it can affect districts $d \neq k$. Additionally, the staggered nature of evolving roads suggests we should pay close attention to the comparisons behind our estimated parameter. Below, we use recent econometric methods to diagnose and check for the robustness of our results.

5 State-led repression

Panel A in Table 1 presents estimates of equation (1) using different measures of state-led repression as the dependent variable. Columns 1-3 examine the extensive margin, i.e. whether at least one event of state-led repression took place in a district-year. The results suggest that exposure to the road network increased the probability of experiencing repression. To gauge the magnitude of this estimate, consider that between 1955 and 1985 the average district went from being 155 kilo-

[9] As a consequence of these comparisons, the few districts not experiencing variation in R_{dt} over time contribute to the efficiency of β by providing information to estimate ϕ_t but have no influence in the point estimate of β.

meters (km) from the closest road to being only 73 km away, a reduction of 50 percent in distance or equivalent increase in exposition. Put differently, doubling the distance to the network decreases repression by 1 percentage point. From a baseline of 5 percent, this coefficient can be interpreted as a 20 percent increase in state-led repression when districts become more connected.

The role of the road network in facilitating repression is similar across the three measures of repression that we observe in the Truth and Justice Report. Columns 4-6 repeat the exercise from the previous columns but now using the total number of repression events as the dependent variable. We find that when districts get closer to the road network, they experience more repression. Increasing exposure to roads by 100 percent is associated with 0.14 more events of state-led repression. From a baseline of 0.23 events, this effect corresponds to an increase of 61 percent. This empirical relationship is again statistically significant at conventional levels. Panel B in Table 1 uses a flexible bin model for distance in kilometers that reveals most of the impact of roads is explained by districts that get closer than 20 kilometers from the road network.[10]

Our interest in a treatment variable that changes over time within units raises additional concerns. De Chaisemartin and d'Haultfoeuille (2020) and Goodman-Bacon (2021) show that if treatment effects are heterogeneous, then estimators such as ours can be biased because some control units could actually be early-treated or always-treated units. The authors propose methods to assess the magnitude of this issue. We use their methods with a treatment indicator for districts closer than 30 kilometers and find that around 75% of our comparisons are correct, with the remaining share comparing late-treated units to either early-treated or always-treated units. Reassuringly, panel C in Table 1 shows that we obtain similar estimates when using estimators that restrict attention only to comparisons of treated and untreated units (Sun and Abraham, 2021; Callaway and Sant'Anna, 2021; Borusyak et al., 2024). Figure A.3 uses the method by Borusyak et al. (2024) to show similar pre-trends across treated and control districts.

Is there a causal connection between roads and repression? Three exercises suggest the relationship is likely to be causal. First, two-stage least squares using hypothetical straight roads connecting locations delivers similar results. Table A.4 presents results and Figure A.4 the lines used. This is a common strategy in the transportation literature (Faber, 2014; Banerjee et al., 2020) which helps to assuage concerns about measurement error in the network. Second, columns 1-

[10]We find similar results defining direct exposure to roads as the network passing through or being closer than 20 kilometers, and as indirect exposure, if roads were constructed in neighboring districts or closer than 20-30 kilometers (Table A.3). In addition, all results remain statistically significant when we use standard errors that take into account unobserved spatial correlation as well as time auto-correlation (Conley, 2010; Colella et al., 2019). For simplicity, we use the logarithm of distance and robust standard errors clustered by district in the remaining of the analysis.

3 in Table A.6 show that unobserved factors driving the construction of the Itaipú and Yacyretá hydroelectric dams are unlikely to be confounders.[11] Similarly, column 4 shows similar results when controlling for the cross-border impact of Argentina on Itapúa. Stroessner repressed heavily early on as dissidents migrated from Paraguay to Misiones in Argentina and attempted to create resistance through the Itapúa region.[12] Third, we now present a wide range of robustness exercises supporting the previous results and suggesting that a causal interpretation is plausible.

Table A.7 shows that the results are unaffected by modelling decisions, influential observations, or unobserved shocks. Columns 1-3 assess the sensibility of results to the scale of the dependent variable. Recent work shows that log-like specifications can arbitrarily affect estimates of the average treatment effect (Mullahy and Norton, 2022; Chen and Roth, 2024). We avoid log-like specifications and follow the recommendations of Chen and Roth (2024) to show that results are similar when using repression events per capita as the dependent variable, and to model the data-generating process explicitly as a Poisson or Negative Binominal model. Column 4 shows that potential measurement error arising from the interpolation of the six years in which we observe the road network is unlikely to affect our estimates: we obtain the same results when we restrict attention to the six years with observed roads. For the initial snapshot in 1955, we use the total number of repression events in the 1955-1959 period. We do the same for each of the seven years with data on the road network, e.g., 1960-1964 for the 1960 snapshot and so on.

Table A.8 shows similar results after including covariates measured before the dictatorship interacted by year indicators to control for time-varying changes. Columns 1-3 add demographic and housing characteristics from the 1950 Census, for which we build a crosswalk file to ensure the correspondence between the 160 districts that existed in 1950 and the 248 in our analysis. Columns 4-6 include topographic, climate, and geographic covariates. Column 7 addresses potential spatial autocorrelation following Bauman et al. (2018). Column 8 selects controls following Belloni et al. (2014) where the treatment to select the covariates is the change in log distance to the closest road between 1955 and 1985. Moreover, Table A.9 shows the robustness of results to potentially influential districts. Columns 1-3 show similar results restricting attention to districts with less than 50, 30, or 15 thousand inhabitants. Column 4 drops the three departments from the north-west region of the country (Alto Paraguay, Boqueron, Presidente Hayes) which always have the

[11]These dams are hallmark projects of the Stroessner dictatorship. The former is a large and expensive dam constructed by both Paraguay and Brazil and was once selected as one of the seven modern Wonders of the World. The latter is an infrastructure project led by Argentina and Paraguay, originally controversial for ecological reasons.

[12]The results also remain similar after controlling for the distance to railroads interacted with indicators for each decade after their nationalization in 1961 (Table A.5). Figure A.4 presents a map with the railroad network.

same exposure to the network in the 1955-1985 period, and the results are the same. Dropping Asunción or districts being connected by roads from the estimation also makes little difference (columns 5-6).[13] Column 7 keeps the 96 districts which experience at least one event of repression and, if anything, the results are even stronger. We also verified that results are the same when dropping single departments (group of districts) or districts from the estimation (Figures A.5 and A.6).

Finally, we checked whether missing geographic information for some repressive events influences our estimates. The missing information originates in primary sources and thus we can only assess this problem statistically. Table A.10 shows that events with missing location are more likely to be detentions in the 1980s; we observe the location of almost all other events. Reassuringly, we find similar results across events with different rates of missing location (Table 1), when restricting attention to the 1955-1979 period (Table A.11), and when using different econometric models to impute the most likely location to events with missing information (Table A.12).

6 Illegal land allocations

Table 2 shows that individuals who were politically connected to Stroessner disproportionally benefited from illegal land allocations. Overall, 7.4% of beneficiaries were connected, 71.1% of which were military connections. Column 1 in panel A shows that politically connected beneficiaries received 46 log points (58%) more hectares than unconnected individuals, i.e. each beneficiary in the dictator's inner circle received on average 2,000 more hectares. Column 2 in the same panel shows that this effect is explained by larger plots given to the military, although the statistically insignificant point estimate in column 3 suggests that politicians could have benefited as well. Columns 1-3 in panel B repeat the estimation but now using beneficiary-district as the unit of observation and including district fixed effects. Missing district information for 396 allocations, and lack of within-district variation for another 30, explain the decrease in the number of observations between the two panels. Panel B shows that connected beneficiaries obtained plots that were 27 log points (31%) larger, a result that is similar across types of connections. Columns 4-6 repeat the analysis but now using as dependent variable the number of plots received by each beneficiary. We find that politically connected and unconnected beneficiaries received a similar number of plots. These results are consistent with hectares being a strong predictor of agricultural production in Paraguay (Bravo-Ureta and Evenson, 1994). Overall, Table 2 shows that illegal land allocations benefited the

[13] Dropping nodes in the network is a common exercise in the literature to assess potential time-varying unobservables driving the location of the infrastructure and outcomes of interest (Banerjee et al., 2020; Forero et al., 2021).

military significantly in terms of hectares, with suggestive evidence of congresspeople and other high-level politicians also being benefited.

Did the road network shape illegal allocations to dictatorship allies? Better access to roads can increase the returns to owning a plot by facilitating market access. Thus, distance to roads could have motivated part of the land allocation process, particularly for valuable plots. We find evidence of this being the case. We estimate equation (1) using illegal allocations as the dependent variable. Column 1 in Table 3 shows that when districts get closer to the network neither the probability of illegal allocation nor the hectares allocated changed. However, districts with more agriculturally productive land were more likely to be affected by roads. Columns 2-3 in Table 3 focus on cotton—the main crop at the time—and columns 4-5 in soybean, important later on. Our goal is to check for the empirical association between roads and illegal land allocations, but now interacting the proximity to roads with agricultural suitability. Columns 2 and 4 use the GAEZ suitability index while columns 3 and 5 use an indicator when districts have on average high suitability (see Appendix A.2). Consistent with our intuition, columns 2-3 show that illegal land allocation was higher in districts highly suitable for growing cotton that were close to the network. We find a similar but weaker connection with soybean suitability, a relatively newer crop at the time. In all, the results support the role of the road network in shaping the illegal allocation of productive land.

The high land concentration in Paraguay is a source of conflict (Hetherington, 2011).[14] Political parties have strong networks of political brokers (Finan and Schechter, 2012; Duarte et al., 2023), thus changes to the status quo (e.g., land reform) are unlikely to emerge. As a consequence, rural conflict is pervasive. Is there a link between Stroessner's illegal land allocations, long-run development, and rural conflict? Table 4 shows that districts with more illegal land allocations between 1955 and 1985 have worse development outcomes after the year 2000. Panel B adds the change in roads as an additional predictor variable for comparison purposes. Districts with more illegal allocations under dictatorship are less developed, as proxied by nighttime lights (column 1), population density (column 2), and agricultural production per hectare (column 3). This relationship holds after accounting for a large set of geographic and socioeconomic characteristics, including how rural districts were, measured before the Stroessner dictatorship began. Using an index that combines the three development outcomes delivers similar results (column 4). Moreover, districts with more illegal allocations exhibit more pollution (column 5), more wildfires (column

[14]Rigorous evaluations of land reform programs have consistently confirmed the relationship between land ownership and rural conflict across countries in Latin America (e.g., Albertus and Kaplan 2012; Albertus et al. 2018; Albertus 2020; Jaimovich and Toledo 2023).

6)—one way to clear forested land for extensive cultivation (Harding et al., 2022)—but similar deforestation rates (column 7).[15] Illegal allocations are also associated with more mining activities (column 8) and with an index of extractive activities that combines all previous outcomes (column 9).[16] These reduced-form relationships are likely to be explained by both direct effects (e.g. land quality) and changes in human behavior (e.g. migration towards roads).

The unequal distribution of land, together with the underdevelopment of areas with more illegal allocations, suggests that conflict over land is likely to take place. Indeed, land occupations have been on the rise and researchers have argued that the source of these actions is related to the conflict between the elite and peasants over the control of scarce resources in the countryside (Mangonnet et al., 2023). Are land occupations related to illegal land beneficiaries? Using novel data with information on land occupations in the 2000s, we find evidence consistent with rising conflict arising from illegal land allocations. Column 10 in Table 4 shows that districts with more illegal allocations during 1955-1985 are more likely to experience land occupations in the 2000s.

7 Conclusion

We have shown the perverse effects of a large road network in Paraguay under the longest dictatorship in South America. Infrastructure development such as roads can facilitate large-scale human rights violations under dictatorship, enable the misallocation of resources, and prevent sustainable development to unfold. These findings suggest caution when evaluating infrastructure projects, particularly under dictatorship, and constitute a warning sign to interpreting the construction of road networks simply as provision of public goods. Although the economic benefits associated with road networks in democratic periods have been extensively documented, the "dark side" of infrastructure can be larger than previously thought. Limited checks and balances under dictatorship give rise to legitimate questions regarding funding for infrastructure projects that might strengthen autocrats. A better understanding of policy implementation under dictatorship can help to improve the lives of millions of people currently ruled by authoritarian governments.

[15] As percentage of area, Paraguay is one of the countries most affected by wildfires and deforestation in Latin America (Graesser et al., 2015; United Nations, 2021). Deforestation in the East was widespread before 2003 but it decreased after regulation (Huang et al., 2007; Ponte et al., 2017). Wildfires and deforestation are weakly correlated across districts in the 2000s because deforestation shifted towards the less regulated West (Baumann et al., 2017).

[16] Outcomes are measured with satellite imagery and are thus unaffected by potential reporting bias caused by roads (see Appendix A.3 for details). Table A.13 shows that results are robust to excluding outliers in the distribution of these outcomes.

References

Acemoglu, D. and Dell, M. (2010). Productivity differences between and within countries. *American Economic Journal: Macroeconomics*, 2(1):169–188.

Agnew, K. (2020). Crime highways: The effect of motorway expansion on burglary rates. *Journal of Regional Science*, 60(5):95–1024.

Akbulut-Yuksel, M., Okoye, D., and Turan, B. (2024). Expressway to votes: Infrastructure projects and voter persuasion. *Economic Journal*, 134:48–94.

Albertus, M. (2020). Land reform and civil conflict: Theory and evidence from Peru. *American Journal of Political Science*, 64(2):256–274.

Albertus, M., Brambor, T., and Ceneviva, R. (2018). Land inequality and rural unrest: Theory and evidence from Brazil. *Journal of Conflict Resolution*, 62(3):557–596.

Albertus, M. and Kaplan, O. (2012). Land reform as a counterinsurgency policy: Evidence from Colombia. *Journal of Conflict Resolution*, 57(2):198–231.

Alix-Garcia, J., Schechter, L., Caicedo, F. V., and Zhu, S. J. (2022). Country of women? Repercussions of the Triple Alliance War in Paraguay. *Journal of Economic Behavior and Organization*, 202:131–167.

Auriol, E., Straub, S., and Flochel, T. (2016). Public procurement and rent-seeking: the case of Paraguay. *World Development*, 77:395–407.

Baires, W., Dinarte, L., and Schmidt-Padilla, C. (2020). Unintended effects of roads: Labor, education and crime outcomes in El Salvador. *Working Paper*.

Bandiera, A., Larreguy, H., and Mangonnet, J. (2023). Family ties, social control, and authoritarian distribution to elites. *Working Paper*.

Banerjee, A., Duflo, E., and Qian, N. (2020). On the road: Access to transportation infrastructure and economic growth in China. *Journal of Development Economics*, 145:102442.

Bauman, D., Drouet, T., Dray, S., and Vleminckx, J. (2018). Disentangling good from bad practices in the selection of spatial or phylogenetic eigenvectors. *Ecography*, 41(10):1638–1649.

Baumann, M., Israel, C., Piquer-Rodríguez, M., Gavier-Pizarro, G., Volante, J. N., and Kuemmerle, T. (2017). Deforestation and cattle expansion in the Paraguayan Chaco 1987–2012. *Regional Environmental Change*, 17:1179–1191.

Bautista, M. A., González, F., Martínez, L., Muñoz, P., and Prem, M. (2023). The geography of repression and opposition to autocracy. *American Journal of Political Science*, 67(1):101–118.

Belloni, A., Chernozhukov, V., and Hansen, C. (2014). High-dimensional methods and inference on structural and treatment effects. *Journal of Economic Perspectives*, 28(2):29–50.

Berechman, J. (2003). Transportation—economic aspects of Roman highway development: the case of Via Appia. *Transportation Research Part A: Policy and Practice*, 37(5):453–478.

Berg, C. N., Deichmann, U., Liu, Y., and Selod, H. (2017). Transport policies and development. *Journal of Development Studies*, 53(4):465–480.

Boccia, A. (2014). *Goiburú. La odisea del insumiso*. Servilibro.

Boccia, A., González, M. A., and Palau, R. (1994). *Es mi informe: los archivos secretos de la policía de Stroessner*.

Borusyak, K., Jaravel, X., and Spiess, J. (2024). Revisiting event-study designs: Robust and efficient estimation. *Review of Economic Studies*.

Bravo-Ureta, B. E. and Evenson, R. E. (1994). Efficiency in agricultural production: The case of peasants farmers in eastern Paraguay. *Agricultural Economics*, 10:27–37.

Brugués, F., Brugués, J., and Giambra, S. (2023). Political connections and misallocation of procurement contracts: Evidence from Ecuador. *Working Paper*.

Bueno de Mesquita, B. and Smith, A. (2011). *The Dictator's Handbook: Why Bad Behavior is Almost Always Good Politics*. PublicAffairs.

Bueno de Mesquita, B., Smith, A., Siverson, R. M., and Morrow, J. D. (2003). *The logic of political survival*. MIT Press.

Burgess, R., Jedwab, R., Miguel, E., and Morjaria, A. (2015). The value of democracy: Evidence from road building in Kenya. *American Economic Review*, 105(6):1817–1851.

Cadot, O., Roller, L.-H., and Stephan, A. (2006). Contribution to productivity or pork barrel? The two faces of infrastructure investment. *Journal of Public Economics*, 90:1133–1153.

Calamunci, F. and Lonsky, J. (2022). Highway to hell? Insterstate highway system and crime. *Working Paper*.

Callaway, B. and Sant'Anna, P. H. (2021). Difference-in-differences with multiple time periods. *Journal of Econometrics*, 225(2):200–230.

Campos, N., Engel, E., Fischer, R. D., and Galetovic, A. (2021). The ways of corruption in infrastructure: Lessons from the Odebrecht case. *Journal of Economic Perspectives*, 35(2):171–1990.

Chen, J. and Roth, J. (2024). Logs with zeros? Some problems and solutions. *Quarterly Journal of Economics*, 139(2):891–936.

Colella, F., Lalive, R., Sakalli, S. O., and Thoenig, M. (2019). Inference with arbitrary clustering.

Comision de Verdad y Justicia, P. (2008). *Informe Final, Anive Hagua Oiko*.

Conley, T. G. (2010). Spatial econometrics. *Microeconometrics*, pages 303–313.

Dalgaard, C.-J., Kaarsen, N., Olsson, O., and Selaya, P. (2022). Roman roads to prosperity: Persistence and non-persistence of public infrastructure. *Journal of Comparative Economics*, 50(4):896–916.

Davenport, C. (2007). State repression and political order. *State repression and political order*, 10(1):1–23.

De Chaisemartin, C. and d'Haultfoeuille, X. (2020). Two-way fixed effects estimators with heterogeneous treatment effects. *American Economic Review*, 110(9):2964–2996.

Deacon, R. T. (2009). Public good provision under dictatorship and democracy. *Public Choice*, 139:241–262.

Donaldson, D. (2018). Railroads of the Raj: Estimating the impact of transportation infrastructure. *American Economic Review*, 108(4-5):899–934.

Duarte, R., Finan, F., Larreguy, H., and Schechter, L. (2023). Brokering votes with information spread via social networks. *Working Paper*.

Dube, O. and Naidu, S. (2015). Bases, bullets, and ballots: The effect of U.S. military aid on political conflict in Colombia. *Journal of Politics*, 77(1):249–167.

Duranton, G. and Turner, M. A. (2012). Urban growth and transportation. *Review of Economic Studies*, 79(4):1407–1440.

Faber, B. (2014). Trade integration, market size, and industrialization: Evidence from China's national trunk highway system. *Review of Economic Studies*, 81:1046–1070.

Finan, F. and Schechter, L. (2012). Vote-buying and reciprocity. *Econometrica*, 80(2):863–881.

Flückiger, M., Hornung, E., Larch, M., and Ludwig, M. (2022). Roman transport network connectivity and economic integration. *Review of Economic Studies*, 89:774–810.

Fogel, R. (1964). *Railroads and American Economic Growth: Essays in Econometric History*. Cambridge University Press.

Forero, A., Gallego, F., González, F., and Tapia, M. (2021). Railroads, specialization, and population growth: Evidence from the first globalization. *Journal of Population Economics*, 34:1027–1072.

Gáfaro, M., Ibañez, A. M., Sánchez-Ordóñez, D., and Ortiz, M. C. (2023). Farm size and income distribution of Latin American agriculture: New perspectives on an old issue. *LACIR Series Working Paper 105*.

Goodman-Bacon, A. (2021). Difference-in-differences with variation in treatment timing. *Journal of Econometrics*, 225(2):254–277.

Graesser, J., Aide, T. M., Grau, H. R., and Ramankutty, N. (2015). Cropland/pastureland dynamics and the slowdown of deforestation in Latin America. *Environmental Research Letters*, 10:034017.

Hansen, M. C., Potapov, P. V., Moore, R., Hancher, M., Turubanova, S. A., Tyukavina, A., Thau, D., Stehman, S. V., Goetz, S. J., Loveland, T. R., Kommareddy, A., Egorov, A., Chini, L., Justice, C. O., and Townshend, J. R. G. (2013). High-resolution global maps of 21st-century forest cover change. *Science*, 342(6160):850–853.

Harding, R., Prem, M., Ruiz, N. A., and Vargas, D. L. (2022). Buying a blind eye: Campaign donations, regulatory enforcement, and deforestation. *American Political Science Review*, pages 1–19.

Henderson, J. V., Storeygard, A., and Weil, D. N. (2012). Measuring economic growth from outer space. *American Economic Review*, 102(2):994–1028.

Hetherington, K. (2011). *Guerrilla Auditors: The Politics of Transparency in Neoliberal Paraguay*. Duke University Press.

Huang, C., Kim, S., Altstatt, A., Townshend, J. R., Davis, P., Song, K., Tucker, C. J., Rodas, O., Yanosky, A., Clay, R., and Musinsky, J. (2007). Rapid loss of Paraguay's Atlantic forest and the status of protected areas - a Landsat assessment. *Remote Sensing of Environment*, 106(4):460–466.

Hummels, D. (2007). Transportation costs and international trade in the second era of globalization. *Journal of Economic Perspectives*, 21(3):131–154.

Jaimovich, D. and Toledo, F. (2023). The grievances of a failed reform: Chilean land reform and conflict with indigenous communities. *Working Paper*.

Japanese International Cooperation Agency (1997). The feasibility study on arterial road development project in the central eastern area of the Republic of Paraguay. *Report*.

Japanese International Cooperation Agency (2000). Feasibility study for the improvement of the national route 2 and route 7 in the Republic of Paraguay. *Report*.

Klor, E. F., Saiegh, S., and Satyanath, S. (2021). Cronyism in state violence: Evidence from labor repression during Argentina's last dictatorship. *Journal of the European Economic Association*, 19(3):102442.

Kretschmer, R., Irala, A., and Palau, M. (2019). *Ocupaciones de Tierra: Marcas del Conflicto Rural*. BASE Investigaciones Sociales.

Lay, M. G. (2009). *Handbook of road technology*. CRC Press.

Leuchars, C. (2002). *To the Bitter End: Paraguay and the War of the Triple Alliance: Paraguay and the War of the Triple Alliance*. ABC-CLIO.

Lewis, P. H. (1980). *Paraguay under Stroessner*. The University of North Carolina Press.

Lewis, P. H. (1993). *Political parties and generations in Paraguay's liberal era, 1869-1940*. The University of North Carolina Press.

Li, X., Zhou, Y., Zhao, M., and Zhao, X. (2020). A harmonized global nighttime light dataset 1992–2018. *Scientific Data*, 7(168).

Mangonnet, J., Feierherd, G., Rocío, L., and Murillo, M. V. (2023). Peasant resistance in times of economic affluence: Lessons from Paraguay. *Working Paper*.

Martincus, C. V., Carballo, J., and Cusolito, A. (2017). Roads, exports and employment: Evidence from a developing country. *Journal of Development Economics*, 125:21–39.

Mullahy, J. and Norton, E. C. (2022). Why transform Y? A critical assessment of dependent-variable transformations in regression models for skewed and sometimes-zero outcomes. *NBER Working Paper No. 30735*.

Nickson, A. and Lambert, P. (2002). State reform and the 'privatized state' in Paraguay. *Public Administration and Development: The International Journal of Management Research and Practice*, 22(2):163–174.

Nickson, R. A. (1981). Brazilian colonization of the eastern border region of Paraguay. *Journal of Latin American Studies*, 13(1):111–131.

Palau, T. (1986). El cultivo del algodón y la soya en el paraguay y sus derivaciones sociales.

Ponte, E. D., Roch, M., Leinenkugel, P., Dech, S., and Kuenzer, C. (2017). Paraguay's Atlantic Forest cover loss - satellite-based change detection and fragmentation analysis between 2003 and 2013. *Applied Geography*, 79:37–49.

Redding, S. J. and Turner, M. A. (2015). Transportation costs and the spatial organization of economic activity. In *Handbook of regional and urban economics*, volume 5, pages 1339–1398. Elsevier.

Roberts, M., Melecky, M., Bougna, T., and Xu, Y. (2020). Transport corridors and their wider economic benefits: A quantitative review of the literature. *Journal of Regional Science*, 60(2):207–248.

Saiz, A. (2006). Dictatorships and highways. *Regional Science and Urban Economics*, 36(2):187–206.

Scharpf, A., Gläbel, C., and Edwards, P. (2022). International sports events and repression in autocracies: Evidence from the 1978 FIFA World Cup. *American Political Science Review*.

Schoenherr, D. (2018). Political connections and allocative distortions. *Journal of Finance*, 74(2):543–586.

Secretaria General de Planificación, P. (1970). *Plan nacional de desarrollo económico y social*.

Straub, S. (2014). Political firms, public procurement, and the democratization process. *TSE Working paper*.

Straub, S. (2015). The story of paraguayan dams: the long-term consequences of wrongdoing in procurement. *Greed, Corruption, and the Modern State: Essays in Political Economy*, 161.

Sun, L. and Abraham, S. (2021). Estimating dynamic treatment effects in event studies with heterogeneous treatment effects. *Journal of Econometrics*, 225(2):175–199.

United Nations (2021). *Wildfires in Latin America: A Preliminary Analysis, Messages and Resources for RC/UNCT*. United Nations Regional Collaborative Platform.

van Donkelaar, A., Hammer, M. S., Bindle, L., Brauer, M., Brook, J. R., Garay, M. J., Hsu, N. C., Kalashnikova, O. V., Kahn, R. A., Lee, C., Levy, R. C., Lyapustin, A., Sayer, A. M., and Marti, R. V. (2021). Monthly global estimates of fine particulate matter and their uncertainty. *Environmental Science and Technology*, 55(22):15287–15300.

Voigtländer, N. and Voth, H.-J. (2022). Highway to Hitler. *American Economic Journal: Applied Economics*.

Wood-Sichra, U., Joglekar, A. B., and You, L. (2016). Spatial production allocation model (SPAM) 2005: Technical documentation. *HarvestChoice Working Paper*.

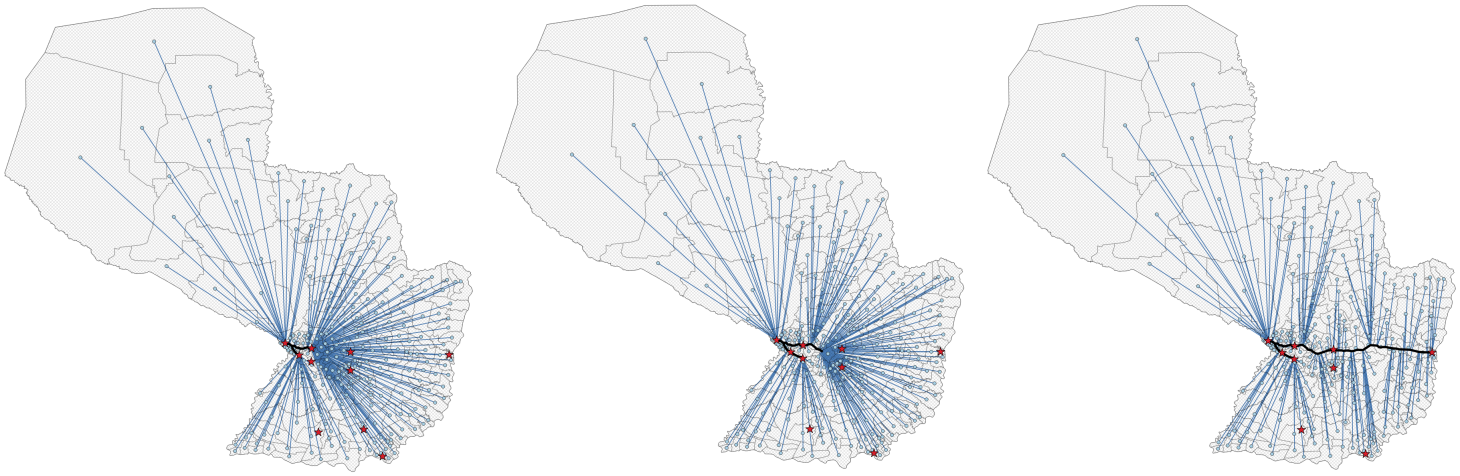
World Bank (1979). Economic memorandum on Paraguay. *Report, Washington DC*.

World Bank (1981). Economic memorandum on Paraguay. *Report, Washington DC*.

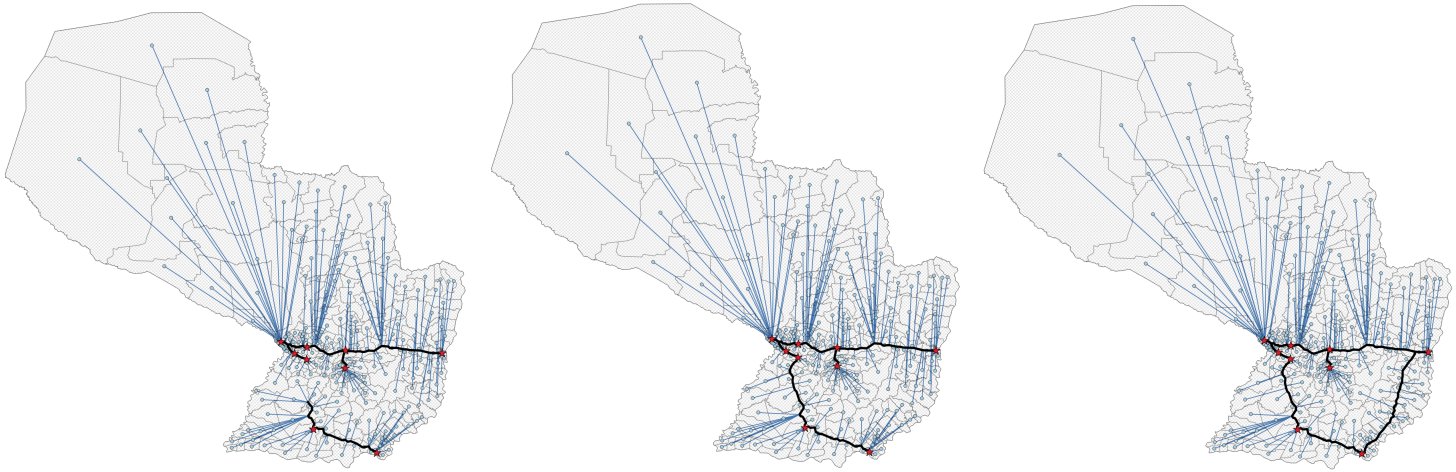
World Bank (1991). Economic memorandum on Paraguay. *Report, Washington DC*.

Yu, Q., You, L., Wood-Sichra, U., Ru, Y., Joglekar, A. K. B., Fritz, S., Xiong, W., Lu, M., Wu, W., and Yang, P. (2020). A cultivated planet in 2010 – part 2: The global gridded agricultural-production maps. *Earth System Science Data*, 12(4):3545–3572.

Figure 1: Construction of paved roads in Paraguay, 1955-1985



(a) 1955 (b) 1960 (c) 1965



(d) 1970 (e) 1975 (f) 1985

Notes: These maps show the construction of paved roads in black lines (—) in Paraguay from 1955 to 1985. Polygons represent districts. Red stars (★) mark main districts being connected by paved roads. Blue lines (—) represent the closest distance from a district's geographic centroid to the road network.

Table 1: Road construction and state-led repression in Paraguay

	Indicator for at least one event of:			Total events of:		
	Repression	Torture	Detention	Repression	Torture	Detention
Panel A	(1)	(2)	(3)	(4)	(5)	(6)
Log distance to closest road	-0.010*	-0.010*	-0.010*	-0.143**	-0.130**	-0.125**
	(0.006)	(0.006)	(0.006)	(0.065)	(0.058)	(0.057)
Panel B						
Distance to road < 10 km	0.043*	0.042*	0.047**	0.632**	0.576**	0.548**
	(0.023)	(0.023)	(0.022)	(0.264)	(0.236)	(0.226)
Distance to road [10,20] km	0.062**	0.052**	0.060**	0.350**	0.300**	0.300**
	(0.030)	(0.023)	(0.028)	(0.152)	(0.131)	(0.131)
Distance to road [20,30] km	0.029*	0.036**	0.034**	0.241*	0.217*	0.208*
	(0.016)	(0.017)	(0.016)	(0.125)	(0.111)	(0.111)
Distance to road [30,40] km	0.003	0.006	0.003	0.060	0.052	0.049
	(0.011)	(0.012)	(0.011)	(0.089)	(0.077)	(0.077)
Distance to road [40,50] km	-0.008	-0.007	-0.008	-0.024	-0.024	-0.026
	(0.009)	(0.009)	(0.009)	(0.098)	(0.087)	(0.088)
Distance to road [50,60] km	0.002	0.010	0.006	-0.077	-0.074	-0.068
	(0.019)	(0.018)	(0.022)	(0.168)	(0.143)	(0.144)
Panel C						
Distance to road <30 km	0.040***	0.038***	0.040***	0.277***	0.249***	0.237***
Borusyak et al. (2024)	(0.014)	(0.013)	(0.014)	(0.066)	(0.061)	(0.057)
Distance to road <30 km	0.040**	0.038**	0.040**	0.277***	0.249***	0.237***
Callaway and Sant'Anna (2021)	(0.017)	(0.016)	(0.016)	(0.088)	(0.079)	(0.075)
Distance to road <30 km	0.027**	0.020	0.026**	0.402**	0.354**	0.342**
Sun and Abraham (2021)	(0.013)	(0.013)	(0.013)	(0.173)	(0.157)	(0.151)
Observations	7,688	7,688	7,688	7,688	7,688	7,688
Districts	248	248	248	248	248	248
District fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Mean dependent variable	0.054	0.047	0.048	0.233	0.197	0.202

Notes: This table presents the empirical relationship between distance to the closest road and state-led repression in the period 1955-1985. The unit of observation is a district-year. Columns 1-3 use indicators for at least one event of repression as dependent variables. Columns 4-6 use the total number of repression events as dependent variable. Standard errors are clustered by district. *** p<0.01, ** p<0.05, * p<0.1.

Table 2: Illegal land allocation and connections to the regime

	Log hectares			Number of plots		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Individual level						
Connected	0.462***			0.083		
	(0.117)			(0.086)		
Military connected		0.592***			0.163	
		(0.144)			(0.111)	
Politically connected			0.184			-0.103
			(0.164)			(0.083)
Observations	2,544	2,544	2,544	2,544	2,544	2,544
R-squared	0.005	0.006	0.000	0.000	0.001	0.000
Mean dependent variable	7.483	7.483	7.483	1.319	1.319	1.319
Panel B: Within district						
Connected	0.272***			-0.034		
	(0.101)			(0.086)		
Military connected		0.279**			0.026	
		(0.133)			(0.116)	
Politically connected			0.230*			-0.157*
			(0.123)			(0.088)
Observations	2,259	2,259	2,259	2,259	2,259	2,259
R-squared	0.461	0.461	0.460	0.066	0.066	0.066
Mean dependent variable	7.119	7.119	7.119	1.280	1.280	1.280
District fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents the empirical relationship between the log number of hectares (columns 1-3, or number of plots in columns 4-6) and an indicator for beneficiaries with political connections to the dictatorship. In panel A, the unit of observation is an individual receiving illegal allocations, while in panel B the unit of observation is an individual receiving illegal lands in a given district. Missing district information for 396 allocations, and lack of within-district variation for another 30, explain the decrease in the number of observations between panel A and B. *Connected* is a dummy that takes the value one if an individual is connected to the dictatorship, while *Military (Politically) connected* is a dummy that takes the value one if the individual is part of the army (congress or minister). Panel B includes district-level fixed effects. Robust standard errors are presented in parenthesis. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 3: Roads and illegal land allocation

Suitability:		Cotton		Soy	
		Continuous	Discrete	Continuous	Discrete
	(1)	(2)	(3)	(4)	(5)
Panel A: Any land					
Log distance to closest road × Suitability		-0.016***	-0.027**	-0.005	-0.025
		(0.006)	(0.013)	(0.004)	(0.017)
Log distance to closest road	0.007	0.013*	0.015*	0.004	0.008
	(0.008)	(0.007)	(0.008)	(0.008)	(0.008)
R-squared	0.316	0.317	0.317	0.316	0.316
Mean dependent variable	0.112	0.112	0.112	0.112	0.112
Panel B: Log total hectares					
Log distance to closest road × Suitability		-0.117***	-0.198**	-0.028	-0.177
		(0.045)	(0.095)	(0.040)	(0.154)
Log distance to closest road	0.062	0.105*	0.121*	0.047	0.071
	(0.060)	(0.062)	(0.064)	(0.063)	(0.061)
Observations	7,688	7,688	7,688	7,688	7,688
R-squared	0.335	0.336	0.335	0.335	0.335
Mean dependent variable	0.819	0.819	0.819	0.819	0.819
Districts	248	248	248	248	248
District fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes

Notes: This table presents the empirical relationship between road construction and the illegal allocation of agricultural land. *Any land* is a dummy that takes the value one if there was at least one land allocation in that district-year. *Log total hectares* is the hyperbolic sine transformation for the total number of hectares allocated in a year-district. The unit of observation is a district-year. Columns 2 and 3 (4 and 5) present the soil suitability for cotton (soy) based on the GAEZ Soil Suitability index classes for rain-fed conditions and high inputs. Columns 2 and 4 present the results for a standardized index, while columns 3 and 5 present it for a dummy that takes a value of one for a suitability higher than three (i.e., less than moderate constraints to grow the crop). Standard errors are clustered by district. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Illegal land allocations and long-run development

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Development				Extractive activities					
Outcome:	Ln Nighttime lights	Ln Population density	Agricultural production	Score (standardized)	Pollution	Wild fires	Deforestation	Any mine	Score (standardized)	Land occupation
Panel A										
Log hectares	-0.037***	-0.054***	-0.009**	-0.051***	0.016*	0.015**	-0.000	0.008*	0.023**	0.009*
	(0.011)	(0.018)	(0.005)	(0.015)	(0.009)	(0.006)	(0.002)	(0.004)	(0.011)	(0.005)
Panel B										
Log hectares	-0.037***	-0.055***	-0.011**	-0.052***	0.017*	0.016***	-0.000	0.008**	0.024**	0.010*
	(0.011)	(0.017)	(0.004)	(0.014)	(0.009)	(0.006)	(0.002)	(0.004)	(0.011)	(0.005)
Change in roads distance	-0.021	-0.050	-0.054**	-0.061	0.062	0.035*	0.002	0.014	0.068*	0.025
	(0.053)	(0.082)	(0.024)	(0.065)	(0.038)	(0.020)	(0.006)	(0.014)	(0.036)	(0.017)
Observations	248	248	248	248	248	248	248	248	248	248
R-squared	0.507	0.528	0.629	0.553	0.852	0.528	0.602	0.179	0.652	0.218
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Socio-demographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean dep var	1.851	4.016	0.779	0	15.20	0.880	0.287	0.0887	0	0.165

Notes: This table shows the relationship between land allocations and long-term outcomes. The dependent variables are all computed from 2000 until 2020. Log hectares is the logarithm of the sum of illegal land allocations from 1955 to 1985. Change in roads distance is the change in the log distance to the closest roads in 1985 minus 1955. Robust standard errors are presented in parenthesis. The set of geographic controls include: average elevation, average slope of the terrain, ruggedness, average precipitation and temperature, the standard deviation of temperature, isothermality index, and the log distance to rivers. The socio-demographic controls based on the 1950 Census include: share of rural population, share of female population, share of people that speaks an indigenous language, share of illiterate population, share of children going to school, share of population that finished secondary education, share of households with agriculture as the main income, share of population working in agriculture, share of population that owns a house, share of houses with electricity, and share of houses with running water. Robust standard errors presented in parenthesis. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

ONLINE APPENDIX

The Dark Side of Infrastructure: Roads, Repression, and Land in Authoritarian Paraguay

Felipe González, Josepa Miquel-Florensa, Mounu Prem, and Stéphane Straub

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A More details about the data

A.1 Mapping the road network development

For the period of interest, no official road maps providing a distinction between dirt, gravel, and paved roads are available. Similarly, sources on the main road segments generally fail to indicate at which time they were actually paved. In order to reconstruct the evolution of the paved network from the 1940s, we turn to historical national development plan documents for the transport and communications sectors (Secretaria General de Planificación, 1970) as well as economic memorandum from the World Bank (World Bank, 1979, 1981, 1991) and from the Japanese foreign development assistance (Japanese International Cooperation Agency, 1997, 2000).

We establish the extension of the paved road network at different dates in time, crossing information on the total extension of the paved network (World Bank, 1991), on the extension of that network by departments (Secretaria General de Planificación, 1970), as well as additional information from on both realized and planned works on different road segments contained in these different documents, and double-checking resulting figures with both online sources and direct consultations. This allows us to first develop Table A.1, which details the extension of paved roads by departments from 1940 to 1975.

Beyond 1975, information on the extension of paved roads by departments is not available. World Bank (1991) reports the following total extension of roads at the country level: 1,469.4 km in 1980, and 2076.6 km in 1985. In one noteworthy addition to the network, by 1985, road number 6, which links the crossing at km 30 near Ciudad del Este to Encarnación, was constructed. This corresponded to an additional 160 km in the department of Itapúa, and 90 km in the department of Alto Paraná. The remaining newly paved roads mostly correspond to a densification of the asphalt network around Asuncion and in the Central department, and have little incidence on the distance to the roads for the large majority of districts in the analysis. The next big push occurred in the 1990s, with the paving of part of the trans-Chaco road in the West, road 4 to Pilar, and roads 3 and 4 in the North, connecting Concepción and Pedro Juan Caballero. By 2000, the paved network would exceed 3,000 km.

This allows us to identify 6 snapshots (1950-55, 1960, 1965, 1970, 1975, and 1985), which we digitize and georeference. The resulting paved road network at five-year intervals, and the distance of each district to the paved road network in each period, is represented in Figure 1. Figure A.2 shows that the distance to the road network across the sample of 248 districts included in the analysis decreased significantly between 1955 and 1985.

A.2 Land suitability

We use land suitability by district to capture the economic potential of land. Cotton has been a traditional crop in Paraguay. By 1981, almost 140 thousand productive units were dedicated to cotton and it represented 44 percent of the country's exports (Palau, 1986). Cotton suitability was therefore likely to be an important criteria in establishing the value of plots to be allocated. Soybean became important for Paraguayan agriculture later, with small areas being cultivated until

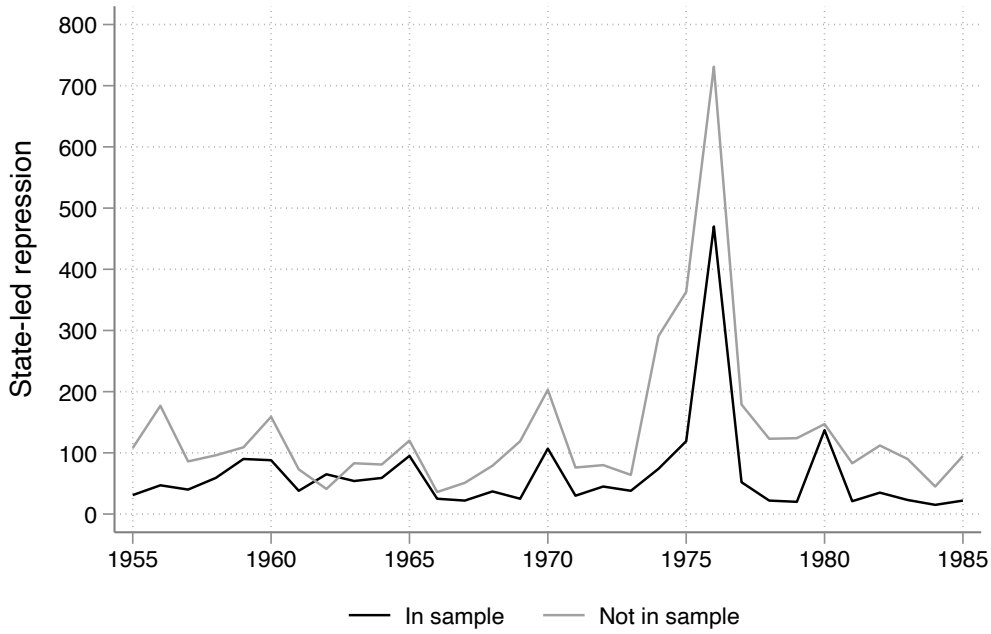
the 1970s. Since then, there has been an expansion of cultivated areas.[17] Soybean suitability could have been relevant for land allocation, but it should have mattered less than cotton given the characteristics of the cultivation process. We measure cotton and soybean suitability (rain-fed) by district using data from the well-known FAO Global Agro-Ecological Zones (GAEZ).

A.3 Long-run development outcomes

We examine long-run development by using several measures that point towards both the productive nature of districts and the prevalence of intense extractive activities at the local level. To measure economic activity, we use nighttime lights (Henderson et al., 2012; Li et al., 2020) and gridded datasets with information about population density (WorldPop) and agricultural production (Wood-Sichra et al., 2016; Yu et al., 2020). The gridded dataset has a granularity of 10×10 kilometers, information by crop, and is available for the years 2000, 2005, and 2010. We use agricultural production (measured in metric tons, per hectare) of the following crops: cassava, groundnuts, cotton, maize, rice, sorghum, soybean, sugarcane, wheat, sesame, and sunflower. To measure the extractive activities, we use pollution from van Donkelaar et al. (2021), wildfires from NASA's Earth Observing System Data and Information System (EOSDIS), deforestation from Hansen et al. (2013), and mining activity. Information on mines comes from the Catastro Minero conducted by the Ministry of Mines and Energy of Paraguay. The *catastro* contains information on all the licenses given by 2022. Paraguay's diverse geology offers a great variety of soils and resources, and the most important minerals exploited are gold, copper, cobalt, iron, precious minerals, and aluminum. Finally, we shed light on the relationship between the dictatorship's land policies, development, and rural conflict in the 2000s by examining land occupations between 1990 and 2019 documented by Kretschmer et al. (2019).

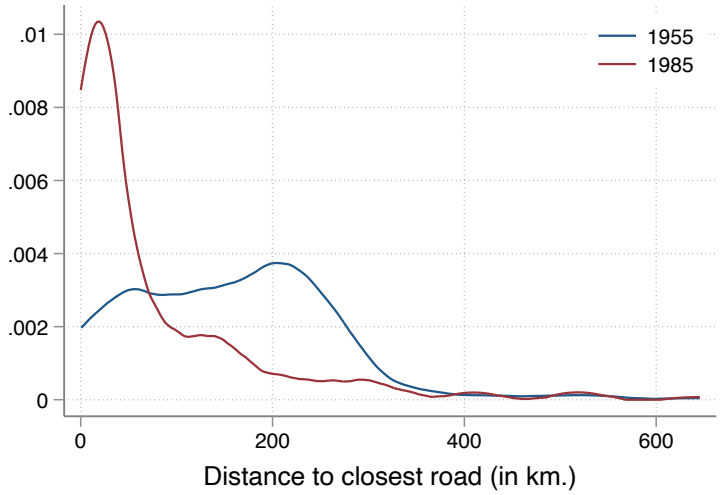
[17] According to the Paraguayan Chamber of Oleaginosas exporters (CAPECO), Paraguay is nowadays the third-world exporter of soy and the sixth-world producer. Soy production represents around 18 percent of GDP.

Figure A.1: State-led repression over time in Paraguay



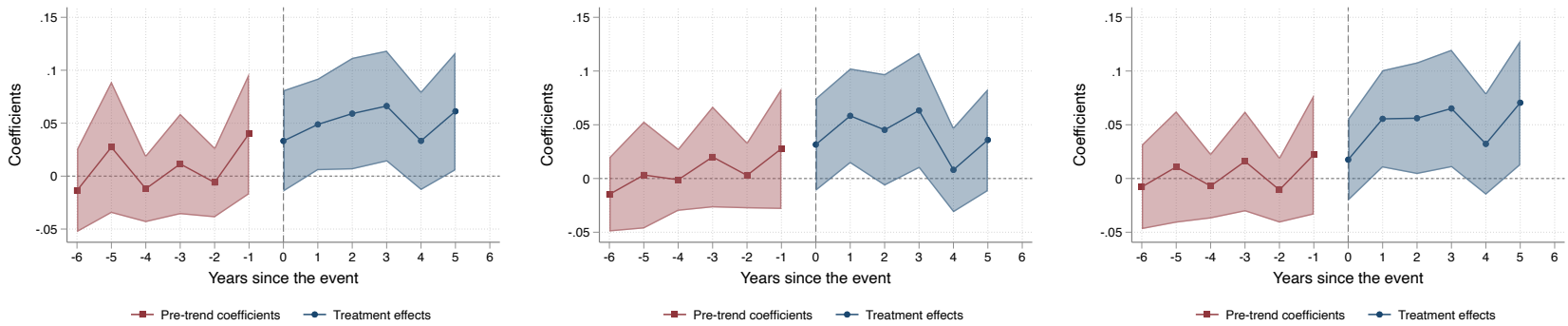
Notes: This figure shows the number of state-led repression events per year as revealed by the *Truth and Justice Commission* in Paraguay. The black line represent the total number of events for which we have information about the district where they took place. The gray line represents the number of events without district information.

Figure A.2: Descriptive statistics, distance to closest road

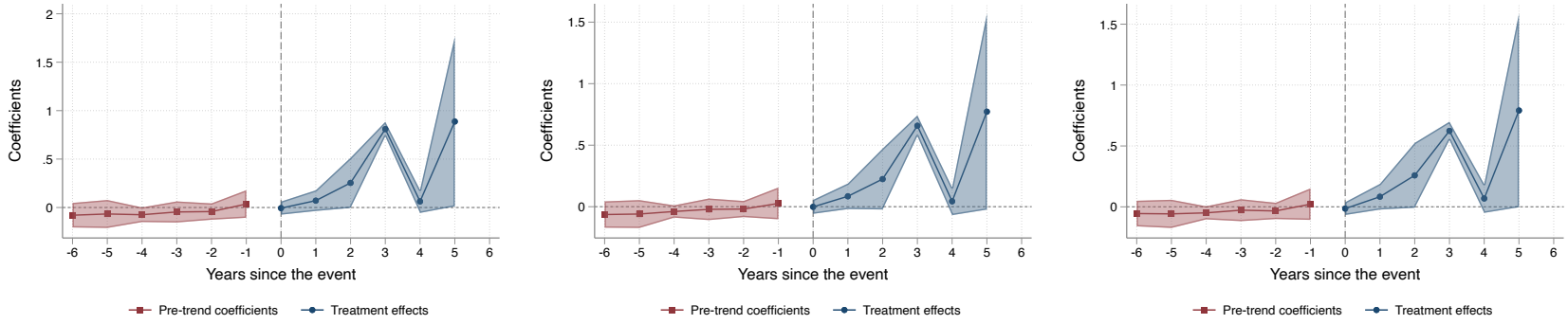


Notes: This figure shows the distribution of distance to the closest paved road across 248 districts in Paraguay. The blue lines shows the distribution in 1955 and the red line in 1985.

Figure A.3: Dynamic staggered difference-in-difference based on Borusyak et al. (2024)



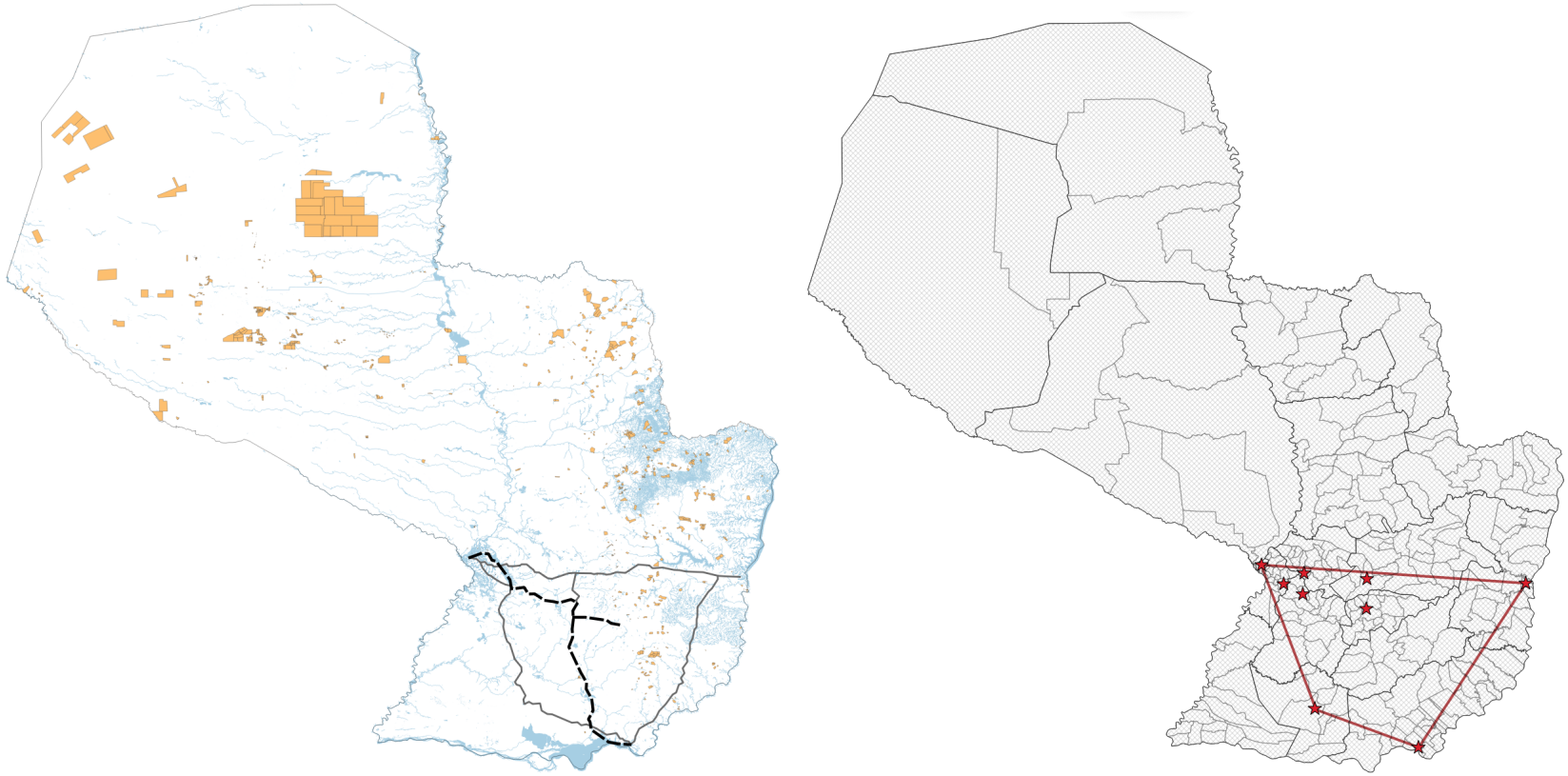
(a) Indicator: Repression (b) Indicator: Torture (c) Indicator: Detention



(d) Level: Repression (e) Level: Torture (f) Level: Detention

Notes: Estimates from a dynamic difference-in-differences estimation. The event indicator equals one if a district gets closer than 30 kilometers from the road network. Circles represent point estimates and colored areas the 95 percent confidence interval. The p-values for the differential pre-trends test suggested by the authors using ten pre-treatment periods are 0.43, 0.53, 0.65, 0.14, 0.09, and 0.15, respectively.

Figure A.4: Additional maps

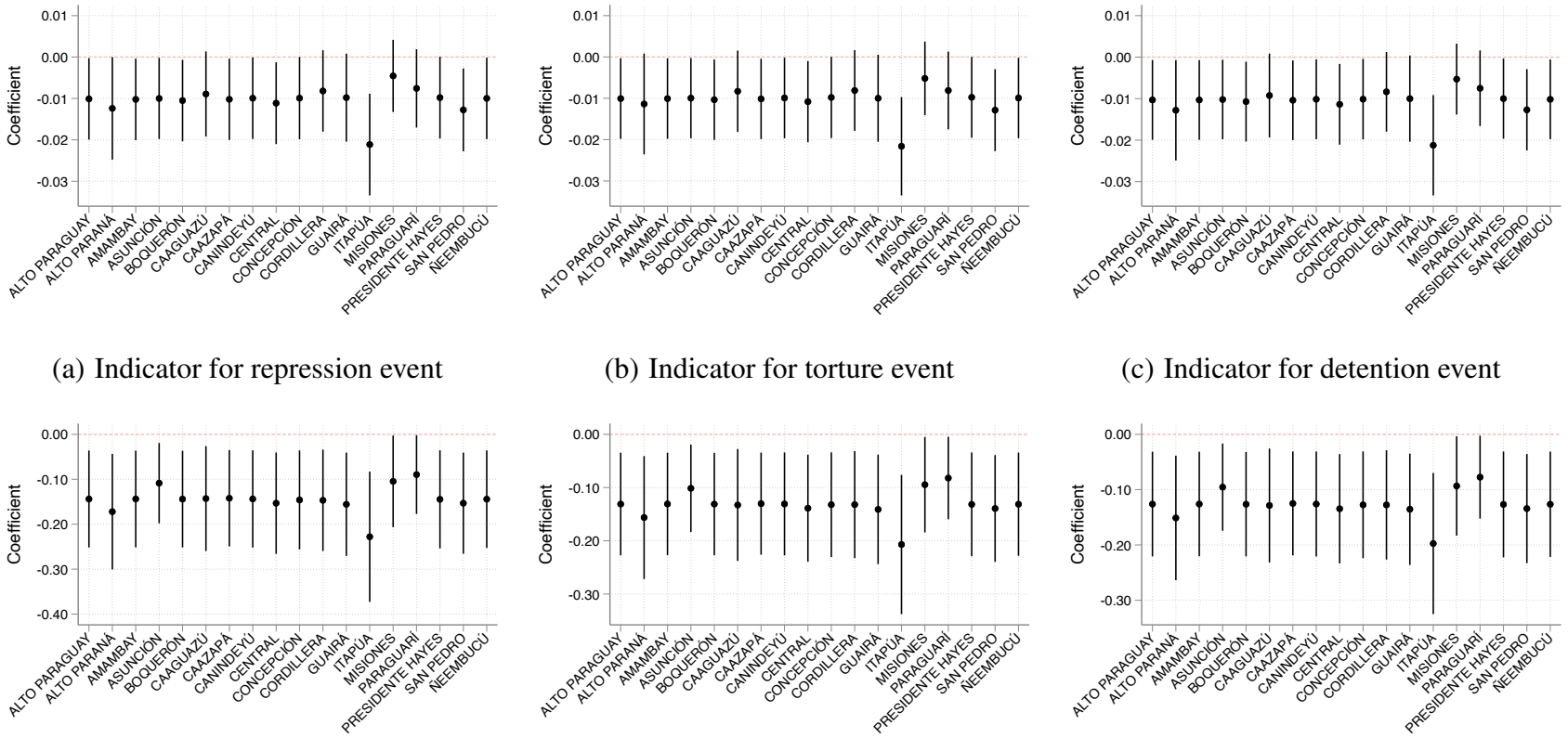


(a) Railroads, water, and indigenous communities

(b) Straight lines strategy

Notes: Panel (a) shows a map of Paraguay with the railroad network (dash black), road network (solid grey), rivers and lakes (light blue), and the location of indigenous communities (orange polygons) in the 2010s. The location of indigenous communities comes from a recent study conducted by the Federation for the Autonomy of Indigenous Populations (FAPI) in Paraguay Panel (b) shows the straight lines used in an alternative instrumental variables strategy.

Figure A.5: Robustness, excluding single departments from estimation



(a) Indicator for repression event

(b) Indicator for torture event

(c) Indicator for detention event

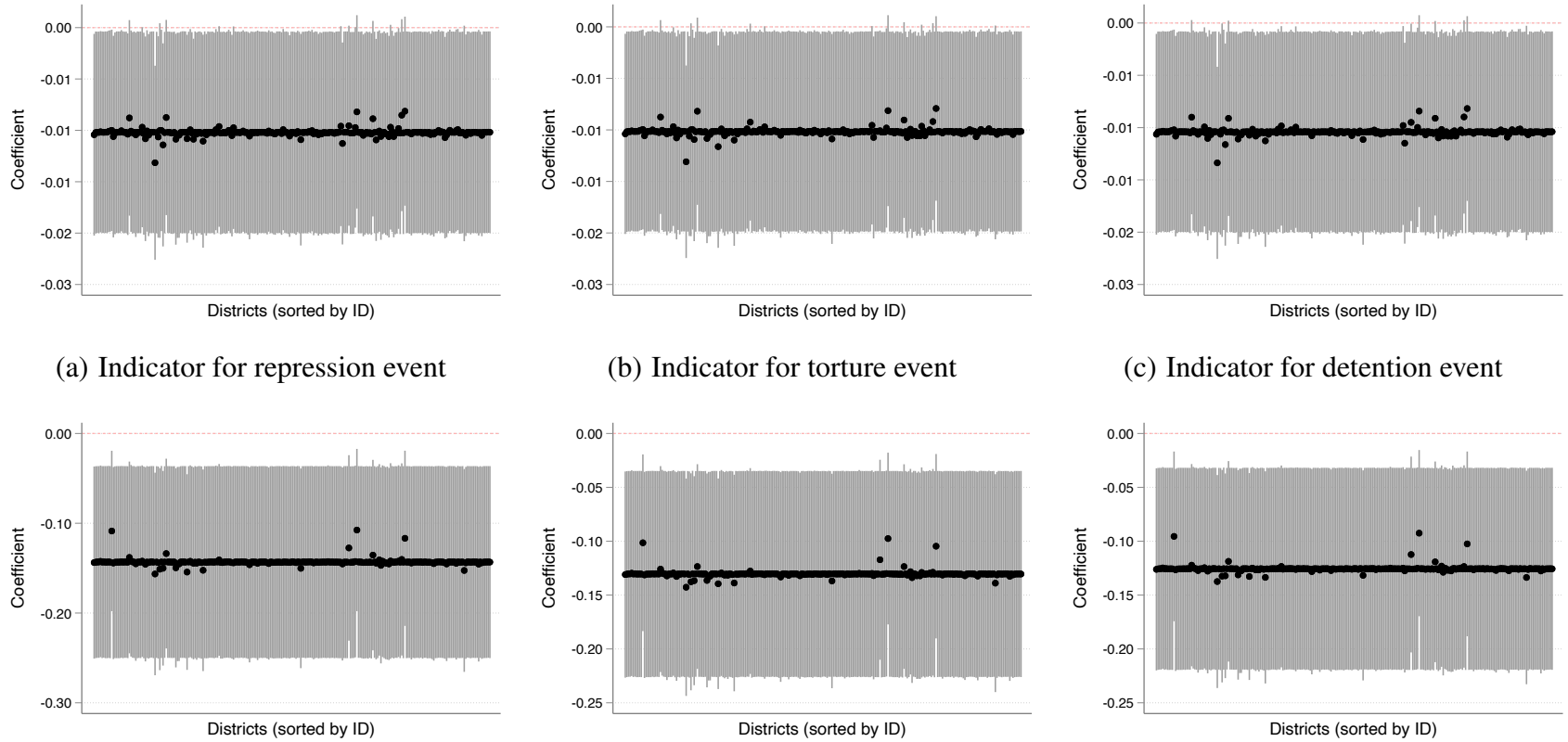
(d) Number of repression events

(e) Number of torture events

(f) Number of detention events

Notes: This figure shows the robustness of the empirical relationship between roads and state-led repression to dropping different departments (groups of contiguous districts) from the estimation. Each figure corresponds to a dependent variable. The *y*-axis measures the coefficient and the *x*-axis specifies which group of districts were dropped from the estimation. Black dots correspond to point estimates and vertical lines denote 90 percent confidence intervals.

Figure A.6: Robustness, excluding single districts from estimation



(a) Indicator for repression event

(b) Indicator for torture event

(c) Indicator for detention event

(d) Number of repression events

(e) Number of torture events

(f) Number of detention events

Notes: This figure shows the robustness of the empirical relationship between roads and state-led repression to dropping each one of the 248 districts. Black dots correspond to point estimates and vertical lines denote 90 percent confidence intervals.

Table A.1: Extension of the road network over time by department

	1940	1950	1955	1960	1965	1969	1975	1985
Región Central								
Central XI	12	88.5	95	114.5	150.8	232.7	232.7	248.7
Cordillera III	0	0	0	60	60.4	64.3	64.3	109.3
Guairá IV	0	0	0	0	0	40	40	108
Paraguarí IX	0	0	0	20	23.9	28.6	123.6	152.6
Caazapá VI	0	0	0	0	0	0	0	0
Región Itapúa								
Itapúa VII	0	0	0	0	0	94.1	94.1	281.1
Región Alto Paraná								
Caaguazú V	0	0	0	0	151	151.5	151.5	167.5
Alto Paraná X	0	0	0	0	84.5	84.5	84.5	204.5
Amambay XIII	0	0	0	0	0	0	0	0
Región Misiones								
Misiones VIII	0	0	0	0	0	114.3	114.3 1	164.3
Ñeembucú XII	0	0	0	0	0	0	0	0
Región Concepción - San Pedro								
Concepción I	0	0	0	0	0	0	0	0
San Pedro II	0	0	0	0	0	0	0	38
Región Bajo Chaco								
Pte. Hayes XIV	0	0	0	0	0	0	0	56
Región Chaco Norte								
Boquerón XV	0	0	0	0	0	0	0	0
Olimpo XVI	0	0	0	0	0	0	0	0
Total	12	88.5	95	194.5	470.6	810	905	1530

Notes: This table presents the evolution of the kilometers of paved roads by department from 1940 to 1985. Departments are grouped by region, according to the pre-1992 division, which comprises 16 departments in 7 regions. The Capital district Asunción, which does not belong to any region, is not included. For 1985, urban roads in Asunción and the Central department are not included as no detailed record are available, explaining the difference with the total of over 2,000 km stated above.

Table A.2: Descriptive statistics

	Mean	Median	St. Dev	Min	Max	Observations
Panel A – State-led repression	(1)	(2)	(3)	(4)	(5)	(6)
Indicator repression	0.05	0.00	0.22	0.00	1.00	7,688
Indicator torture	0.05	0.00	0.21	0.00	1.00	7,688
Indicator detention	0.05	0.00	0.21	0.00	1.00	7,688
Number of repression events	0.23	0.00	2.32	0.00	75.00	7,688
Number of torture events	0.20	0.00	2.01	0.00	64.00	7,688
Number of detention events	0.20	0.00	2.06	0.00	70.00	7,688
Panel B – Distance to closest road (in kms)						
In year 1955	155	157	105	0.55	645	248
In year 1960	139	138	105	0.54	645	248
In year 1965	106	77	105	0.46	645	248
In year 1970	79	40	103	0.11	645	248
In year 1975	79	39	103	0.11	645	248
In year 1985	73	30	105	0.11	645	248
Panel C – Illegal land allocations						
Years 1954-1959	1224.88	400	2643.35	0.00	16500	50
Years 1960-1964	2094.44	400	4783.38	0.00	52233	154
Years 1965-1969	1561.04	225	4107.59	0.00	56246	368
Years 1970-1974	1409.25	532	4144.49	0.00	85732	533
Years 1975-1984	3825.86	624	12598.63	0.00	148499	1437
Years 1985-1989	4449.29	4000	12592.65	0.00	143683	398

Notes: This table presents descriptive statistics for the main variables used in the analysis. Panel A describes state-led repression in the panel data of 248 districts observed yearly between 1955 and 1985. Panel B describes the distance (in kilometers) to the closest paved road in each of 6 years in the period 1955-1985. Panel C describes the illegal land allocations showing the average area (in Hectares) of the illegally allocated plots.

Table A.3: Direct and indirect exposure to the road network

	Indicator for at least one event of:			Total events of:		
	Repression	Torture	Detention	Repression	Torture	Detention
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Based on roads in district and neighbours						
Direct effects (in district)	0.130***	0.118***	0.117***	1.234*	1.052*	1.068
	(0.034)	(0.034)	(0.033)	(0.737)	(0.613)	(0.651)
Spillover effects (neighbours)	0.060***	0.055***	0.058***	0.152**	0.137**	0.137***
	(0.018)	(0.016)	(0.017)	(0.056)	(0.050)	(0.049)
Panel B: Based on distance						
Direct effects (< 20 km)	0.104***	0.093***	0.096***	0.698*	0.595*	0.608*
	(0.020)	(0.019)	(0.020)	(0.377)	(0.314)	(0.333)
Spillover effects ($\in (20, 30]$)	0.030	0.031*	0.031*	0.110	0.104*	0.101*
	(0.019)	(0.019)	(0.019)	(0.068)	(0.063)	(0.061)

Notes: This table presents the empirical relationship between Stroessner's road network and state-led repression. Panel A examines changes in repression in districts where roads were constructed (direct effects) and geographically contiguous districts (neighbours). Panel B examines the same relationship but in districts closer than 20 kilometers from roads (direct effects) and in districts located 20-30 kilometers from the road network (spillover effects). The distances of 20 and 30 kilometers are supported by a semi-parametric estimation for the effect of distance to roads on repression. In both panels, we measure directly and indirectly exposed districts with indicator variables. Standard errors are clustered at the district level. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

Table A.4: Two-stage least squares estimation

	Indicator for at least one event of:			Total events of:		
	Repression	Torture	Detention	Repression	Torture	Detention
	(1)	(2)	(3)	(4)	(5)	(6)
Distance to closest road	-0.009**	-0.008*	-0.009**	-0.102**	-0.084**	-0.084**
	(0.004)	(0.004)	(0.004)	(0.041)	(0.036)	(0.036)
Observations	7,688	7,688	7,688	7,688	7,688	7,688
R-squared	0.001	0.001	0.001	0.002	0.002	0.002
District fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Mean dependent variable	0.0535	0.0471	0.0484	0.233	0.197	0.202
Districts	248	248	248	248	248	248

Notes: This table presents the empirical relationship between distance to the closest road and state-led repression in the period 1955-1985. The unit of observation is a district-year. The first stage use as instrument the distance to the straight lines in panel (b) of Figure A.4. The F-statistic on the excluded instrument is 7,169. Standard errors are clustered at the district level. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

Table A.5: Distance to the network of railroads

	Indicator for at least one event of:			Total events of:		
	Repression	Torture	Detention	Repression	Torture	Detention
	(1)	(2)	(3)	(4)	(5)	(6)
Log distance to closest road	-0.011*	-0.011*	-0.011*	-0.158**	-0.138**	-0.143**
	(0.006)	(0.006)	(0.006)	(0.070)	(0.062)	(0.063)
Log distance to train × 1960s	0.001	-0.002	-0.002	0.082	0.059	0.056
	(0.005)	(0.004)	(0.004)	(0.075)	(0.064)	(0.062)
Log distance to train × 1970s	0.005	0.004	0.003	0.107	0.083	0.087
	(0.006)	(0.005)	(0.005)	(0.080)	(0.071)	(0.072)
Log distance to train × 1980s	0.014***	0.011***	0.010**	0.236	0.197	0.191
	(0.004)	(0.004)	(0.004)	(0.183)	(0.157)	(0.148)
Observations	7,688	7,688	7,688	7,688	7,688	7,688
R-squared	0.270	0.257	0.260	0.458	0.451	0.428
District fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Mean dependent variable	0.054	0.047	0.048	0.233	0.202	0.197
Districts	248	248	248	248	248	248

Notes: This table presents the empirical relationship between distance to the closest road and state-led repression in the period 1955-1985. The unit of observation is a district-year. Columns 1-3 use indicators for at least one event of repression as dependent variables. Columns 4-6 use the total number of repression events as dependent variable. Standard errors are clustered by district. *Log distance to train × 1960s (1970s or 1980s)* is the log distance to the closest railroad interacted with a duumy that takes the value one for the 1960 (1970 or 1980) decade. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

Table A.6: Other infrastructure projects and Itapúa

Dependent variable: Total number of state-led repression events				
Additional control for:	*Log distance to dam after construction*			*Itapúa 1955-76*
Panel A	(1)	(2)	(3)	(4)
Log distance to closest road	-0.156**	-0.143**	-0.155**	-0.167**
	(0.069)	(0.065)	(0.069)	(0.070)
Itaipú dam	1.888		2.098*	
	(1.174)		(1.232)	
Yacyretá dam		0.019	-1.236	
		(1.865)	(1.953)	
Indicator Itapúa in 1955–1976				0.346***
				(0.122)
Panel B				
Itaipú dam	-0.597		-0.214	
	(1.019)		(0.965)	
Yacyretá dam		-2.265	-2.117	
		(2.178)	(2.108)	
Indicator Itapúa in 1955–1976				0.151*
				(0.081)
Panel C				
Log distance to closest road	-0.156**	-0.143**	-0.156**	-0.191**
	(0.069)	(0.065)	(0.070)	(0.076)
× Itaipú dam	0.000		-0.006	
	(0.008)		(0.006)	
× Yacyretá dam		0.031*	0.035**	
		(0.019)	(0.017)	
× Indicator Itapúa in 1955–1976				0.141***
				(0.050)
Itaipú dam	1.825		3.140*	
	(1.829)		(1.695)	
Yacyretá		-6.612	-8.749	
		(5.453)	(5.320)	
Indicator Itapúa in 1955–1976				0.264**
				(0.110)
Observations	7,688	7,688	7,688	7,688
Districts	248	248	248	248
District fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Avg. dependent variable	0.233	0.233	0.233	0.233

Notes: The unit of observation is a district-year. In panel A, column 1 controls for the log distance to the Itaipu dam interacted with an indicator that takes the value one before 1974 and zero otherwise; column 2 controls for the log distance to the Yacyretá dam interacted with a dummy that takes the value one after 1983; column 3 adds both controls from columns 1 and 2; column 4 adds as a control a dummy for the Itapúa department interacted with a dummy that takes the value one from 1955 to 1975. Panel B repeats these exercises but drops log distance to closest road from the specification. Panel C repeats the exercises from panel A adding interaction terms. Standard errors are clustered by district. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

Table A.7: Robustness to specification decisions

Robustness exercise:	Number of events per 1,000 inhab.	Poisson	Negative binomial	Collapse to periods with roads data
	(1)	(2)	(3)	(4)
Panel A – Repression				
Log distance to closest road	-0.016**	-0.513**	-0.292***	-0.844**
	(0.007)	(0.246)	(0.053)	(0.403)
Panel B – Torture				
Log distance to closest road	-0.014**	-0.562**	-0.324***	-0.777**
	(0.007)	(0.264)	(0.056)	(0.369)
Panel C – Detention				
Log distance to closest road	-0.014**	-0.538**	-0.305***	-0.736**
	(0.006)	(0.246)	(0.056)	(0.357)
Observations	7,688	2,852	2,852	1,240
District fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Districts	248	92	92	248

Notes: This table presents robustness exercises for the empirical relationship between roads and state-led repression. The unit of observation is a district-year. Each robustness exercises is described in the header of the corresponding column. Standard errors are clustered by district. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

Table A.8: Robustness to different covariates

Covariates:	Demographic	Economic	Development	Geographic	Lat/lon polynomials	Average distance	Moran I	LASSO selected
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A – Repression								
Log distance to closest road	-0.137**	-0.137**	-0.109**	-0.188**	-0.179**	-0.140**	-0.174**	-0.182**
	(0.062)	(0.062)	(0.054)	(0.083)	(0.078)	(0.065)	(0.083)	(0.079)
Panel B – Torture								
Log distance to closest road	-0.127**	-0.125**	-0.102**	-0.166**	-0.160**	-0.127**	-0.155**	-0.160**
	(0.057)	(0.055)	(0.050)	(0.073)	(0.071)	(0.058)	(0.076)	(0.072)
Panel C – Detention								
Log distance to closest road	-0.122**	-0.120**	-0.097**	-0.163**	-0.154**	-0.123**	-0.151**	-0.155**
	(0.055)	(0.054)	(0.048)	(0.073)	(0.069)	(0.057)	(0.074)	(0.070)
Observations	7,688	7,688	7,688	7,688	7,688	7,688	7,688	7,688
Districts	248	248	248	248	248	248	248	248
District fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents robustness exercises for the empirical relationship between roads and state-led repression by adding different sets of controls interacted with year fixed effects. The unit of observation is a district-year. Column 1 includes the share of population that lives in rural areas, is female, speaks Guaraní, is illiterate, has at least secondary education, and children that go to school. Column 2 includes the share of population that economically active and works in the agriculture sector, as well as the share of households that mainly depend on agriculture. Column 3 includes the share of home ownership, and the share of houses with electricity and with access to clean water. Characteristics for columns 1 to 3 come from the 1950 Census. Column 4 includes average elevation, average slope, terrain ruggedness, the precipitation average and standard deviation precipitation, the isothermality, and log distance to the closest river. Column 5 includes a second-degree polynomial of latitude and longitude. Column 6 adds the log average distance of the districts to the centroide to all the rest of the districts. Column 7 includes the Moran I eigenvectors with an eigenvalue greater than 0.01 with the aim of capturing spatial autocorrelation among our districts (Bauman et al., 2018). In column 8, we select controls following Belloni et al. (2014) where the treatment to select the covariates is the change in log distance to closest road between 1955 and 1985. Standard errors are clustered by district. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

Table A.9: Robustness to sample composition

Robustness exercise:	Districts with less than 50,000 inhab.	Districts with less than 30,000 inhab.	Districts with less than 15,000 inhab.	Drops departments in the north-west region	Drops connecting districts	Drops Asunción from estimation	Only districts with some repression
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A – Repression							
Log distance to closest road	-0.110**	-0.118**	-0.122**	-0.147**	-0.110*	-0.109**	-0.253**
	(0.054)	(0.058)	(0.059)	(0.068)	(0.059)	(0.054)	(0.123)
Panel B – Torture							
Log distance to closest road	-0.103**	-0.111**	-0.112**	-0.133**	-0.102*	-0.101**	-0.231**
	(0.050)	(0.053)	(0.055)	(0.060)	(0.054)	(0.050)	(0.110)
Panel C – Detention							
Log distance to closest road	-0.097**	-0.103**	-0.104**	-0.129**	-0.094*	-0.096**	-0.222**
	(0.048)	(0.051)	(0.053)	(0.059)	(0.053)	(0.048)	(0.108)
Observations	7,626	7,440	6,634	7,223	7,409	7,657	2,976
Districts	246	240	214	233	239	247	96
District fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents robustness exercises for the empirical relationship between roads and state-led repression. The unit of observation is a district-year. Each robustness exercises is described in the header of the corresponding column. Standard errors are clustered by district. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

Table A.10: Difference across events with and without location

	Average [st. dev] among events of repression with observed location	Difference among districts without location information
	(1)	(2)
Detention	0.847	0.119***
	[0.360]	(0.008)
Torture	0.798	-0.680***
	[0.402]	(0.009)
Execution	0.014	-0.014***
	[0.119]	(0.003)
Exile	0.106	-0.097***
	[0.308]	(0.007)
Disappeared	0.056	-0.045***
	[0.231]	(0.005)
Female	0.172	-0.057***
	[0.377]	(0.009)
Missing year	0.023	0.187***
	[0.149]	(0.006)
During the 50s	0.127	-0.037***
	[0.333]	(0.008)
During the 60s	0.227	-0.103***
	[0.419]	(0.010)
During the 70s	0.437	-0.107***
	[0.496]	(0.012)
During the 80s	0.184	0.060***
	[0.387]	(0.010)
Districts	2,236	8,898

Notes: This table presents differences in observable variables across repression events with and without information on the location where these took place. Column 1 presents the average and standard deviation for districts with location information. Column 2 presents the statistical difference in observable variables among the events without location information. We calculate the different by estimating a simple cross-sectional regression using as dependent variable the observable variable in each row and as main right-hand side variable an indicator that takes the value of one for events with missing location. Robust standard errors in parentheses. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

Table A.11: Robustness of results in the 1955-1979 period

	Indicator for at least one event of:			Total events of:		
	Repression	Torture	Detention	Repression	Torture	Detention
Panel A	(1)	(2)	(3)	(4)	(5)	(6)
Log distance to closest road	-0.011	-0.011	-0.011	-0.186**	-0.168**	-0.161**
	(0.008)	(0.008)	(0.007)	(0.087)	(0.080)	(0.077)
Panel B						
Distance to road < 30km	0.050**	0.048**	0.052***	0.509***	0.456***	0.437***
	(0.020)	(0.018)	(0.020)	(0.177)	(0.159)	(0.153)
Observations	6,200	6,200	6,200	6,200	6,200	6,200
Districts	248	248	248	248	248	248
R-squared	0.277	0.268	0.269	0.502	0.494	0.494
District fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Mean dependent variable	0.0556	0.0490	0.0502	0.261	0.222	0.226

Notes: This table presents the empirical relationship between distance to the closest road and state-led repression in the period 1955-1985. The unit of observation is a district-year. Columns 1-3 use indicators for at least one event of repression as dependent variables. Columns 4-6 use the total number of repression events as dependent variable. Standard errors are clustered by district. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

Table A.12: Road construction and state-led repression: Imputations

Imputation	Based on overall share:			Based on yearly share:		
	Repression	Torture	Detention	Repression	Torture	Detention
Panel A	(1)	(2)	(3)	(4)	(5)	(6)
Log distance to closest road	-0.159**	-0.138**	-0.144**	-0.297**	-0.260**	-0.267**
	(0.067)	(0.059)	(0.062)	(0.133)	(0.117)	(0.117)
Panel B						
Indicator for distance to road < 30km	0.453***	0.389***	0.408***	0.820***	0.709***	0.729***
	(0.142)	(0.122)	(0.129)	(0.271)	(0.234)	(0.236)
Observations	7,688	7,688	7,688	7,688	7,688	7,688
R-squared	0.491	0.478	0.461	0.464	0.454	0.429
District fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Mean dependent variable	0.494	0.423	0.411	0.494	0.423	0.411
Districts	248	248	248	248	248	248

Notes: This table presents the empirical relationship between distance to the closest road and state-led repression in the period 1955-1985. The unit of observation is a district-year. All columns use the total number of repression events as dependent variable. In columns 1-3, we impute the repression events without district by using the interaction between the total events in that year and the share of total events that the district experience in the whole period. In columns 4-6, we impute the repression events without district by using the interaction between the total events in that year and the share of total events that the district experience in that particular year. Standard errors are clustered by district. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

Table A.13: Illegal land allocations and long-term development: Robustness to outliers

Outcome:	Development				Extractive activities					
	Ln Nighttime lights	Ln Population density	Agricultural production	Score (standardized)	Pollution	Wild fires	Deforestation	Any mine	Score (standardized)	Land invasion
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Winsorized at 1%										
Log hectares	-0.036***	-0.053***	-0.010**	-0.050***	0.013	0.015***	-0.000	0.008*	0.023**	0.009*
	(0.011)	(0.018)	(0.004)	(0.015)	(0.009)	(0.006)	(0.002)	(0.004)	(0.011)	(0.005)
Panel A: Winsorized at 5%										
Log hectares	-0.034***	-0.042***	-0.009**	-0.048***	0.009	0.016***	0.000	0.008*	0.026**	0.009*
	(0.011)	(0.016)	(0.004)	(0.015)	(0.009)	(0.005)	(0.002)	(0.004)	(0.011)	(0.005)
Observations	248	248	248	248	248	248	248	248	248	248
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Socio-demographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table shows the relationship between land allocations and long-term outcomes. The dependent variables are all computed from 2000 until 2020. Log hectares is the logarithm of the sum of land allocations from 1955 to 1985. Change in roads distance is the change in the log distance to the closest roads in 1985 minus 1955. Robust standard errors are presented in parenthesis. The set of geographic controls include: average elevation, average slope of the terrain, ruggedness, average precipitation and temperature, the standard deviation of temperature, isothermality index, and the log distance to rivers. The socio-demographic controls based on the 1950 Census include: share of rural population, share of female population, share of people that speaks an indigenous language, share of illiterate population, share of children going to school, share of population that finished secondary education, share of households with agriculture as the main income, share of population working in agriculture, share of population that owns a house, share of houses with electricity, and share of houses with running water. Robust standard errors presented in parenthesis. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1.