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Public good or public bad? Indigenous institutions and the demand for public goods

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PUBLIC GOOD OR PUBLIC BAD?
INDIGENOUS INSTITUTIONS AND THE DEMAND FOR PUBLIC GOODS

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Eduardo Hidalgo (University of Cologne)
Nayeli Salgado (Vienna University of Economics and Business)

Working Paper 23-01

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Public good or public bad? Indigenous institutions and the demand for public goods *

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Abstract

This paper argues that the underprovision of public goods can be partly explained by lower demand from Indigenous groups with high preferences for Indigenous identity and a high capacity for coordination. Examining the post-Mexican Revolution period (1920s-1950s), when the state used the first road network for nation-building, our diff-in-diff analysis shows that pre-colonial political centralisation is associated with less road infrastructure. This is attributed to stronger capacity for collective action and stronger Indigenous identity preferences. Finally, we show that poor road infrastructure today is linked to lower economic performance.

Keywords: Indigenous institutions, public good provision, collective action, Indigenous identity

JEL Classification: H41, H79, N7, O18.

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"Indigenous people are not against development, but they reject "development" models which have been imposed on them without their participation".

(United Nations, 2018)

1 Introduction

The literature in economics has long established that ethnic diversity can lead to underprovision of public goods.[1] Specifically, scholarly evidence has documented that in countries with more diverse societies, it is harder to meet individual preferences in policy decisions. However, the literature has not sufficiently explored how public goods can be rejected by certain social groups, particularly when these goods are seen as undermining identities and traditions. This is often the case for large-scale infrastructure projects, which can have positive economic effects but negative impacts on social cohesion, livelihoods, the environment and the health of Indigenous people.[2] Human rights activists are aware that Indigenous groups often oppose such projects in spite of their potential economic benefits.[3] Despite these events, the economics literature has largely neglected to explain why public goods may be rejected by these groups. This paper seeks to explore which Indigenous groups are more likely to reject public goods, as well as examine the mechanisms that explain their success.

This paper investigates whether Indigenous people who descend from politically centralised societies in pre-colonial times are better able to reject the implementation of large-scale infrastructure projects than Indigenous people who descend from politically fragmented societies. To this end, we use heterogeneity in the proportion of Indigenous people who descend from different levels of political organisation in pre-colonial times. In particular, we use an index of Indigenous institutions developed by Elizalde (2020).[4] This measure is the Indigenous population-weighted average of Murdock (1967)'s *Jurisdictional Hierarchy Beyond the Local Community* index for all Indigenous groups within each municipality.[5] Following Gennaioli and Rainer (2007), the degree of political complexity of ethnic institutions captures the ability of ethnic groups to coordinate and implement policies at the local level. Our empirical analysis uses this variation to examine the demand for large-scale infrastructure projects in municipalities with varying degrees of ethnic institutions. Our aim is therefore to understand which Indigenous groups are the most likely to reject such projects.

We employ a quasi-experimental framework from post-revolutionary Mexico to explore the relationship between road expansion and Indigenous institutions. After the Mexican Revolution

[1] See Alesina et al. (1999), Alesina et al. (2003); Alesina and La Ferrara (2005); Montalvo and Reynal-Querol (2005); Montalvo and Reynal-Querol (2017).

[2] See Duflo and Pande (2007); Lipscomb et al. (2013); Hornung (2015) Baum-Snow et al. (2017); Donaldson (2018)

[3] See UN Human Rights Council reports A/HRC/39/17/Add.2 for Mexico; A/HRC/39/17/Add.3 for Guatemala; A/HRC/33/42/Add.2 for Honduras; A/HRC/36/46/Add.1 for the United States

[4] See also Gennaioli and Rainer (2007); Michalopoulos and Papaioannou (2013); Michalopoulos and Papaioannou (2014); Dippel (2014); Angeles and Elizalde (2017)

[5] This index of ethnic institutions ranges from 0-2, with higher values representing municipalities with indigenous populations descended from ethnic groups with more complex political organisation in pre-colonial times.

(1920–1950), the new state used a large-scale road-building programme as a tool for nation-building. As Waters (2006) puts it, roads during this period represented both a challenge to Indigenous identity and traditions — as they enabled individuals to "*come into more direct contact with the market forces and institutions of the state*" — and a public good that could bring economic development.

This paper leverages two unique sources of variation in Mexico. First, a new state aimed to create a national identity by providing road infrastructure to all strata of society without distinction between Indigenous and non-Indigenous populations (Waters, 2006). However, roads posed a threat to Indigenous identity and traditions, leading to their rejection of road infrastructure (Bess, 2017). Second, Indigenous groups in Mexico prior to colonisation had varying levels of political complexity, from centralised systems administered by the Aztec Empire to numerous scattered nomadic groups with minimal political organisation (e.g. the Huichol group in northern Mexico) (Adams and Macleod, 2000; Angeles and Elizalde, 2017). Given that Europeans were unable to rule over the numerous villages and towns, existing systems of governance remained in the form of collective forms of organisation at the local level (Angeles and Elizalde, 2017; Elizalde, 2020). Using these two sources of variation we investigate whether politically centralised or politically fragmented Indigenous groups are better able to reject the implementation of a large-scale road-building project.

To test our main hypothesis, we create a dataset with a new digital map of the Mexican road network, coding the expansion of roads since 1920.[6] To our knowledge, this is the first study to examine the temporal evolution of the Mexican road network since the beginning of the 20th century.

In our main econometric strategy, we exploit the fact that the state used the provision of road infrastructure as a nation-building tool after the Mexican Revolution. We employ a difference-in-differences strategy to evaluate the expansion of road construction among municipalities with different levels of Indigenous institutions. We find that municipalities with a higher share of Indigenous people from politically centralised pre-colonial societies experienced lower road expansion than municipalities with a larger share of Indigenous people from politically fragmented societies.[7] Utilising a flexible difference-in-differences approach, we show that differences in road infrastructure provision became significant after 1940, when road infrastructure in Mexico was significantly expanded. Our findings are robust to various specifications of the primary outcome and explanatory variables.

The validity of our identification strategy depends on the assumption that road infrastructure

[6] Roads are defined as all federal and state highways that are part of the Mexican road network. According to the Law on Roads, Bridges and Federal Motor Transport, federal and state highways are those that connect with roads from abroad, link two or more subnational states and are generally built by the government with federal funds.

[7] We classify politically centralised and politically fragmented municipalities according to Dippel (2014). Specifically, he classifies politically centralised Indigenous groups as those with a value of 1 (small chiefdoms) and 2 (larger chiefdoms) from Murdock's Jurisdictional Hierarchy Index, and as politically fragmented those with a value of zero (stateless societies). Therefore, we classify a municipality as politically *centralised* if the value of our index of Indigenous institutions is greater than zero; if the value of this index is zero, we classify municipalities as politically *fragmented*.

in municipalities with different levels of Indigenous institutions would have followed parallel trends in the absence of nation-building and the use of roads as a tool to create a national sense of *Mexicanidad*. To test this assumption, we first use newly digitised data on colonial roads and the railway network up to 1920 to examine whether our measure of Indigenous institutions correlates with the provision of infrastructure projects in Mexico prior to the revolution. We find no correlation between these variables. Second, we take advantage of the shift in road infrastructure policy in the mid-1950s, when road construction increasingly focused on modernisation instead of nation-building. We find that post-1950s road infrastructure follows parallel trends between municipalities with different levels of Indigenous institutions, suggesting that the different trends in road infrastructure were a consequence of the way the state used roads for nation-building in post-revolutionary Mexico (1920s to 1950s).

Furthermore, we perform an additional robustness check to confirm our main hypothesis. We hypothesise that Indigenous people reject the provision of large-scale infrastructure projects when the state attempts to use these projects as a tool for nation building. Therefore, Indigenous people in post-revolutionary Mexico did not view roads as a public good that could bring prosperity to their communities, but rather as a public "bad" that could affect their identity and traditions by integrating Indigenous communities into the notion of *Mexicanidad*. If our hypothesis is correct, we thus expect not only a reduced provision of road infrastructure, but also a reduced state presence in politically centralised municipalities. We explore this using data on the number of bureaucrats as a proxy for state presence for each Mexican municipality between 1900 and 1940, drawn from Garfias (2018). Our results suggest that during the nation-building process, the new state was significantly less intrusive in municipalities with more Indigenous populations that had politically centralised characteristics in the pre-colonial period. This finding provides evidence that Indigenous people in politically centralised municipalities were better able to reject the state presence than in politically fragmented municipalities.

Indeed, our main argument is that Indigenous people rejected roads due to the process of nation-building, which aimed to override Indigenous identities and traditions by improving connectivity through roads. However, we acknowledge that the lack of data on Indigenous uprisings against road construction during the period under study prevents us from further validating this argument. However, we do not believe that this invalidates the findings of our study. Rather, our main objective is to improve our understanding of which Indigenous groups opposed large-scale infrastructure projects. However, to better understand this, we also provide qualitative evidence that support our hypothesis.

Next, we rule out the possibility of supply-side discrimination in road infrastructure provision by performing different checks. First, we examine whether municipalities with non-Indigenous people receive a higher share of road infrastructure than those with Indigenous people. Our results do not show any evidence of discrimination. Second, we construct a counterfactual road network that maximises population connectivity between the state capitals and Mexico City. After controlling for the counterfactual road network, our variable of interest, the Indigenous Institution index, is

still negatively associated with road development between 1920 and 1960, suggesting a lack of demand for road infrastructure by municipalities with centralised Indigenous institutions. Finally, we control for various measures which previous literature has shown to be associated with the supply of public goods and ethnic diversity, such as ethnic fractionalisation and polarisation, and the share of Indigenous people in each municipality.

We examine two potential mechanisms to explain our main findings. The first mechanism posits that politically centralised Indigenous groups may be better positioned to coordinate collective action due to their greater capacity for achieving political objectives. To support this mechanism, we examine the land restitution policy instituted in the early 20th century, which redistributed 16 million hectares of ancestral land to Indigenous people (Elizalde, 2020). The process of land redistribution was not straightforward, as powerful large landowners in rural Mexico regularly blocked petitions. As a result, permanent collective organisation of the Indigenous population was necessary in order to execute the restitution (land occupations, protests, barricades, etc.). Consistent with Elizalde (2020), we find that in municipalities with Indigenous populations originating from politically centralised societies of the pre-colonial period, a larger share of ancestral land was redistributed. In addition to this evidence, we utilise survey data from the Latin American Public Opinion Project (LAPOP) to assess Indigenous attitudes and beliefs. Our results suggest that individuals originating from politically centralised societies are more likely to engage in collective actions such as participation in demonstrations, seizure of private property or land, and road blockades than individuals from politically fragmented ethnic groups in pre-colonial times.

Our second mechanism argues that municipalities with a politically centralised Indigenous population have a higher preference for preserving their Indigenous identity and consequently a lower preference for road infrastructure. To do this, we use survey data from the "National Survey on Discrimination" of Mexico (ENADIS) to measure individuals' preferences regarding Indigenous identity. We select questions related to attitudes towards an individual's national identity and find that those from politically centralised pre-colonial societies are more likely to be proud of their Indigenous identity, to preserve their Indigenous culture and traditional practises, and to identify with their Indigenous identity rather than with national identity than those from politically fragmented societies.

Finally, we turn to the economic consequences of the differential development of road infrastructure in post-revolutionary Mexico. We provide suggestive evidence that the total stock of road infrastructure in the late 1950s is positively associated with economic outcomes such as electricity rate, drainage rate, literacy rate, and nighttime lighting density. These results have far-reaching implications for policy. The United Nations has reported that Indigenous peoples often contest large-scale infrastructure projects. Nonetheless, our research suggests that refusing such projects could result in a decrease in long-term development outcomes.

Related literature: Our paper relates to several strands in the literature. First, this paper contributes to the literature on the role of ethnicity in the provision of public goods by demonstrating a new mechanism of underprovision: the outright rejection of public goods by ethnic groups

when they undermine their identity and traditions.[8] Building on the seminal work of Alesina et al. (1999), which argued that greater ethnic diversity leads to fewer public goods, we evaluate the impact of Mexico's first large-scale road building programme in post-revolutionary Mexico. Our study finds that the programme was less successful in municipalities with more politically centralised Indigenous groups, potentially due to the fact that the provision of road infrastructure was used to override pre-existing ethnic identities and cultural traditions.

Second, our work is related to recent findings that document a positive correlation between pre-colonial institutions and contemporary economic outcomes in Africa, the Americas, and Asia.[9] For example, Gennaioli and Rainer (2007) find that public goods provision is associated with a higher degree of political centralisation among pre-colonial African ethnic groups. Angeles and Elizalde (2017) argue that pre-colonial Indigenous groups in Latin America were better able to organise and defend their collective interests, leading to better economic outcomes. Dell et al. (2018) compare economic outcomes between Vietnamese areas that were under centralised and decentralised states in the pre-colonial period, finding that those under centralised administrative forms of organisation had developed better local collective actions. Our research contributes to this growing literature by demonstrating that pre-colonial institutions can also have surprisingly unintended negative consequences for long-term development. Specifically, we find that in municipalities with more politically centralised Indigenous groups, large-scale infrastructure projects are more likely to be rejected.

Our work is also related to the literature analysing the economic impact of large-scale infrastructure projects.[10] These studies have documented that infrastructure projects produce winners and losers.[11]For instance, Duflo and Pande (2007) showed that rural poverty in India increased where dams were built. Building on this work, our research examines road infrastructure development in Mexico, focusing on politically centralised Indigenous groups. We find that road infrastructure development is significantly lower in areas with politically centralised Indigenous groups, leading to worse long-term economic outcomes. Our results have important policy implications. Human rights activists have recently highlighted the negative impacts of large-scale infrastructure projects on Indigenous populations. Understanding which types of Indigenous groups are better able to reject these projects could help governments develop more successful and less threatening negotiation strategies.

Finally, our findings add to the existing literature analysing the main determinants of cultural persistence.[12] An important question in this literature is why traditions persist in some settings and not in others (Tabellini, 2008). Giuliano and Nunn (2020) addressed this query in the context of Indigenous peoples in the US, showing that those living in areas with a history of environmental

[8]Alesina et al. (2003); Alesina and La Ferrara (2005); Montalvo and Reynal-Querol (2005); Montalvo and Reynal-Querol (2017), Alesina et al. (1999)

[9]See: Michalopoulos and Papaioannou (2013); Michalopoulos and Papaioannou (2014); Chiovelli (2014) Bandyopadhyay and Green (2016); Elizalde (2020)

[10]Duflo and Pande, 2007; Lipscomb et al., 2013; Baum-Snow et al., 2017; Donaldson, 2018

[11]See in particular: Duflo and Pande (2007); Baum-Snow et al. (2017); Asher and Novosad (2020)

[12]For a summary see: Nunn (2012)

instability are more likely to maintain their traditional languages. Our study augments this body of literature by demonstrating which types of Indigenous groups are better able to preserve cultural traditions. We demonstrate that in Mexican municipalities where Indigenous people were better able to reject cultural integration during the nation-building process in the form of better transport access, Indigenous identities and traditions are more likely to survive today.

The paper is arranged as follows. Section 2 gives a historical overview of road infrastructure and Indigenous people in Mexico. Section 3 develops our hypothesis. Section 4 presents our data, empirical strategy and main results. Section 5 discusses possible mechanisms. Section 6 shows the economic consequences of road infrastructure. Section 7 concludes.

2 Background

The first national road network in Mexico was not created until after the Mexican Revolution and had two main objectives. First, it was to serve as an instrument for nation-building. In the words of Waters (2006), the post-revolutionary state saw road infrastructure as *"something that could help bring Mexicans together if controlled by the national government...[it] was a nationalist project that via discourses and practices forged national identity"*. Second, the construction of the road network was intended to connect people and markets in order to promote economic progress (Bess, 2017).

In 1918, Venustiano Carranza, the first post-revolutionary president, stressed the need to begin the "social reconstruction of the nation" through road infrastructure (Bess, 2017). However, the national road building programme did not begin until 1925. From the beginning, the development of the road network served as an instrument of nation-building. The inauguration of roads was often reported nationally and large celebrations were held to convey nationalist messages. In 1936, at the inauguration of a road in the village of Tepoztlan in the southern state of Morelos, an Indigenous resident addressed Mexican President Lazaro Cadenas in Nahualt (the lingua franca of the former Aztec Empire) and Spanish: "*like a doctor, you have identified the cause of our illness [poverty] and administered the right medicine [roads] to alleviate it*". The roads have helped isolated communities develop a new sense of national integration. Waters (2006) expresses this clearly: roads in post-revolutionary Mexico signified both "*a change in individual identities...*[by expanding] *the process of Mexicanidad*" and a way for individuals to "*come into more direct contact with market forces and the institutions of the state*".

Road building generally took place at the regional and local level (Bess, 2014). Roads brought many positive outcomes for communities by connecting them to towns and markets, but also posed significant threats to the natural environment and the social cohesion of communities, including Indigenous villages. To minimise confrontations, local governments relied on board meetings attended by bureaucrats and residents to influence the provision of road infrastructure, including on issues related to construction (Bess, 2017; Bess, 2014).

The community was also involved in the construction of roads. The formation of brigades at the

local level was encouraged throughout the country. In some regions, for example, road construction even became a grassroots activity, with people volunteering to do collective days of work for road construction. This not only provided jobs, but also led to communities engaging in the process of state consolidation as part of national integration (Waters, 2006).

The provision of road infrastructure was also supported by a highly centralised state bureaucracy. In 1925, a National Roads Authority (NRA) (or *"Comision de Caminos"*) was created. The NRA was not only responsible for managing revenues for road infrastructure, but also controlled the entire logistical infrastructure of road construction, from the provision of machinery and labour to the supply of technical expertise and construction work (Bess, 2017). The state essentially centralised the provision of roads throughout the Mexican territory.

Between the 1920s and the 1950s, 31,094 kilometres of roads were built, representing 41% of the total road stock in 1990. We focus on this period in our study because this was the phase in which the new state consolidated its power (Hodges and Gandy, 1983). For example, Manuel Avila Camacho, president of Mexico between 1940 and 1946, declared in 1941: "*it is not possible to truly integrate a sense of the nation without an ample road network that facilitates economic exchange [and] connects human groups*" (Bess, 2014).

After the 1950s, modernisation policies became more important than nation building. Public infrastructure was therefore increasingly seen as an important element in promoting local markets and economic growth. This led to a significant change in public policy, particularly in the provision of road infrastructure, which was gradually developed to meet the needs of the private sector and foreign multinational companies (Hodges and Gandy, 1983). Then, in the late 1980s, road infrastructure was substantially taken over by the private sector through private concessions known as Built, Operate and Transfer. International companies thus increasingly took over responsibility for road infrastructure, from technical implementation and investment to construction and maintenance (Blankespoor et al., 2017).

Nevertheless, the road infrastructure in Mexico was developed in different ways. In particular, road development in the southern states was apparently less than in those north of central Mexico. These contrasting patterns are important when considering that these regions often differ not only in their distinct Indigenous heritage, but also in the degree of state presence. In three of the southern states with more entrenched Indigenous practises, Chiapas, Guerrero and Oaxaca, some of their Indigenous communities have managed to develop considerable autonomy in policy implementation through political dialogue or conflict (Harvey, 1998; Díaz-Cayeros et al., 2014)[13]. In these communities, the presence of the state was mostly weak.

Qualitative evidence suggests that Indigenous communities are opposed to road infrastructure. Indigenous people viewed road infrastructure not as a public good that would improve their standard of living, but as a "threat" to the continuation of their existing forms of social organisation and traditions (Waters, 2006; Bess, 2017). This means that the provision of road infrastructure

[13]The most prominent examples of Indigenous autonomy in the southern states of Mexico are the Indigenous Mayan guerrillas in Chiapas and the use of Indigenous practises (*usos y costumbres*) to elect community leaders in Oaxaca.

came into conflict with the ethnic identity and traditions of Indigenous people, leading to resistance to road construction within their communities.

We argue that resistance to road infrastructure was only possible through the concerted and sustained organisation of Indigenous groups to resist it - an institutional legacy that can be traced back to pre-colonial times. At the time of first contact with Europeans, Indigenous groups in Mexico had very different political structures and institutional complexity, ranging from city-states administered by the Aztec Empire to numerous small tribes whose political organisation did not go beyond the village level (Adams and Macleod, 2000). Colonialism, however, intervened deeply in this established institutional order and led to a radical change in the ethnic structure of the Indigenous population.

However, pre-colonial institutional factors were not erased by the arrival of Europeans and continue to influence outcomes to this day (Angeles and Elizalde, 2017). Indigenous populations remained within their ancestral territories thanks to colonial policies to control them. These Indigenous settlements were referred to as *Pueblos de Indios*. Importantly, they enjoyed self-government throughout the colonial period, so that the Indigenous population could continue to use their traditional forms of organisation to meet their collective needs (e.g. labour and taxes) (Tanck de Estrada, 2005). Indigenous people thus played a key role as the main source and organiser of labour during the colonial period (Lang, 1975). In the words of Lang (1975), "*The Spanish enterprise in the New World rested on the indigenous social order*".

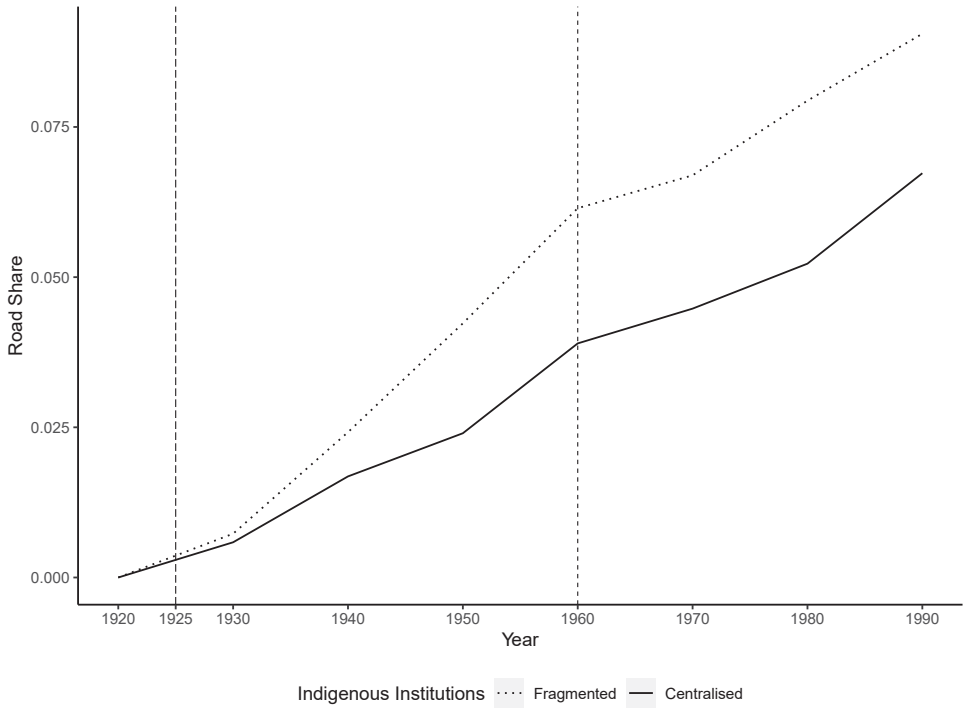


FIGURE 1: Road infrastructure and Indigenous institutions in Mexico, 1920-1990

Notes: This figure shows the development of road infrastructure in two groups of municipalities with different levels of Indigenous institutions. The "Centralised" group (solid line) are the municipalities with an Indigenous institutions index above 0. The "Fragmented" group (dashed line) are the municipalities with an Indigenous institutions index of 0. The vertical dashed line in 1925 represents the beginning of the nation building period in Mexico, and the vertical dashed line in 1960 represents the end of the nation building period. Road infrastructure is the proportion of the municipal area covered by a 2 km buffer along roads.

Figure 1 shows road infrastructure in two groups of municipalities between 1920 and 1990. The solid line includes municipalities with Indigenous populations originating from centralised societies of the pre-colonial period. The dashed line includes municipalities with more Indigenous people originating from fragmented societies. The two vertical lines mark the beginning of the road building programme in 1925 and the end of the nation-building period in 1960 respectively. The differences in road building between these two groups are striking. During the nation-building period from the 1920s to the 1950s, roads were constructed more rapidly in municipalities where the Indigenous population had a legacy of fragmented societies, while in municipalities where the majority of the population can be associated with centralised societies, road construction was much slower. In this study, we aim to examine these contrasting patterns of road infrastructure in more detail, particularly between the 1920s and 1950s, when state power was consolidating in Mexico.

3 Hypothesis development

To understand why road infrastructure differs in municipalities with different levels of pre-colonial Indigenous institutions, we develop a conceptual framework based on the description of post-revolutionary Mexican history. The expansion of the road network after the Mexican Revolution was essentially a manifestation of state power and nation building. Therefore, road infrastructure in post-revolutionary Mexico was both a public good and a symbol of the adoption of a new national identity for the Indigenous population.

We present a model for the link between road infrastructure and Indigenous institutions. We focus on the demand side for roads because we assume that the supply side, the Mexican state, does not discriminate against certain groups of people because it wants to create the idea of *Mexicanidad* (a unified nation). Therefore, the demand side should determine the allocation of road infrastructure during the period of nation building.

Municipality $i \in I$ can invest part of its resources $0 \leq x \leq 1$ (time, money, etc.) in avoiding roads $r^i(x)$, where $r^i(\cdot)$ is an increasing and concave function. As in the empirical analysis, roads can be viewed as proxies for state dominance. Let us assume that the preferences of this municipality (we abstract from heterogeneity within a municipality) can be represented by the increasing and quasiconcave utility function:

$$u^i(r^i(x), 1-x). \tag{1}$$

We denote the partial derivative of a function $f(\cdot)$ w.r.t. to its k-th argument by $f_k(\cdot)$ and let

$$x^i \in \arg\max_x u^i(r^i(x), 1-x). \tag{2}$$

For an interior solution, x^i is characterized by the FOC

$$r_1^i(x^i) = \frac{u_2^i(r^i(x^i)), 1-x^i)}{u_1^i(r^i(x^i)), 1-x^i)}. \tag{3}$$

It follows from this optimality condition that the optimal amount of resources invested x^i - and hence the optimal amount of roads avoided $r^i(x^i)$ - may differ between municipalities for two reasons: First, the efficiency of converting invested resources into avoided roads $r^i(\cdot)$ might differ between municipalities with different levels of Indigenous institutions (e.g. due to differences in the ability to collectively organise resistance to the central state). Second, the willingness to give up resources to avoid more roads might differ $u_2^i(\cdot)/u_1^i(\cdot)$ (e.g. due to a higher preference for preserving Indigenous identity and way of life). From now on, we assume that municipalities can be ordered in a meaningful way, with a higher index i corresponding to "centralised" Indigenous institutions and an index j corresponding to "fragmented" Indigenous institutions.[14]

[14] We follow Gennaioli and Rainer (2007) for this classification

Hypothesis 1

$$i > j \quad \Rightarrow \quad \min \left\{ r^i(\cdot) - r^j(\cdot), \frac{u_2^i(\cdot)}{u_1^i(\cdot)} - \frac{u_2^j(\cdot)}{u_1^j(\cdot)} \right\} \geq 0. \tag{4}$$

This assumption states that a "centralised" municipality can avoid more roads for all the resources invested, or is willing to give up more resources to avoid an additional road (or both). The idea is that the observed heterogeneity in road avoidance can be attributed to differences in the ability to avoid roads and preferences for avoiding roads. Note that empirically we only have data on roads avoided and not on resources invested. This leads to the following mechanisms as to why "centralised" municipalities would avoid a greater central state presence than "fragmented" municipalities.

Mechanism 1: collective action

$$i > j \quad \Rightarrow \quad r^i(x^i) \geq r^j(x^j). \tag{5}$$

The first mechanism states that a "centralised" municipality will choose to avoid a greater number of roads because it has a lower cost of avoiding roads than a "fragmented" municipality. This would mean that municipalities with "centralised" Indigenous institutions are better able to coordinate to meet their collective demands. The following proposition provides examples of utility functions (in increasing order of generality) that are consistent with the model presented above.

Mechanism 2: identity preferences

$$r^i(\cdot) = r^j(\cdot) \quad \Rightarrow \quad \frac{u_2^i(\cdot)}{u_1^i(\cdot)} > \frac{u_2^j(\cdot)}{u_1^j(\cdot)} \tag{6}$$

The second mechanism states that if "centralised" and "fragmented" municipalities have a similar cost function for avoiding roads, the marginal rate of substitution is higher for"centralised" municipalities than for "fragmented" municipalities. This implies that "centralised" municipalities receive a higher utility for an additional unit of avoided roads than "fragmented" municipalities due to stronger preferences for self-determination and the preservation of traditional traditions. Consequently, the number of avoided roads would be higher in "centralised" municipalities than "fragmented" municipalities, because "centralised" municipalities would be willing to invest more resources in avoiding roads.

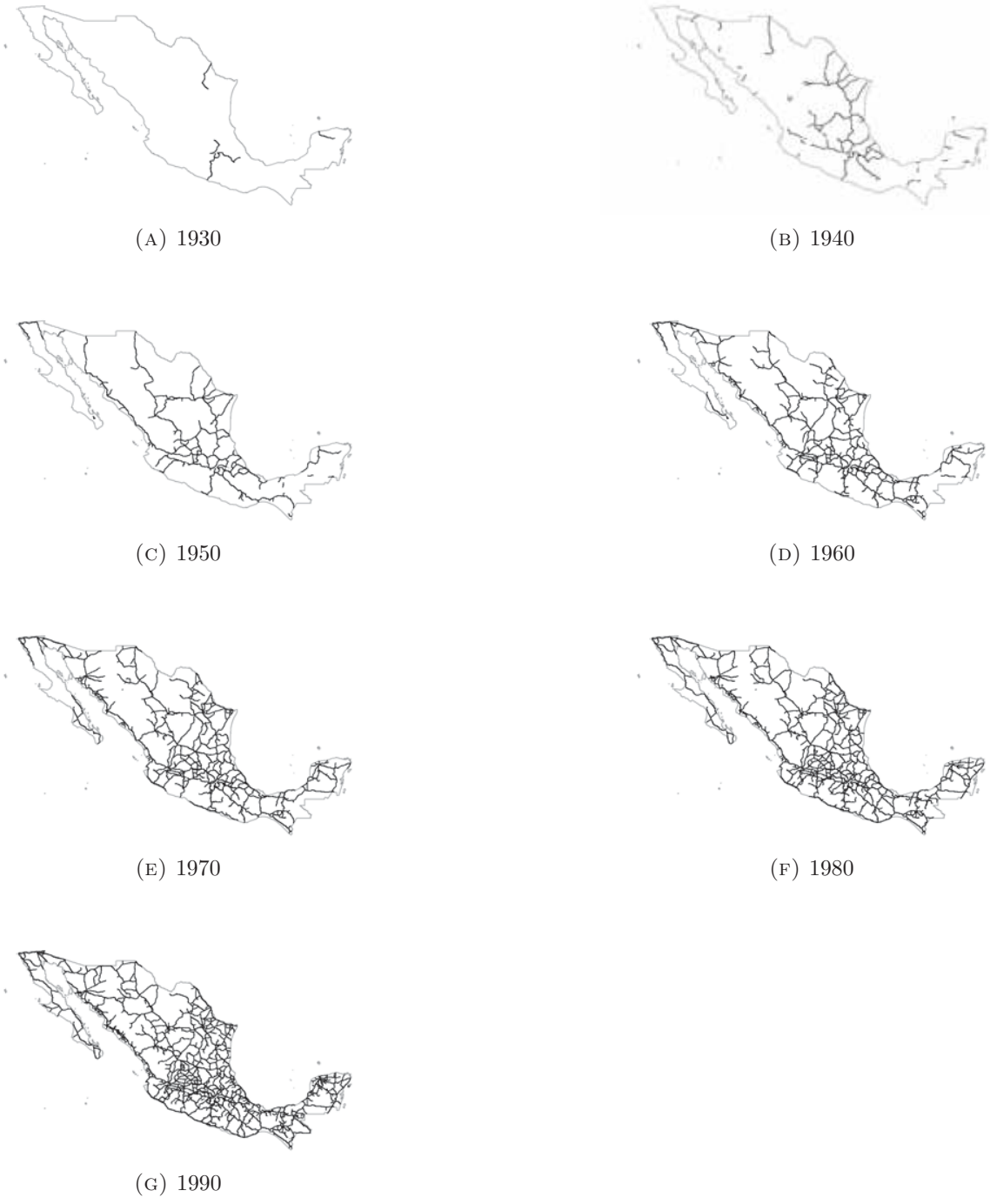
4 Data and empirical framework

4.1 Construction of outcome: expansion of road infrastructure

Our dependent variable is road share, which is defined as the proportion of the municipal area covered by a 2 km buffer along roads, following Dalgaard et al. (2018).[15] Our main period of study is the 1920s to 1950s, when roads were used as a tool for nation building. Figure 2 shows the spatial development of road infrastructure in Mexico from 1930 to 1990. It can be seen that road construction developed into a large-scale infrastructure project during the 20th century. In 1930, more than 2,000 municipalities had no road infrastructure, but by 1990 this number had halved.

We constructed our dependent variable by relying on unique collections on Mexican transport systems obtained from the Mexican Ministry of Transport. In our digital map, we geocoded the extent of road length in each decade after 1920, when roads were not built in Mexico. To our knowledge, this is the first comprehensive attempt to map the evolution of Mexico's road network over time. The online appendix contains a detailed description of how this variable was constructed.

[15] To capture the adjacent investments along the European road network, Dalgaard et al. (2018) apply a 5 km buffer instead. Since we mainly want to capture the effects of the roads themselves in our study, we reduce the buffer to 1 km on each side. Yet, as robustness checks in section 4.6.2 we apply buffers of different sizes. Figure A.9 shows an example of a road lane and the 1 km buffer along both sides.



(A) 1930 (B) 1940

(C) 1950 (D) 1960

(E) 1970 (F) 1980

(G) 1990

FIGURE 2: Road infrastructure in Mexico between 1930-1990.

Notes: This figure shows the development of road infrastructure in Mexico between 1930 and 1990. The geo-referenced maps were produced from unique collections published by the Mexican Ministry of Transport and Communications, showing the cartography of the Mexican road network since the beginning of the 20th century. The maps were georeferenced using the 2015 national road network. Sources: SCT (1988), SCT (1987) and *Instituto Nacional de Estadistica y Geografia*.

4.2 Construction of variable of interest: Indigenous institutions

We measure Indigenous institutions following the literature on long-run development.[16]. Specifically, we use the index of Indigenous institutions developed by Elizalde (2020). The author combines detailed census data on the proportion of each Indigenous group in all Mexican municipalities from the early twentieth century with anthropological information on the political complexity of Indigenous groups as contained in Murdock's Ethnographic Atlas (Murdock, 1967). From this Atlas, the variable *Jurisdictional Hierarchy Beyond the Local Community* was used. This variable classifies ethnic groups based on their different levels of political complexity in pre-colonial times. The variable ranges from 0 to 4, with 0 denoting ethnic groups that have no political authority beyond the local community (stateless societies); 1 denoting small chiefdoms; 2 denoting larger chiefdoms or small states; and finally, 3 and 4 denoting states and larger states (see the online appendix for more details on the sources and construction of this index). The resulting variable is an Indigenous population weighted average of the Murdock's variable on the political complexity of the Indigenous population for each municipality in Mexico. Formally, the index takes the following form:

$$IndInst_i = \sum \frac{IndigPop_{eit=1930}}{IndigPop_{it=1930}} \cdot \mathbf{JH}_e \tag{7}$$

In equation 7, $IndInst$ is the index of Indigenous institutions in municipality i. $IndigPop_{eit=1930}$ represents the total number of Indigenous people of ethnic group e in 1930 in municipality i. $IndigPop_{it=1930}$ represents the total number of Indigenous people from municipality i in 1930. $\mathbf{JH}_e$ is the respective degree of political complexity of ethnic group e based on Murdock's Jurisdictional Hierarchy Index. The index ranges from 0 to 2, with lower values denoting municipalities with less complex Indigenous institutions, while higher values represent the opposite. This index captures the political complexity of the Indigenous population within each municipality in Mexico up to 1930.

We use only the index created with data from the 1930 census.[17] This is because while we assume that Indigenous people remain within their historic settlements, we cannot rule out the possibility of Indigenous people moving to avoid road infrastructure. These intentional movements would bias our coefficients (in absolute terms) upwards, as the rejection of road infrastructure may not be due to how effectively Indigenous groups reject the implementation of road infrastructure, but to these movements. By using the different proportions of Indigenous groups from the last census after the Mexican Revolution, we reduce selection into the treatment by possible movements of Indigenous people in subsequent years. However, our results are robust to different forms of the index, such as using the average value between 1930 and 1960, using the index value in each period, or using the total population as the denominator of the index.

We restrict our sample to municipalities with Indigenous populations in 1930, the rationale

[16] See: Gennaioli and Rainer (2006); Gennaioli and Rainer (2007); Michalopoulos and Papaioannou (2013); Angeles and Elizalde (2017); and Elizalde (2020)

[17] We use 1930 because this is the first census with information on the ethnic composition of the different Indigenous populations.

being that we are interested in capturing the impact of institutional factors on road infrastructure development that are primarily driven by Indigenous populations. Municipalities with no Indigenous population show no value for Indigenous institutions. Figure B.3 shows the spatial distribution of municipalities with Indigenous populations (grey) and non-Indigenous populations (lightest grey) in Mexico.

Using our continuous *IndInst* index, we construct a binary indicator of pre-colonial political *centralisation*, following Dippel (2014). We label a municipality as politically *centralised* if municipality i has an *IndInst* index greater than 0, and we label a municipality as politically *fragmented* if municipality i has an *IndInst* index equal to 0.[18] Formally, our *centralisation* dummy variable has the following form:

$$centralisation_i = \begin{cases} Centralised\ if\ IndInst > 0 \\ Fragmented\ if\ IndInst = 0 \end{cases} \tag{8}$$

4.3 Construction of covariates

To rule out alternative mechanisms influencing our results, we control for the following confounding factors:[19].

Population. We control for population density, as the provision of road infrastructure (and public goods in general) may have been more costly in less densely populated regions. In addition, we control for the proportion of Indigenous population to rule out the mechanism of discriminatory policies towards municipalities with a high proportion of Indigenous population.

Geography. A large number of studies have shown that geographical endowment is an important source for the long-term development of a state (Engerman and Sokoloff, 1997; Bruhn and Gallego, 2012; Herbst, 2014). For example, Herbst (2014) argues that the complexity of African geography is a major reason for the persistent lack of state centralisation. We add a set of variables that measure some of the geographical characteristics of municipalities. These are: Latitude, longitude, altitude, land area of the municipality and a land suitability index.

Pueblos de Indios. We are interested in the impact of Indigenous institutions among the Indigenous population. However, there is evidence that the original location of Indigenous population has lasting long-term impacts (Arteaga, 2018). Therefore, we control for the original location of Indigenous people in Mexico (Tanck de Estrada, 2005).

[18] Gennaioli and Rainer (2007) were the first to empirically measure pre-colonial institutions in the context of African countries. They defined politically centralised societies as those groups with a value of 2 and above according to Murdock's Jurisdictional Hierarchy Index, while those with a value of 0 and 1 were classified as politically fragmented societies. We do not follow this classification and instead use the approach of Dippel (2014). Dippel (2014) focuses on the Native American context, specifying only Indigenous groups with a value between 0and 2 of Murdock's Jurisdictional Hierarchy Index. Since the majority of Indigenous groups in the United States report a value of zero, the Dippel (2014) study classifies as politically centralised those Indigenous groups with a value of 1 and 2 of Murdock's Jurisdictional Hierarchy Index, and those with a value of zero as politically fragmented. Since our data is more similar to Dippel (2014)'s study, we follow his approach. Nevertheless, our main specifications are subject to Gennaioli and Rainer (2007)'s classification of pre-colonial political centralisation

[19] For the detailed description and corresponding sources for all controls, see the online appendix.

TABLE 1: Descriptive Statistics

	All Municipalities			Centralised			Fragmented		
Statistic	N	Mean	St. Dev.	N	Mean	St. Dev.	N	Mean	St. Dev.
Road share	6,297	0.02	0.06	3,115	0.02	0.05	3,182	0.02	0.07
IndInst	6,297	0.39	0.55	3,115	0.78	0.56	3,182	0.00	0.00
Population	6,297	9,108	19,008	3,115	6,741	12,865	3,182	11,426	23,286
Pop Density	6,297	42.91	103.33	3,115	37.81	60.89	3,182	47.90	132.10
Indigenous pop	6,297	1,559	2,701	3,115	2,441	3,293	3,182	697	1,523
Share of Indigenous pop	6,297	0.33	0.34	3,115	0.54	0.30	3,182	0.13	0.23
Pueblos Indios	6,297	2.41	2.83	3,115	2.56	3.14	3,182	2.25	2.48
Area sq km	6,297	716	2,260	3,115	374	915.64	3,182	1,051	3,010
Soil suitability	6,297	79.87	24.64	3,115	87.43	12.23	3,182	72.47	30.73
Elevation km	6,297	1.35	0.88	3,115	1.22	0.88	3,182	1.48	0.87
Ancestral Land	6,297	0.06	0.22	3,115	0.07	0.24	3,182	0.04	0.19
Indigenous Polarization	6,285	0.31	0.39	3,115	0.56	0.37	3,182	0.06	0.20
Indigenous Fractionalisation	6,297	0.16	0.20	3,115	0.29	0.19	3,182	0.03	0.10
Fractionalisation	6,297	0.28	0.24	3,115	0.45	0.19	3,182	0.12	0.18

Notes: This table shows the descriptive statistics of the variables used for the analysis. The panel *All Municipalities* includes all municipalities used in the analysis. The panel *Centralised* includes all municipalities labelled as centralised. The panel *Fragmented* includes all municipalities that are marked as fragmented. *Centralised* municipalities are defined as those with an Indigenous institution index greater than zero, and *Fragmented* municipalities are defined as those with an Indigenous institution index equal to zero.

Ethnic diversity. There is ample evidence in the literature that the provision of public goods is associated with ethnic diversity, especially in developing countries (Alesina and La Ferrara, 2005; Miguel and Gugerty, 2005; Montalvo and Reynal-Querol, 2017). To rule out the possibility that ethnic heterogeneity within municipalities may also have influenced variation in road provision in post-revolutionary Mexico, we construct two measures of ethnic diversity according to Alesina et al. (2003) and Montalvo and Reynal-Querol (2005): ethnic fractionalisation and ethnic polarisation of the Indigenous population, respectively.[20]

Table 1 shows the descriptive statistics of our main variables and controls. The first three columns show the statistics of our full sample of municipalities. The mean road share between 1920 and 1960 is 0.02 (0.07 sd). Comparing the mean values between municipalities within the centralised and fragmented groups in the following columns, it is clear that municipalities classified as centralised have a lower road share than fragmented municipalities. Furthermore, there are significant mean differences in our set of confounding factors between these two groups of municipalities, demonstrating the importance of controlling for these confounding factors.

4.4 Empirical strategy

4.4.1 Specifications: Difference-in-Differences

To examine which types of Indigenous groups were better able to reject road infrastructure in Mexico, we use the difference-in-differences (DiD) approach embedded in equation 9:

[20] The measures were calculated for each municipality in Mexico from 1920 to 1960. Since no data are available for the period before 1930, the index for 1920 is extrapolated using the observed data for 1930

$$Road_{it} = \alpha_i + \tau_t + \delta_{s,t} + \beta(IndInst_i * postPR_t) + (X_i' * postPR_t)\gamma + Z_{it}'\rho + \epsilon_{it} \quad (9)$$

In equation 9, $Road_{it}$ is the road share in municipality i at time t. α_i, τ_t, and $\delta_{t,s}$ are municipality, time and state-by-time fixed effects, respectively. $IndInst_i$ is our index of Indigenous institutions as defined in equation 7, while $postPR$ is the treatment indicator that takes the value of 1 after the start of the first national road construction programme (1925) and 0 otherwise. The coefficient of interest is β, which captures the differential evolution of road share between municipalities with different levels of $IndInst$, before and after the start of the road programme. X_i' is a vector of time-invariant covariates: *Pueblos de Indios*,latitude, longitude, municipality area, elevation and land suitability. Z_{it}' represents a vector of time-variant covariates that includes: Population density, proportion of Indigenous population and the two indices of ethnic heterogeneity (polarisation and fractionalisation) in municipality i at time t. Note that time-invariant controls interact with the treatment indicator $postPR$. In all specifications, standard errors are clustered at the municipality level, and our sample includes only municipalities with Indigenous population in 1930.

We use a second specification in which we use the *centralisation* indicator that classifies municipalities as politically centralised or politically fragmented. Our second diff-in-diff strategy is embedded in equation 10, in which β captures the differences in road share between politically *centralised* and politically *fragmented* municipalities before and after the start of the road programme. The rest of the model resembles equation 9.

$$Road_{it} = \alpha_i + \tau_t + \delta_{t,s} + \beta(centralisation_i * postPR_t) + \Gamma(X_i' * postPR_t) + \rho Z_{it}' + \epsilon_{it} \quad (10)$$

The diff-in-diff setting allows us to mitigate potential endogeneity problems that might bias our estimator. First, one might worry that time-invariant factors such as geography or culture affect our results, as they are correlated with both the IndInst index and the road share. To counter this, we control for time-invariant confounders by adding municipality fixed effects. Second, we add time fixed effects to control for time-varying factors that affect all Mexican municipalities equally (e.g. economic shocks). Third, we could still think about time-varying factors that affect municipalities within a given state.[21] For example, the southern state of Guerrero enacted a law in the 1930s that provided for deductions from civil servants' salaries to raise revenue for road infrastructure. This law only affected municipalities within that state. To control for such shocks, we therefore include state-by-time fixed effects. Finally, we interact our various time-invariant covariates with

[21] Mexico has 32 states, which are the largest administrative units below the national level, one administrative level above the municipalities.

our treatment indicator $postPR$, to control for differences in the evolution of the road share across municipalities with different geographical levels and historical factors before and after the start of the road construction programme.

One might also worry that confounding factors that vary at the time level of municipality x are correlated with both our outcome and the main variable of interest. To address this concern, we include a series of controls for municipality x time. First, we control for population density in municipality i and time t to rule out the possibility of population distribution effects on road infrastructure provision (Herbst, 2014). Second, previous research has documented lower provision of public goods in areas with a higher proportion of Indigenous population (Montenegro and Stephens, 2006; The World Bank, 2015). We control for the proportion of Indigenous population to rule out the hypothesis that the state discriminates against municipalities with a higher proportion of Indigenous population. Finally, there is evidence in the literature that economic outcomes are associated with ethnic diversity, especially in developing countries (Alesina and La Ferrara, 2005; Miguel and Gugerty, 2005; Montalvo and Reynal-Querol, 2017).To rule out that ethnic heterogeneity also influenced road infrastructure in post-revolutionary Mexico, we construct and control for two measures of ethnic diversity according to Alesina et al. (2003); and Montalvo and Reynal-Querol (2005): ethnic fractionalisation and ethnic polarisation, respectively, in municipality i at time t.

4.4.2 Main results

Column (1) of table 2 shows a pooled OLS regression of road share on Indigenous institutions. The result shows a negative and significant correlation between Indigenous institutions and road share between 1920 and 1960. Figure B.6 illustrates the graphical representation of this correlation. The causal effect of this correlation should be interpreted with caution due to possible endogeneity problems. However, the sign of this estimator suggests that municipalities with a higher share of Indigenous institutions are correlated with lower road infrastructure, which is in line with our main hypothesis.

Columns (2) and (3) of table 2 show the results of the difference-in-differences specification from equation 9. In column (2), we control for municipality fixed effects, time fixed effects and state-by-time fixed effects. In column (3) we add our set of time-invariant and time-varying controls.

The results of columns (2) and (3) in table 2 confirm the main hypothesis of the paper. The interaction term between $IndInst_i$ and $postPR$ is negative and statistically different from zero. Furthermore, the coefficients are stable to the inclusion of our set of controls. The results suggest that after the start of the road construction programme, road infrastructure was lower in municipalities with a higher index of Indigenous institutions. The coefficient of interest is -0.014, so a one standard deviation increase in the IndInst index leads to a 0.008 decrease in road share. The effect is of non-negligible magnitude, as the average road share between 1920 and 1960 is 0.02. Therefore, in 1960, a one standard deviation increase in the IndInst index resulted in a 40% lower road share compared to the mean.

In column (4) our indicator *centralisation* is used. The result shows that in post-revolutionary Mexico, road infrastructure was significantly lower in municipalities where a larger proportion of the Indigenous population came from politically centralised societies of the pre-colonial period. This suggests that Indigenous people coming from pre-colonial societies with state characteristics (e.g. *Aztecs* or *Tarascos*) were better able to reject road infrastructure than those coming from politically *"fragmented"* societies (e.g. *Chinantec*, *Cocopa* or *Huichol*).

Our results are particularly interesting in light of the evidence provided by Gennaioli and Rainer (2007). They find that regions with pre-colonial centralised institutions are associated with better provision of public goods in Africa, including road infrastructure. Our results differ from those of this study in one important respect. We find that in regions with *centralised* Indigenous institutions, road infrastructure was lower in Mexico. Nevertheless, this need not be understood as a counter-position to the positive impact of pre-colonial institutions on economic development, but as a relevant complement to the seminal work of Gennaioli and Rainer. As these authors point out for the African case, ethnic groups in regions with a legacy of politically centralised pre-colonial states were better able to organise themselves by developing better accountability mechanisms for local leaders. In our study, we interpret our findings in a similar way: Indigenous groups with *centralised* Indigenous institutions were better able to coordinate collective action to oppose a large infrastructure project. Road infrastructure in Mexico was not seen by indigenous communities as a public "good", but rather as a public "bad" which threatened their ethnic identity and traditions (Waters, 2006; Bess, 2017).

TABLE 2: Road share and Indigenous institutions (DiD)

	Road Share			
	(1)	(2)	(3)	(4)
IndInst	−0.010***			
	(0.002)			
IndInst x postPR		−0.014***	−0.014***	
		(0.003)	(0.003)	
Centralisation x postPR				−0.011***
				(0.004)
Municipality FE		✓	✓	✓
Time FE		✓	✓	✓
State x time FE		✓	✓	✓
Time Invariant Controls			✓	✓
Time Variant Controls			✓	✓
N	6,297	6,297	6,297	6,297
R^2	0.010	0.046	0.069	0.067
Mean Road Share	0.02	0.02	0.02	0.02
SD Road Share	0.06	0.06	0.06	0.06

Notes: This table presents the estimates used to examine the impact of Indigenous institutions on road share. The dependent variable in all columns is our measure of road share. Column (1) shows the correlation between Indigenous institutions and road share. In columns (2) and (3), the independent variable is the interaction between the continuous Indigenous institutions index, IndInst, and the post-treatment variable, postPR. Column (2) contains municipality, time and state by time fixed effects. Column (3) contains all fixed effects, time-varying control variables such as population density, proportion of Indigenous population, ethnic fractionalisation and ethnic polarisation, and time-invariant control variables such as the number of *Pueblos Indios*, latitude, longitude, municipality area, altitude and land suitability. In column (4), our independent variable of interest is the interaction term between our binary dummy variable for indigenous institutions and the indicator for time after treatment, postPR. Standard errors are clustered at the municipality level (in parentheses). Statistical significance at the 99%, 95%, and 90% confidence level denoted: ***, **, and *.

4.4.3 Flexible Difference-in-Differences

In this section, we use an additional specification to test whether differential road infrastructure development was an immediate phenomenon shortly after the road programme started or whether it took a few years to become relevant. Therefore, we estimate a flexible difference-in-differences approach embedded in equation 11:

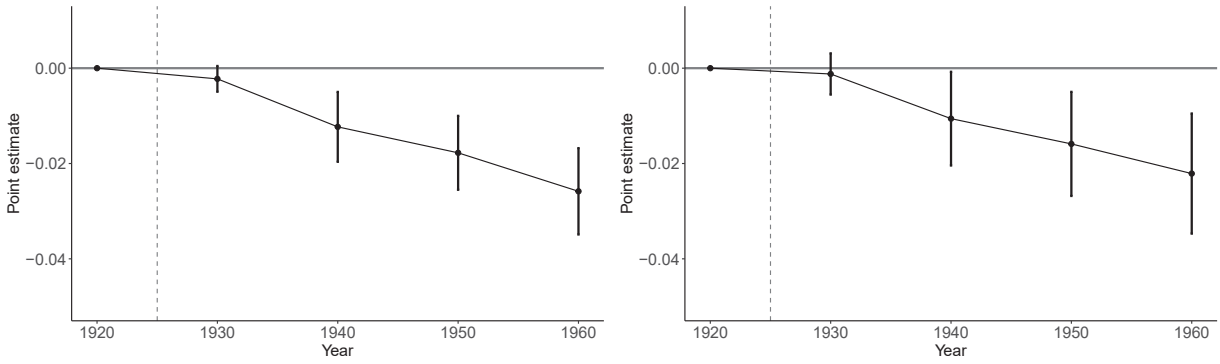
$$Road_{it} = \alpha_i + \tau_t + \delta_{t,s} + \sum_{t=1920}^{1960} \beta_t (IndInst_i * T_t) + \sum_{t=1920}^{1960} \Gamma (X_i' * T_t) + Z_{it}'\rho + \epsilon_{it} \tag{11}$$

In equation 11 we interact our treatment variable, $IndInst_i$ or $centralisation_i$, with our time indicator T_t. With this specification, we can observe whether the road share varies between different levels of Indigenous institutions or between politically fragmented and politically centralised

municipalities in each time period, and we compare this to our base year (1920). The rest of the model remains the same as in equation 9.

Figure 3 shows the coefficient of interest (β_t) of the flexible difference-in-differences approach from equation 11. The vertical line marks the year when road construction started (1925). The error bars show the 95% confidence intervals. Table 11 shows the results of this regression.

Subfigure 3a shows the coefficient for the interaction term between $IndInst_i$ and T_t. The coefficients are negative and increase in absolute value with time. These results show a negative relationship between road share and our IndInst index in each year compared to 1920. Thus, the result shows that differences in road infrastructure between municipalities with different IndInst increased in the post-revolution period, which was arguably characterised as a nation-building period. Moreover, the differential effect (in absolute terms) increases over time and is significant at least at the 5% level in 1940, 1950 and 1960, but not in 1930. Since road construction started in 1925, it may have taken some time for the investment to come to fruition, which is reflected in the zero differences from the 1930 census.[22] Similarly, most of the investment in road infrastructure was made by the state in the 1940s (see figure B.1), which would likely have been documented in the 1950 and 1960 censuses. Comparing the coefficients for 1940, 1950 and 1960, we find that they increase in absolute terms over time, indicating zero convergence in terms of road infrastructure between municipalities with different IndInst index levels.



(A) Indigenous Institutions: IndInst

(B) Fragmented vs Centralised

FIGURE 3: Flexible-DiD estimates

Notes: This figure shows the point estimates for the interaction between $IndInst_i$ and T_t for the flexible difference-in-differences embedded in equation 11. The vertical line marks 1925, the year when road construction began in Mexico. The error bars show the 95% confidence intervals. Subfigure 3a shows the coefficients using our continuous measure of Indigenous institutions. Subfigure 3b shows the coefficients for comparing the "centralised" and "fragmented" groups. All regressions control for time-varying control variables such as population density, proportion of Indigenous population, ethnic fractionalisation and ethnic polarisation; and time-invariant control variables such as number of *Pueblos Indios*, latitude, longitude, municipality area, altitude and land suitability; municipality, time and state-by-time fixed effects. The standard errors are clustered at the municipality level to construct our confidence intervals

.

[22] For example, a section of the famous Panamericana was completed in 1936 after more than a decade of planning and construction (Bess, 2017).The section of this road runs from the northern city of Nuevo Laredo in the state of Tamaulipas to Mexico City.

Subfigure 3b shows the results using our *centralisation* indicator, which also support the main hypothesis of the paper. The figure shows that in municipalities with a larger proportion of Indigenous population coming from politically centralised societies in pre-colonial times, road infrastructure during the nation-building period was significantly lower than municipalities where the majority of the Indigenous population came from a politically fragmented society.

In summary, these results show that during the nation-building period (1920sto 1950s), the state's ability to provide road infrastructure was more limited in municipalities with "centralised" Indigenous institutions. Differences in the proportion of roads between municipalities with different levels of Indigenous institutions are significantly different from zero in the 1940s and 1950s, when road infrastructure was significantly developed. Interestingly, these differences are mainly caused by municipalities with "centralised" Indigenous institutions.

4.5 Robustness checks

4.5.1 Parallel trend assumption: pre-treatment period

The validity of our identification strategy rests on the assumption that road infrastructure in municipalities with different levels of indigenous institutions would have developed in parallel in the absence of the nation-building period. In this subsection we provide evidence to support this assumption.

As mentioned in the Background section, there was no road infrastructure in Mexico until the beginning of the 20th century. Roads (or fully paved highways) did not exist until after 1925, when the first large-scale road building programme was launched by the post-revolutionary governments (Chias et al., 2010; Bess, 2016). Before roads existed, Mexico had two types of transport infrastructure: colonial roads (dirt roads) and railways (Hernán, 1994). The colonial roads consisted of a small network of bridleways that were already built during the colonial period (1521-1810). During the colonial period, these roads were essentially used to transport mineral resources - especially silver and gold - to the most important ports in Mexico at the time (e.g. Veracruz), from where they were shipped to the Spanish Empire. The colonial roads in central Mexico connected the most productive agricultural plantations with the large urban areas, while the southern colonial roads connected areas of high Indigenous population density, including some areas in Guatemala (Hernán, 1994).

During the dictatorial regime of Porfirio Diaz (1884-1911) (Bess, 2016), the railways became a symbol of national power. Under Diaz's regime, the railway network was expanded from 893 km to 19,205 km by 1920 (Coatsworth, 1979). The railways became the engine of growth for transporting raw materials and primary products produced on the large plantations in central and northern Mexico to the United States, thus promoting the economic progress of Mexico's northern and central regions (Coatsworth, 1979).

To test whether pre-revolutionary transport infrastructure correlates with our Indigenous institution index, we digitised and georeferenced i) the total length of roads built during the colonial

period and ii) the total length of railways up to 1920.[23] We calculate the share of colonial roads and railways up to 1920 at the municipality level and use the following cross-sectional specification:

$$Infrastructure_i = \alpha + \beta IndInst_i + X_i'\Gamma + Z_i'\lambda + \mu_s + \epsilon_i \tag{12}$$

$Infrastructure_i$ is either the share of colonial roads up to 1821 or the share of railways up to 1920. $IndInst_i$ is our Indigenous institutions index as defined in equation 7. In another specification, we replace $IndInst_i$ with our indicator for *centralisation*. X' represents a vector of geographical characteristics, such as altitude, latitude, longitude, land suitability, municipal area and *Pueblos de Indios*. Z' is a vector of demographic characteristics, such as population density in 1800 if we use colonial roads as the dependent variable; if we use railways as the outcome, we include population density in 1920 and the proportion of indigenous population in 1920. μ_s represents state fixed effects. We report standard errors that are robust to heteroskedasticity.

TABLE 3: Pre-revolutionary infrastructure

	Colonial road share		Railway share 1920	
	(1)	(2)	(3)	(4)
IndInst	−0.005*		−0.004	
	(0.003)		(0.003)	
centralisation		−0.001		0.0005
		(0.004)		(0.005)
State FE	✓	✓	✓	✓
Controls	✓	✓	✓	✓
N	1,166	1,166	1,147	1,147
R^2	0.070	0.068	0.269	0.268
Mean DV	0.02	0.02	0.04	0.04

Notes: This table presents the estimates used to examine the impact of Indigenous institutions and the binary variable *centralisation* on public infrastructure before the revolution. The dependent variable in columns (1) and (2) is the colonial road share. In columns (3) and (4), the dependent variable is the share of railways by 1920. All columns include state fixed effects, geographic controls such as latitude, longitude, municipal area, altitude and land suitability, and demographic controls such as the number of *Pueblos Indios*, and colonial population density. In addition, we add population density in 1920 and the proportion of indigenous population as control variables in columns (3) and (4). Robust standard errors in parentheses. Statistical significance at the 99%, 95%, and 90% confidence level denoted: ***, **, and *.

Table 3 shows the results of the cross-sectional regression in equation 12. In columns (1) and (2), we use colonial roads as the dependent variable. Columns (1)-(2) show that the share of colonial roads is statistically insignificant, especially between municipalities with different levels of

[23] Our main sources are the Mexican Ministry of Transport and the Mexican National Archives. More details on the description and sources of these variables can be found in the online appendix.

Indigenous institutions. In the following two columns (3)-(4) we use the share of railways up to 1920 as the dependent variable. The results are broadly similar to those in the previous columns. We find that the railway network in the pre-revolutionary period is not correlated with either measure of Indigenous institutions.

In light of these findings, we are confident that without the Mexican Revolution and the process of nation-building, the construction of large-scale public transport infrastructures, including roads, would have followed parallel trends between municipalities with different levels of Indigenous institutions.

4.5.2 Parallel trend assumption: post-treatment period

In this section we will take further steps to prove the assumption of parallel trend. We use the change in road infrastructure policy in the mid-1950s when the state adopted a modernisation policy vis-à-vis nation building. After the mid-1950s, the road construction programme became more diversified across the Mexican territory to meet private sector demand (Hodges and Gandy, 1983; Bess, 2017). We therefore hypothesise that after the nation-building period, road infrastructure would show parallel trends between municipalities with different Indigenous institutions, as Indigenous people would no longer see roads as a threat to their identity.

The turning point in the politics of public infrastructures is clear from the qualitative data of Hodges and Gandy (1983). They argue that while the state provided fuel oil and dams, railways and roads in the late 1950s, private companies were after the profits. Then, in the late 1980s, road infrastructure was substantially taken over by the private sector through private concessions known as Built, Operate and Transfer. Companies thus increasingly assumed responsibility for road infrastructure, from technical implementation and investment to construction and maintenance. One of the most ambitious road building programmes in the world was carried out in Mexico at the time, when some 3,600 kilometres of roads were built in just one presidential term (6 years), which was about a third of the time it took in Western Europe (Foote, 1997).

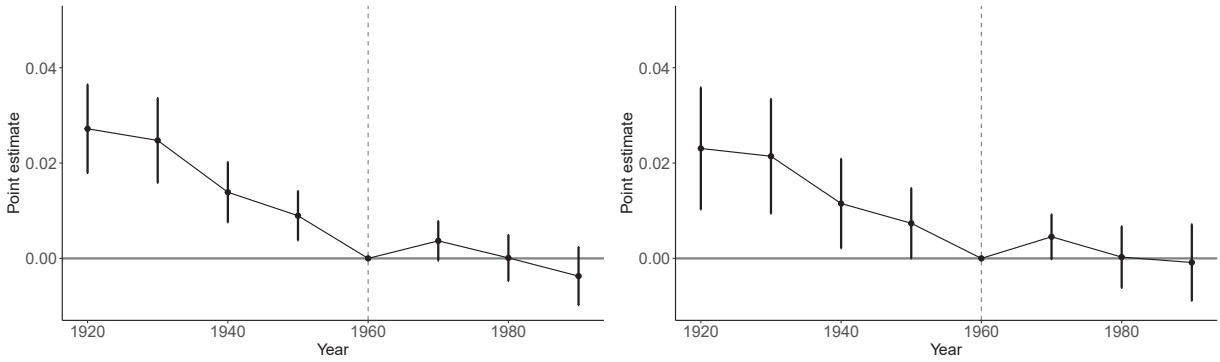
Figure 1 shows that after 1960, policies on the provision of road infrastructure changed between municipalities with different levels of Indigenous institutions. In the 1950s, the Mexican state changed its nation-building policy to one of promoting economic growth. Therefore, the 1960 census was designed to capture roads built during the last decade of the nation-building phase. Graphical inspection of figure 1 supports our hypothesis that road infrastructure followed parallel trends between centralised and fragmented municipalities, when roads were no longer used as a tool for nation building. To test this more formally, we use the following flexible diff-in-diff specification:

$$Road_{it} = \alpha_i + \tau_t + \delta_{t,s} + \sum_{t=1920}^{1990} \beta_t (IndInst_i * T_t) + \sum_{t=1920}^{1990} \Gamma (X_i' * T_t) + Z_{it}' \rho + \epsilon_{it} \qquad (13)$$

Equation 13 follows a flexible difference-in-differences approach, similar to equation 11. How-

ever, in this specification, our base period is 1960. We use 1960 as the base period because this year captures all roads built in the last decade of the nation-building process in the 1950s. In this specification, the coefficients of interest (β_t) capture the differential impact of Indigenous institutions on road share in each year compared to our base year, i.e. 1960.

Figure 4 shows the coefficient of interest of the flexible difference-in-differences approach from equation 13. The error bars indicate the 95% confidence intervals. The vertical line separates the two periods of interest: the nation-building period (1920-1960) and the subsequent period of political change (1960-1990). Figure 4 follows a similar structure as figure 3. The subfigures 4a-4b show the results using our continuous *IndInst* Index and the political *centralization* indicator, respectively. Table B.2 shows the estimates for these specifications. The results support our hypothesis by showing that after the termination of the state's nation-building policy, road development follows parallel trends between centralised and fragmented municipalities.



(A) IndInst Index

(B) Fragmented vs Centralised

FIGURE 4: Flexible-DiD estimates for parallel trend

Notes: Figure 4 shows the point estimates for the interaction between $IndInst_i$ and T_t for the flexible difference-in-differences embedded in equation 11. The vertical line marks 1960, the end of the nation-building period. The error bars show the 95% confidence intervals. Subfigure 4a shows the coefficients using our continuous measure of Indigenous institutions. Subfigure 4b shows the coefficients for comparing the "centralised" and "fragmented" groups. All regressions control for time-varying control variables, such as population density, proportion of Indigenous population, ethnic fractionalisation and ethnic polarisation; and time-invariant control variables, such as number of *Pueblos Indios*, latitude, longitude, municipality area, altitude and land suitability; municipality, time and state-by-time fixed effects. The standard errors are clustered at the municipality level to construct our confidence intervals.

4.5.3 Supply Side: discrimination

Our results show that during the nation-building period in Mexico, municipalities with more complex Indigenous institutions received less road infrastructure. We argue that the differences in road infrastructure are due to the fact that Indigenous populations were able to reject the construction of roads, especially during the nation-building period. We interpret this "rejection of public infrastructure" as a lack of demand for road infrastructure. However, one could also argue the opposite. That the state lacks interest in developing road infrastructure in regions with Indigenous populations. In this section, we perform several checks to rule out the possibility that our results

are caused by supply-side discrimination.

First, we examine whether there is a lack of road infrastructure by the state in the form of discrimination against municipalities with more Indigenous populations. We address this question by comparing the difference in road provision between municipalities with and without Indigenous populations in 1930, and with different proportions of Indigenous populations. The basic idea is that if the state discriminated against municipalities because of their high proportion of Indigenous population, we should observe a significantly lower development of roads in municipalities with Indigenous population than in municipalities without Indigenous population. Figure B.2 shows the difference in the development of road provision between municipalities with Indigenous population (dashed line) and municipalities without Indigenous population (solid line) in 1930. This figure shows that road infrastructure in municipalities with and without Indigenous population was parallel.

Second, we control for a potential supply of a road infrastructure network. To do so, we built a counterfactual road network with the same length in km as the original road network between 1920 and 1960. This counterfactual network would have been built if the Mexican state had maximised population connectivity between the state capitals and Mexico City. Figure B.5 in the appendix shows maps of the counterfactual road network between 1930 and 1960.[24]

We use the specification in equation 9 and include the counterfactual road network as a control variable. The idea behind this is that the supply side biases our main results. We would expect that our variable of interest, the Indigenous institution index, does not affect the evolution of the real road network if the supply side is a confounding variable.

Table 4 is a replication of our main results in table 2, but includes the counterfactual road network as a control variable. The estimates are smaller in (absolute) size, but still negative and statistically different from zero. These results show that after controlling for potential road infrastructure on the supply side, the demand side through the index of Indigenous institutions influenced the development of road infrastructure in Mexico between 1920 and 1960.

Last, the literature has shown that regions with ethnic higher levels of ethnic diversity have lower levels of public goods provision due to a lack of supply of public goods (Alesina et al., 2003; Alesina and La Ferrara, 2005; Montalvo and Reynal-Querol, 2005). Therefore, to mitigate potential concerns that ethnic diversity rather the indigenous institution index is driving our main results. We control for ethnic fractionalisation, ethnic polarisation and the share of Indigenous population in all our specifications to exclude other mechanisms that could potentially affect our main results.

[24] In appendix A see a description of how we built the counterfactual network.

TABLE 4: Indigenous institutions index Vs Counterfactual road network

	Road Share			
	(1)	(2)	(3)	(4)
IndInst	−0.006***			
	(0.002)			
IndInst x postPR		−0.010***	−0.010***	
		(0.003)	(0.002)	
Centralisation x postPR				−0.007**
				(0.003)
Counterfactual road network	0.308***	0.268***	0.256***	0.257***
	(0.029)	(0.034)	(0.035)	(0.035)
Municipality FE		✓	✓	✓
Time FE		✓	✓	✓
State x time FE		✓	✓	✓
Time Invariant Controls			✓	✓
Time Variant Controls			✓	✓
N	6,297	6,297	6,297	6,297
R^2	0.206	0.150	0.162	0.160
Mean Road Share	0.02	0.02	0.02	0.02
SD Road Share	0.06	0.06	0.06	0.06

Notes: This table presents the estimates used to examine the impact of Indigenous institutions on road share. The dependent variable in all columns is our measure of road share and we control in all columns for the counterfactual road network. Column (1) shows the correlation between Indigenous institutions and road share. In columns (2) and (3), the independent variable is the interaction between the continuous Indigenous institutions index, IndInst, and the post-treatment variable, postPR. Column (2) contains municipality, time and state by time fixed effects. Column (3) contains all fixed effects, time-varying control variables such as population density, proportion of Indigenous population, ethnic fractionalisation and ethnic polarisation, and time-invariant control variables such as the number of *Pueblos Indios*, latitude, longitude, municipality area, altitude and land suitability. In column (4), our independent variable of interest is the interaction term between our binary dummy variable for indigenous institutions and the indicator for time after treatment, postPR. Standard errors are clustered at the municipality level (in parentheses). Statistical significance at the 99%, 95%, and 90% confidence level denoted: ***, **, and *.

4.6 Rejection of roads: qualitative evidence

To further confirm that Indigenous people in the "centralised" municipalities rejected roads during the nation-building period (1920s to 1950s), we would need to augment our dataset with extensive historical data on Indigenous uprisings. However, to our knowledge, this data is not available. Although this analysis could have supported our findings, we do not believe that this is crucial for the main objective of this paper, which is to investigate which types of Indigenous groups rejected roads.

In any case, as we will show from the evidence of mechanisms in the next section, Indigenous groups in "centralised" municipalities tend to have better capacities for collective action that enable them to persuade the state to meet their demands. This would suggest that road development was lower in "centralised" municipalities because Indigenous groups had greater capacity to coordinate

collective action. We argue that Indigenous people demanded less road development because it was used as a nation-building tool to establish the notion of *Mexicanidad*. Road infrastructure was therefore not seen as a public "good" for Indigenous communities, but rather as a public "bad" that threatened their ethnic identity and traditions.

However, in the absence of quantitative data on Indigenous uprisings, we provide qualitative evidence of Indigenous peoples' rejection of roads. The analysis draws on disputes related to the construction of roads in Mexico between the 1930s and 1950s, when roads were used as a means of nation-building.

An example of Indigenous rejection of roads comes from Los Altos, a region of 17 municipalities in the southern state of Chiapas. In this region, policies implemented since the mid-1930s aimed at integrating the Indigenous population into the process of "Mexicanidad" met with significant resistance from Indigenous communities. Thus, through decentralised state institutions such as the National Indigenous Institute, the state promoted the assimilation of Indigenous culture into the national identity of the *Mexicanidad* through the provision of various public goods, including roads. This led to an Indigenous uprising in the late 1940s, opposing the construction of a road to connect the region to the main cities in the state of Chiapas. In the early 1950s, the Indigenous people even invaded the construction site in large numbers and threatened direct action if the construction of the road continued (Kulher, 1975). It was not until the 1960s that road construction could be resumed.

Other qualitative evidence suggests that opponents of road building were prepared to use violence to prevent road building in their communities. Bess (2017) documents the claims of a supporter of road construction from the southern state of Veracruz in the late 1920s, who expressed that "*...uneducated peasants who opposed [road construction] went so far as to take up arms. These people ... were ready to use violence in their opposition to progress*". In the 1940s, for example, the Tzotzil in a community in Chiapas opposed road construction because they believed that roads would give access to *ladinos* (of mixed Spanish and Indigenous descent), leading to a deterioration of Indigenous autonomy and a potential threat to their traditions (Waters, 2006).

Opposition manifested itself in clear forms of organisational capacity. Harvey (1998) documented anecdotal evidence from the southern state of Chiapas, where Indigenous communities stopped the construction of a road in the Lancandon region. This construction was intended to demarcate several communities from this region. The organisation made several trips to the affected communities to inform them about the road construction. This led to the mobilisation of hundreds of people who even took on the army. As the movement grew rapidly, negotiations soon took place with the government, which was only able to carry out the technical studies for the construction of the road.

4.6.1 Validating hypothesis: bureaucrats

In this section we develop an alternative analysis to further validate the main hypothesis of the paper. An important argument of our hypothesis is that Indigenous people may be more inclined

to reject the provision of large-scale infrastructure projects if the state appears to use such projects as a tool for nation-building. This would mean that in the post-revolutionary period, Indigenous people did not see roads as a public good that could bring economic progress to their communities, but rather as a public "bad" that threatened their identity and traditions. Thus, if our hypothesis is correct, we would expect not only a reduced provision of road infrastructure in post-revolutionary Mexico, but also a limited state presence in politically centralised municipalities as a whole.

To explore this question, we examine whether the development of the new state after the Mexican Revolution differed between politically centralised and politically fragmented municipalities. In doing so, we draw on recent work by Garfias (2018) and Acemoglu et al. (2015), which use bureaucrats as proxies for state capacity in Mexico and Colombia, respectively.

We therefore collect data on bureaucrats per thousand inhabitants for each municipality in Mexico between 1900-1940, taken from Garfias (2018). Figure B.8 illustrates the unconditional mean of bureaucrats per 1000 inhabitants in 1900, 1930 and 1940 between politically centralised (solid line) and politically fragmented (dashed line) municipalities. We find that the number of bureaucrats around 1900 is greater in fragmented municipalities than in centralised municipalities, suggesting that prior to the Mexican Revolution, in municipalities with Indigenous populations originating from politically centralised societies of the pre-colonial period, Indigenous populations were better able to keep the pre-revolutionary state out of their communities. Moreover, the graph shows that the increase in bureaucrats is significantly greater in fragmented municipalities than in centralised municipalities. Thus, from this graphic inspection, it is clear that the presence of the state in these two groups of municipalities differed greatly during the nation-building process, implying that the new state was able to make greater inroads in the politically fragmented municipalities.

To formally examine the above patterns of state presence, in table B.3 we repeat our basic specification from table 2, but use bureaucrats per 1000 inhabitants as the dependent variable. The results from table B.3 support our main hypothesis of this paper. During the nation-building process, state presence, as a proxy for bureaucrats, was significantly lower in municipalities where Indigenous institutions are more centralised.

4.6.2 Specification

In this section we show that our results are robust to different specifications. First, we use alternative forms of $IndInst_i$. Table B.4 shows the results. In column (1), we use the total population instead of the total Indigenous population in the denominator of the equation 7. In column (2) we use the average $IndInst_i$ between 1930 and 1960. In column (3) we use the time-varying form of our index. The results show that the coefficients (in absolute terms) are slightly larger than our baseline models in column (3) in table 2, indicating a potential upward movement of the Indigenous population, as described in section 4.

Second, in table B.5 we show that our results are robust to different forms of our dependent variable. In column (1), we use road density instead of road share. To calculate road density, we divide the length of roads in km by the total km^2 in each municipality. In columns (2) and (3) we

use road shares with buffers of 10 km^2 and 500 m respectively. Our main results are not challenged in any way. We are therefore confident that the results are robust to our arbitrary decision to choose a buffer of 2 km^2.

Finally, we check whether outliers affect our main results. To do this, we first remove all observations that have a road share greater than 0.4. As figure B.4 shows, our result is heavily skewed to the left. We then transform our dependent variable using its inverse hyperbolic sine form (ihs). The advantage of using the ihs transformation instead of logs is that we can keep the zeros in the data. As table B.6 shows, our results are robust to these two transformations of our main result, suggesting that outliers do not affect our main estimates.

5 Mechanisms

Our main findings show that Indigenous peoples coming from politically centralised societies of the pre-colonial period were better able to reject road infrastructure in Mexico after the Mexican Revolution. In the following subsections, we propose two possible mechanisms to explain our findings. As highlighted in section 3, mechanism (I) assumes that because of the legacy of pre-colonial centralised institutions, better capacities for collective action were developed in municipalities with "centralised" Indigenous institutions. Therefore, Indigenous peoples in politically centralised municipalities coordinate more effectively to get the state to meet their collective demands than in municipalities with "fragmented" Indigenous institutions. The mechanism (II) states that in municipalities with "centralised" Indigenous institutions, Indigenous peoples derive higher benefits from avoiding roads than in municipalities with "fragmented" Indigenous institutions. Therefore, a municipality with "centralised" Indigenous institutions would have a higher preference for maintaining its Indigenous identity and consequently a lower preference for removing its Indigenous identity.

5.1 Mechanism (I): collective action

In this section we provide evidence that supports mechanism (I). To do so, we follow Elizalde (2020) and use the redistribution of ancestral land carried out after the Mexican Revolution.

Between 1917 and 1992, the Mexican state implemented an extensive land restitution policy. In the early twentieth century, a significant proportion of the Indigenous population was dispossessed of their ancestral lands. One of the main features of the Mexican Revolution at the beginning of the twentieth century was therefore the restitution of Indigenous land. The post-revolutionary governments therefore enforced a reform of land ownership with Article 27 of the Mexican Constitution of 1917. In a period of about 75 years, the state was able to redistribute 16 million hectares of ancestral land to the Indigenous population.

However, the redistribution of ancestral lands was not a simple process and required sustained collective organisation of the Indigenous population. The process of restitution of ancestral lands not only proved administratively cumbersome, but also posed a major challenge, especially in the demarcation of ancestral territories, which was crucial to the extent of land to be transferred

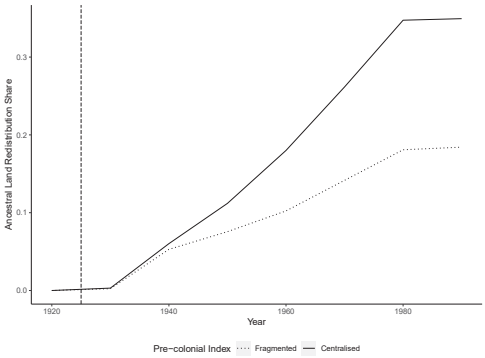
(Harvey, 1998). Powerful landowners in rural Mexico opposed such policies, for example by making the demarcation work a lengthy process (Harvey, 1998). Faced with these constraints, Indigenous people had to resort to a wide range of collective methods to make their demands more successful: from land occupations to barricades to organising short-term guerrillas and developing grassroots events to make their demands heard by the state (Elizalde, 2020).

Figure 5a shows the evolution of redistribution of ancestral land in politically "centralised" and politically "fragmented" municipalities between 1920 and 1990.[25] Figure 5a highlights several important observations. First, redistribution of ancestral land occurred in both groups of municipalities throughout the reform. Second, ancestral land was redistributed more in municipalities with "centralised" Indigenous institutions than in politically "fragmented" municipalities. These trends show that Indigenous people in municipalities with "centralised" Indigenous institutions were better able to coordinate collective action to achieve (or reject) the provision of collective goods believed to be of greater (or lesser) interest to their own communities.

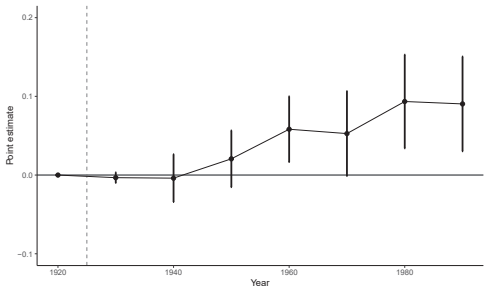
To formally investigate whether there are differences in ancestral land redistribution conditioned by the level of Indigenous institutions, we follow Elizalde (2020). We estimate a flexible difference-in-differences approach similar to the equation 11. However, in this specification, the dependent variable is *Ancestral Land*, which measures the cumulative share of ancestral land redistributed in municipality i at time t.

Figure 5b shows the estimates when comparing the different evolution of redistribution of ancestral land between municipalities with "fragmented" and "centralised" Indigenous institutions. Consistent with Elizalde (2020), the estimates show that municipalities with "centralised" Indigenous institutions receive a larger share of ancestral land over time than politically "fragmented" municipalities. This evidence supports mechanism (I).

[25] Our measure of ancestral land is the ratio of total km^2 redistributed ancestral land in municipality i per total km^2 area of municipality i



(A) Ancestral land redistribution



(B) Ancestral land Redistribution: centralised vs fragmented

FIGURE 5: Mechanism: collective action

Notes: Subfigure 5a shows the evolution of redistribution of ancestral land between the two groups of municipalities with different levels of Indigenous institutions. The "centralised" group (solid line) includes municipalities with an index of Indigenous institutions above 0. The "fragmented" group (dashed line) includes municipalities with an index of Indigenous institutions equal to 0. Subfigure 5b shows the coefficients comparing redistribution of ancestral land between the groups: "fragmented" vs. "centralised'" following Elizalde (2020).

5.2 Mechanism (I): evidence from surveys

In this section, we provide further evidence for mechanism (I) by using contemporary survey data to show that centralised Indigenous groups have a higher propensity for cultural attitudes towards collective action.

We collect individual-level data on collective action preferences from the Latin American Public Opinion Project (LAPOP). As far as we know, this is the only survey that collects information on individuals' ethnicity and preferences for participating in collective action. If our results are due to mechanism (I), individuals with "centralised" indigenous institutions would have a higher preference for collective action than individuals with "fragmented" Indigenous institutions. For the question *In the last 12 months, have you participated in a demonstration or protest march?* , the proportion of people with "centralised" Indigenous institutions answering *yes* should be higher than for people with "fragmented" Indigenous institutions.

We use the survey waves for 2010, 2012 and 2014, where information on Indigenous ethnicity was only collected by LAPOP. Ideally, we would like to use a dataset for the years of our analysis (1920-1960); however, to the best of our knowledge, this information/ dataset does not exist. We are therefore aware that these individual preferences may be the result of years of state indoctrination; the results of this section should therefore be interpreted with caution.

In the survey we find eight different Indigenous groups: Aztecs, Zapotecs, Mixtecs, Mayas and Others. We match each Indigenous group with data from Murdock (1967) and classify them according to their respective degree of pre-colonial political centralisation. Following Dippel (2014), we classify as politically "centralised" those individuals who described themselves as part of an ethnic group with values 1 (petty chiefdoms) and 2 (larger chiefdoms) of Murdock's *Jurisdictional*

Hierarchy beyond the Local Community variable. Those who self-report belonging to an ethnic group in category zero of Murdock's index (stateless societies) are classified by us as politically "fragmented". Therefore, Aztecs, Zapotecs, Mixtecs and Mayas are classified as politically "centralised", while all Indigenous people who described themselves as "other" Indigenous are classified as politically "fragmented".[26] We are then able to compare preferences for collective action between individuals with "fragmented" and "centralised" Indigenous institutions.

It is worth pointing out other disadvantages of the data. We first acknowledge that there may be selection in terms of "being Indigenous", as only people who described themselves as Indigenous stated their ethnic group. In addition, only 138 people reported their ethnicity; therefore, with such a small sample, we could not run a regression analysis as this may have resulted in poorly estimated coefficients with very large standard errors. In view of these shortcomings, we could only perform a mean comparison of the questions we selected.

From the LAPOP surveys, we select five different questions that denote individual commitment to collective action. Table B.8 shows the questions selected for this analysis. The questions are: Q1: (*Prot3*) Have you participated in a demonstration or protest march in the last 12 months? Q2: (*cp5**) In the last 2 weeks, have you tried to help solve a problem in your community or neighbourhood? Q3: (*E5*) Of people taking part in legal demonstrations. How much do you approve or disapprove of this? Q4: (*E14*) Of people seizing private property or land to protest. How much do you approve or disapprove of this? Q5: (*E15*) People taking part in road blockades to protest. How much do you approve or disapprove?.[27]. Note that questions Q1 and Q2 are yes/no questions. Therefore, the mean shows the proportion of people who answered *yes*, broken down by ethnic group. Questions Q3, Q4 and Q5, on the other hand, asked people how much they agreed or disagreed on a scale of 1 to 10. Therefore, the mean value shows how much an ethnic group agrees or disagrees with the respective statement.

Figure B.9 shows the mean and 95% level confidence interval (error bars) of responses for each question by ethnic group, while Table B.9 presents the comparison of means more formally. The results show that individuals who come from politically centralised societies in pre-colonial times are 3.8 and 9.9 percentage points more likely to answer *yes* than people who come from politically fragmented societies in terms of their preferences for participation in demonstrations and community support. Similarly, mean comparisons show that politically centralised individuals have a higher preference for participating in legal demonstrations, seizing private property or land and blocking roads as a form of protest than individuals with a heritage of politically fragmented societies.

This section, taking into account the above drawbacks, provides evidence that individuals with centralised Indigenous institutions are more likely to engage in collective actions than individuals with fragmented Indigenous institutions, which explains why centralised individuals were more

[26] The political complexity of the Zapotecs and Mixtecs was recorded in Murdock's atlas as being integrated into the Mexican state. These Indigenous groups were among the most politically centralised societies before colonisation. A detailed description of our variables can be found in the appendix A.

[27] In brackets we give the original names of the selected questions from LAPOP

likely to reject roads in post-revolutionary Mexico.

5.3 Mechanism (II): identity

In this section we provide evidence that supports the mechanism (II). This mechanism states that individuals with "centralised" indigenous institutions have a higher utility for preserving their identity and therefore have a higher interest in rejecting road infrastructure than individuals with "fragmented" Indigenous institutions.

To prove the mechanism (II), we collect data on individual attitudes towards ethnic identity from the "National Survey on Discrimination" in Mexico (ENADIS, Spanish acronym). This survey was only conducted in 2005 and 2010. As mentioned above, the use of current survey data should be treated with caution due to possible bias in individuals' responses.

We consider the "Ethnicity module" from the 2010 survey, where we find about 500 respondents who self-report their Indigenous identity and answer our selected questions. Therefore, we construct our indicator on "centralisation" as in section 5.2.[28] We select three questions that ask about different aspects of attitudes towards individual ethnic identity and create three indicators as follows. From question *mi3*: "How proud are you of your tradition and heritage?" we create the variable $proud_i$ which takes the value 1 if the respondent answered "A lot", and 0 if the respondent answered "a little" or "nothing". From question *mi2*: "Do you keep some of the customs or traditions of your ancestors?" the variable $custom_i$ is formed, which takes the value 1 if the respondent answered "yes" or "yes, partly" and 0 if the respondent answered "no". Finally, from question *mi4*: "Do you feel...", we create the variable $feel_i$, which takes the value 1 if the respondent answered feeling "...more [*ethnicity i*] than Mexican" or "...as [*ethnicity i*] as Mexican", and 0 if the respondent answered "...more Mexican than [*ethnicity i*]".

Using all three questions, we estimate the impact of belonging to a politically centralised ethnic group compared to a politically fragmented ethnic group on respondents' attitudes towards their Indigenous identity. For this purpose, we use an individual-level cross-sectional regression. In all regressions, we control for demographic characteristics such as age, age^2, and gender. In addition, we include municipality fixed effects to account only for individual differences within the municipality. In all our regressions, standard errors are clustered at the municipality level to correct for possible autocorrelation of respondents within the same municipality.

Table B.10 in the appendix shows the results. Column (1) shows that individuals who descend from politically centralised societies in pre-colonial times are more proud of their Indigenous customs and traditions. Individuals descending from "centralised" societies are 10.6 percentage points more likely to say they are proud of their Indigenous tradition and heritage than individuals descending from "fragmented" societies. These results are noteworthy. With 88% of respondents stating that they are proud of their traditions and heritage, this means that (almost) all "centralised" people are proud of their Indigenous traditions and heritage.

[28] ENADIS reported a slightly larger list of Indigenous groups than LAPOP.

Column (2) of table B.10 shows that "centralised" respondents are 16.7 percentage points more likely to preserve their customs and traditions than "fragmented" respondents. Column (3) shows that "centralised" respondents are 10.3 percentage points more likely to feel that their national identity is Indigenous (or as much as Mexican) than "fragmented" respondents.

This section provided survey evidence for mechanism (II). We found that individuals with centralised Indigenous institutions are more proud of their Indigenous identity, more likely to preserve their customs and traditions, and more likely to identify as Indigenous, than individuals with fragmented Indigenous institutions. If identity attitudes are passed on over time and individuals receive better preferences from their ancestors, this would mean that "centralised" individuals would have lower preferences for maintaining road infrastructure, as these roads were arguably used as a tool to create a national sense of *Mexicanidad*. As a result, Indigenous people would have resisted the construction of large-scale infrastructure projects in their communities, especially at a time when roads were a symbol of the adoption of a new national identity.

6 On the economic consequences of road infrastructure

Numerous studies show that transport infrastructure is an important determinant of economic development.[29] In this section, we provide evidence on the economic consequences of differential road infrastructure development in Mexico. To this end, we regress the road share in 1960 on a variety of present-day economic outcomes using the following specification:

$$Y_i = \alpha + \beta Road_{i,1960} + X_i'\Gamma + Z_i'\lambda + \mu_s + \epsilon_i \tag{14}$$

In equation 14, our dependent variable Y_i, is our measure of current economic outcomes in municipality i. We consider four outcomes: the proportion of the population with access to electricity at home in 1990, the proportion of the population with access to a sewage system at home in 1990, the literacy rate in 1990, and the satellite light density at night in 2010.

Our main explanatory variable is $Road_{i,1960}$ which measures the total proportion of roads in municipality i in 1960, when the nation-building period was arguably over. X_i' represents a set of control variables that are time-invariant, such as. the municipality's land area, altitude, land suitability, latitude, longitude and number of *Pueblos de Indios*. Z_i' represents socio-economic variables in 1990, such as population density and the proportion of Indigenous population in municipality i. μ_s represents state fixed effects to account only for variation withinthe state. Note that all variables are measured at the municipality level and we use robust standard errors in all specifications.

Table 5 shows that road infrastructure up to 1960 is positively correlated with better economic outcomes today. The results show that a higher road share in 1960 is strongly correlated with

[29] See: Lipscomb et al. (2013); Hornung (2015); Baum-Snow et al. (2017); Donaldson (2018);

better access to electricity, a sewage system and higher literacy rates in 1990, as well as with night-time satellite lighting density in 2010. Our main findings in section 4.4 show that Indigenous people in municipalities with centralised Indigenous institutions were more likely to reject the implementation of road infrastructure during the nation-building period, leading to worse economic outcomes today. We interpret these findings not against the evidence of the positive impact of pre-colonial institutions on economic outcomes, but as a complementary finding regarding the ability of politically centralised groups to influence policy at the local level.

These findings have important political implications. Indigenous peoples around the world have resisted major infrastructure projects.[30] The impact of large-scale infrastructure projects on the rights of Indigenous peoples is indeed significant. Nevertheless, such projects are important sources of economic growth in the long term.[31] Our results show that in areas where road infrastructure has been less successful, economic outcomes are worse today. We find that an important predictor of road infrastructure development in post-revolutionary Mexico was the legacy of political complexity among Indigenous groups. More recently, these pre-existing institutions have been shown to persist in many parts of the world, particularly in developing countries.[32] Thus, by understanding which types of Indigenous groups are better able to reject large-scale infrastructure projects, governments and developers could design their negotiation strategies to benefit both sides in the implementation of these projects.

[30] See UN Human Rights Council reports A/HRC/39/17/Add.2 for Mexico; A/HRC/39/17/Add.3 for Guatemala; A/HRC/33/42/Add.2 for Honduras; A/HRC/36/46/Add.1 for the United States.

[31] See: Lipscomb et al. (2013); Hornung (2015); Baum-Snow et al. (2017); Donaldson (2018)

[32] textcitegennaioli2007modern; Michalopoulos and Papaioannou (2013); Michalopoulos and Papaioannou (2014); Bandyopadhyay and Green (2016); Angeles and Elizalde (2017); Elizalde (2020); Heldring (2020).

TABLE 5: Correlation between present outcomes and road share by 1960

	Electricity 1990	Drainage 1990	Literacy rate 1990	lnlight density 2010
	(1)	(2)	(3)	(4)
Road share 1960	0.451***	0.495***	0.230***	2.089***
	(0.040)	(0.067)	(0.022)	(0.144)
State FE	✓	✓	✓	✓
Socio Controls	✓	✓	✓	✓
Geo Controls	✓	✓	✓	✓
N	2,085	2,070	2,086	2,085
R^2	0.365	0.514	0.645	0.514

Notes: This table shows the estimates of the cross-sectional regressions embedded in equation 14. In columns (1)-(4) we use the road share up to 1960 as independent variables. Column (1) uses the share of the population with access to electricity in 1990 as the dependent variable. In column (2), the dependent variable is the share of population with access to sewerage in 1990. In column (3), the dependent variable is literacy rate in 1990. Finally, in column (4), we use nighttime satellite light density in 2010 as the dependent variable. All specifications include state fixed effects as well as demographic and geographic controls. Robust standard errors are in parentheses. Statistical significance at the 99%, 95%, and 90% confidence level denoted: ***, **, and *.

7 Conclusion

This paper presents evidence that the low provision of public goods can be partly explained by the lack of demand from Indigenous groups with high preference for Indigenous identity and high coordination capacity. Using the first large-scale road construction programme in post-revolutionary Mexico at the beginning of the 20th century, we show that Indigenous people who descend from politically centralised societies in pre-colonial times were more able to resist the construction of road infrastructure in their municipality.

We find large differences in road infrastructure between municipalities with different levels of Indigenous institutions, before and after the start of the road construction programme. We confirm our identification strategy by showing that pre-revolution public infrastructure does not differ between politically centralised and politically fragmented municipalities: Colonial roads and the railway network up to 1920 do not correlate with our measures of Indigenous institutions. Similarly, we show that after post-revolutionary governments stopped using roads as a means to create a national sense of *Mexicanidad* in the mid-1950s, road development follows parallel trends between politically centralised and politically fragmented municipalities.

We then address two potential mechanisms that explain our results: collective action and higher preferences for preserving Indigenous identity. We test the first mechanism using data from a major ancestral land redistribution reform from the early 20th century. Due to strong resistance from powerful landowners and cumbersome administrative procedures, the success of land restitution

required sustained collective organisation of Indigenous people. Consistent with Elizalde (2020), we show that in municipalities where indigenous people descended from politically centralised societies of the pre-colonial period, a better distribution of ancestral land was achieved. We test the second mechanism by using contemporary survey data on individuals' preferences regarding their Indigenous identity. We show that individuals descended from politically centralised pre-colonial ethnic groups are more proud of their Indigenous customs and traditions, more likely to preserve their Indigenous culture and traditions, and more likely to identify as Indigenous.

Finally, we document the economic consequences of road infrastructure. We show that the rejection of road infrastructure resulted in unintended negative consequences for economic outcomes. In municipalities where road infrastructure was lower, economic outcomes are worse today. These results have important policy implications. Qualitative evidence suggests that Indigenous people are not against large-scale infrastructure projects *per se* but in the imposition of "development" models that undermine their Indigenous identity and traditions within their communities. Understanding which types of Indigenous groups are better able to reject large-scale infrastructure projects may ensure better forms of project implementation, thus facilitating successful projects that are essential for economic growth.

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Online Appendix

A Main dataset: description of variables

Road share. Our dependent variable was created based on unique collections on the Mexican transport system from the National Library of the Mexican Ministry of Transport. Specifically, we used the following publications: "Volúmenes de tránsito local de 1987. Red carretera troncal. República Mexicana" (SCT, 1987); and "El Transporte en México. Pasado, presente, futuro." (SCT, 1988). These collections contain a series of images depicting the development of the road network in Mexico since the early 20th century, allowing us for the first time to chart its changes over time. Although detailed geospatial data is available on transport systems in Mexico, to our knowledge there has been a lack of comprehensive mapping of the development of the road network. We have achieved this as follows.

The main objective was to signpost each road section at 10-year intervals on a georeferenced base map. This was a very laborious approach which enabled us to increase accuracy. Although the maps from the above publications were produced by transport experts, their drawings were not developed using geographic information systems (GIS). Therefore, digitising the roads would not have accurately represented the exact geographical length and location of all roads built during our study period.

For the signage of the individual road sections in each period, we relied on the visual location and information about the individual road sections contained in the maps. This was possible because all the nodes connecting road sections were usually marked on the images. Since the nodes were labelled with the place names, we were able to accurately label the road sections on the georeferenced base map. Figure A.6 shows the nodes and corresponding place names for some road sections built in 1930 (in red) and 1940 (in orange) in northeastern Mexico. While the images on the left refer to the maps extracted from the above publications, the image on the right shows how these road sections were subsequently drawn into the georeferenced base map. Our georeferenced base map was the 2015 National Road Network (NRN), which consists of a series of shapefiles containing detailed geospatial data on all the different elements of Mexico's infrastructure and transport system, including roads. We used the shapefile for the 2015 NRN as this was the most recent version at the time of data processing. The shapefile for our georeferenced base map can be accessed online via the following link: here.

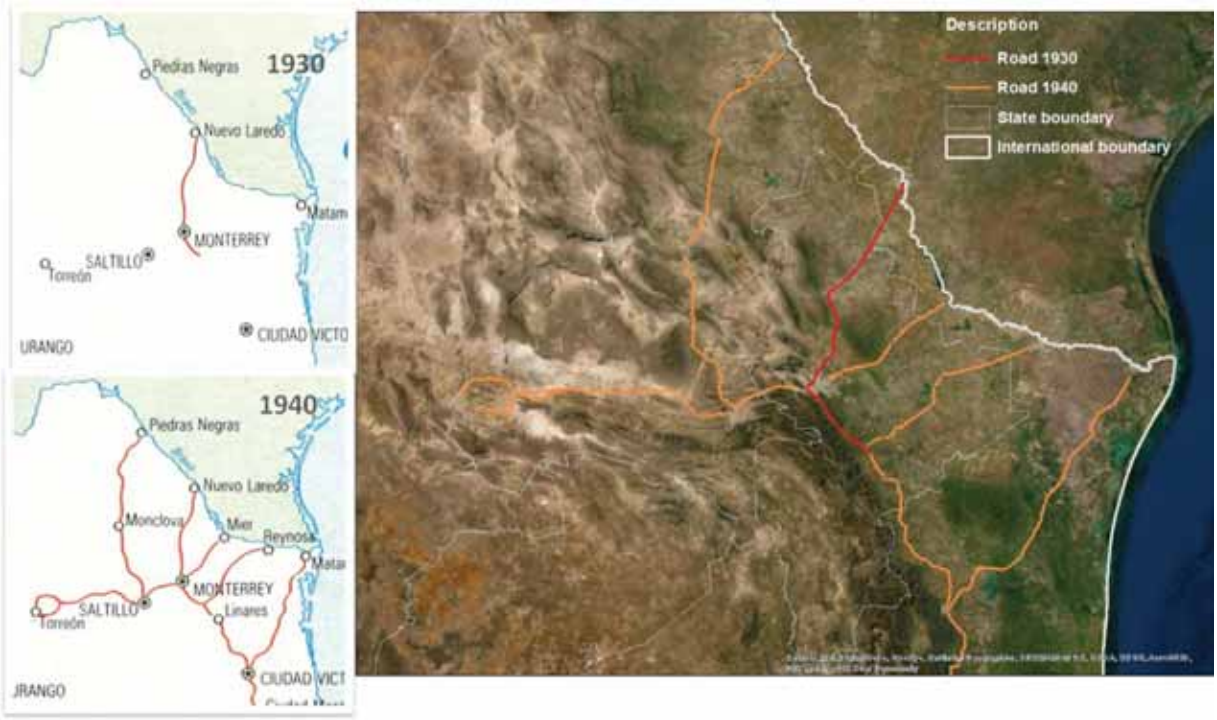


FIGURE A.6: Example of the cartography of roads and georeferenced map in Mexico by 1930 and 1940.

Notes: This figure shows an example of the cartography of roads in Mexico in 1930 and 1940. The maps show the nodes and corresponding names of the localities for some of the road sections that were built in 1930 (in red) and 1940 (in orange) in northeastern Mexico. The two images on the left relate to the cartography prepared as reported in SCT (1988). The image on the right shows how road sections were signposted into the 2015's National Road Network (NRN). Source: SCT (1988) and *Instituto Nacional de Estadistica y Geografia*.

We labelled the road sections manually, individually and per period. We started with the map showing all road sections built until 1930, as shown in figure A.7. Using the visual position and information of the nodes from this map, we were able to draw them into our georeferenced base map. This was done by simply generating an additional attribute for the time period, in this case 1930, into the shapefile of the base map itself. Observations that were not signposted between the printed maps and our georeferenced base map were omitted, so that this shapefile contained all road sections (or more precisely polylines) built up to 1930. We used the same strategy for the remaining periods. In the end, we obtained a number of different shapefiles, each containing the specific universe of roads built in each time period. Figure A.8 shows all the maps used for our main period of analysis (1920-1960) and the corresponding signage results in the georeferenced base map.[A.33] We then simply merged all the road sections into a single master shapefile that contains all the relevant geospatial data, including - and this is important - the period in which they were built.

[A.33] Please note that there is no map for 1920, as no paved roads (or highways) were built by the state in Mexico in 1920.



FIGURE A.7: Cartography or roads in Mexico by 1930

Notes: This figure shows the cartography of roads that were built by 1930. The red lines represent the roads, while some of the white dots denote the nodes connected to the road system. The star symbols depicts the capitals of the federal states. Source: SCT (1988) and *Instituto Nacional de Estadistica y Geografia*.

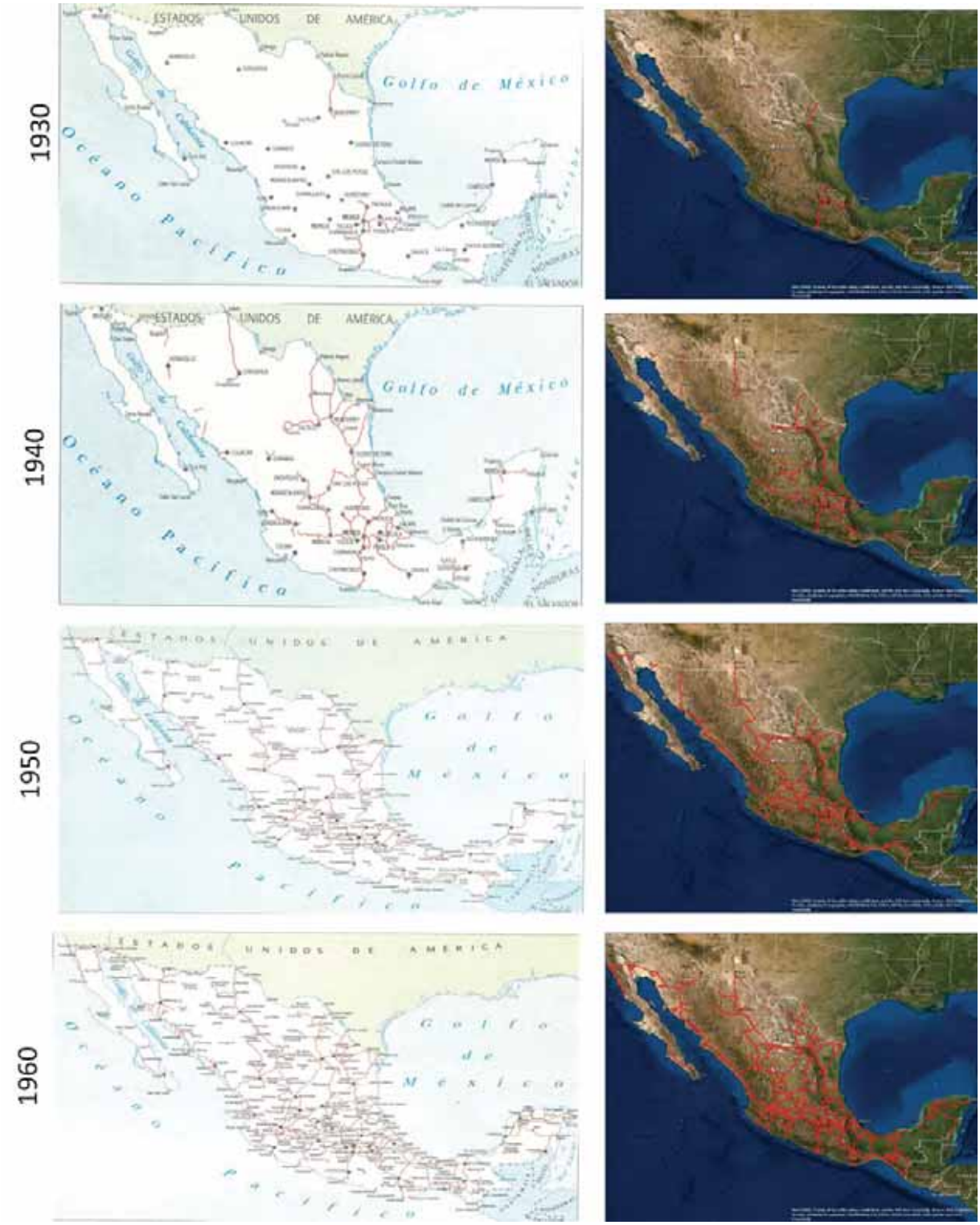


FIGURE A.8: Road network expansion in Mexico between 1930-1960

Notes: This figure shows the development of the road network in Mexico between 1930 and 1960. The images on the left show the cartography of roads as reported in SCT (1988). The images on the right illustrate the georeferenced map using the 2015's National Road Network (NRN). Source: SCT (1988) and *Instituto Nacional de Estadistica y Geografia*.

Finally, to obtain our main dependent variable, road share, we followed Dalgaard et al. (2018) and calculated buffers of 1 km along each side of the roads using ArcGIS. Then, using ArcGIS, we simply calculated the area fraction of the buffers within each municipality. Figure A.9 shows a graphical example of how the road share variable is calculated. The figure shows a Mexican municipality crossed by a road (orange line) and the corresponding 2 km buffer.



FIGURE A.9: Buffer 2km^2

Notes: The figure shows a Mexican municipality that is crossed by a road (orange line), we calculated a 2km buffer along the road. To calculate the road share we compute the share of the area of the municipality that is covered by the 2km buffer. We use this procedure to calculate our dependent variable for each road in each Mexican municipality from 1920 to 1990.

Indigenous institutions index. We follow Elizalde (2020) to create an index of indigenous institutions. The index combines anthropological data on the political complexity of Indigenous populations with census data on the different proportions of Indigenous groups in Mexico. To this end, he digitised and collected detailed census data on the proportions of Indigenous groups over the total population by Indigenous language at the municipality level since the 1930 census. The anthropological data came from Murdock's Ethnographic Atlas (Murdock, 1967). In particular, the variable Jurisdictional Hierarchy Beyond the Local Community (v32) was used, which breaks down ethnic groups according to their respective levels of political complexity. The variable varies between 0 and 4, where 0 denotes ethnic groups that have no political authority beyond the local community (stateless societies); 1 represents small chiefdoms; 2 denotes larger chiefdoms or small states; and finally, 3 and 4 represent states and larger states.

In using Murdock's data, the first step was to match the groups between the anthropological and census data. According to the published version of the Atlas (Murdock, 1967), 19 ethnic groups had some information on v32, using the censuses from 1930 to 1960. It is important to note that a total of 15 groups gave an exact level of jurisdiction hierarchy. 3 groups were instead classified by Murdock himself as part of the Mexican or Guatemalan state when referring to their respective level of the jurisdictional hierarchy without giving a specific value. These groups are: Mam (Guatemalan

state), Mixtec (Mexican state) and Zapotec (Mexican state). Similarly, another group (Mazatec) has been identified as a "mutual" group without specifying a precise jurisdictional hierarchy level: Chinantec-Mazatec. The jurisdictional hierarchy levels for these groups were then supplemented with ethnographic sources, particularly for Mixtecs, Zapotecs and Mams. In particular, it was documented that the Mixtecs and Zapotecs were organised into large kingdoms before contact with the Europeans, while the Mams belonged to a group that had characteristics of a small chiefdom (Adams and Macleod, 2000). The Mixtecs and Zapotecs were therefore assigned a level two jurisdiction hierarchy and the Mams level one. The Mazatecs were simply given the same jurisdictional hierarchy level (zero) as their corresponding "mutual" group (Chinantec).

Finally, groups reported in the census data but not found in the Murdock Atlas were classified as "Other". The total populations belonging to these groups were assigned a jurisdiction hierarchy level of zero. This strategy was used because all major groups that were categorised (Aztec, Tarasco, Totonac, Mixe and Maya) or partially categorised (Mixtec, Zapotec and Mams) could be found between Murdock's Atlas and the census data.

Our preferred form of the index is based on Murdock's categorisation of the political complexity of the Indigenous groups as given in column 1 of the table A.6. Nevertheless, following Angeles and Elizalde (2017) and Elizalde (2020) in table B.7, we tested the robustness of our results by applying a more conservative categorisation to the groups reported in Panel B of table A.6 that Murdock classified as part of the Mexican or Guatemalan state. Specifically, we downgraded the Mixtecs, Zapotecs and Mams one level in their jurisdictional hierarchy. Thus, the Mixtecs and Zapotecs were downgraded from level two (larger chiefdoms or smaller states) to level one (small chiefdoms), while the Mams were downgraded from level one (small chiefdoms) to level zero (stateless societies) (see categorisation in column 2 of the table A.6). Second, these three groups were assigned the average level of the jurisdictional hierarchy from the 15 groups in Panel A of table A.6, which have a full categorisation based on Murdock's Atlas (see categorisation in column 3 of table A.6). Finally, we excluded the entire population corresponding to the Indigenous groups categorised as 'other' and whose category was assigned level zero in the jurisdictional hierarchy. We excluded this population because their groups were not found in Murdock's Atlas and in the census data.

Table B.7 shows the results using the conservative approach in Murdock's classification to the jurisdictional hierarchy, as given in table A.6. Column (1) shows the results using $IndInst$, with the groups with a partial classification downgraded by one level in their jurisdiction hierarchy as described above. Column (2) shows the results using the Indigenous Institutions measure, where the same groups with a partial categorisation were assigned to the average level of the jurisdictional hierarchy of the 15 groups that reported a full categorisation (see Panel A of table A.6). Finally, column (3) shows the results using $IndInst$ excluding the Indigenous population corresponding to the groups classified as "other". The results in table B.7 show that our baseline specifications are robust to these different categorisations.

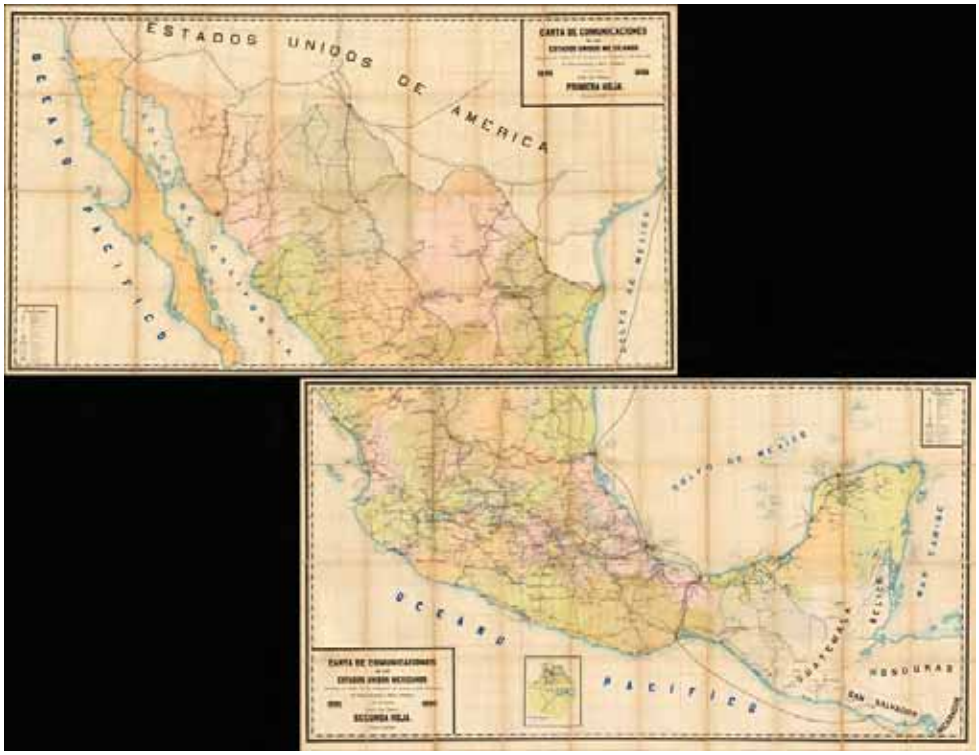
Railways. To construct a variable on railways, we used a similar strategy to that used to construct our main dependent variable. We therefore signposted the railways using the publications

TABLE A.6: Categorisation for Jurisdictional Hierarchy by Indigenous groups

Indigenous group	(1)	(2)	(3)
Panel A: Complete categorisation on Jurisdictional Hierarchy			
Aztec	Level two	Level two	Level two
Chichimeca	Level zero	Level zero	Level zero
Chinantec	Level zero	Level zero	Level zero
Cocopa	Level zero	Level zero	Level zero
Huichol	Level zero	Level zero	Level zero
Mixe	Level one	Level one	Level one
Papago	Level zero	Level zero	Level zero
Pima	Level zero	Level zero	Level zero
Popoluca	Level zero	Level zero	Level zero
Seri	Level zero	Level zero	Level zero
Tarahumara	Level zero	Level zero	Level zero
Tarasco	Level two	Level two	Level two
Totonac	Level one	Level one	Level one
Yaqui	Level zero	Level zero	Level zero
Maya	Level one	Level one	Level one
Panel B: Partial categorisation on Jurisdictional Hierarchy			
Mam	Level one	Level zero	Average level
Mazatec	Level zero	Level zero	Level zero
Mixtec	Level two	Level one	Average level
Zapotec	Level two	Level one	Average level

Notes: This table shows all the Indigenous groups with some Jurisdictional Hierarchy information (v32), as reported by Murdock's Atlas (Murdock, 1967). Column (1) provides the categorisation that was used to compute IndInst. Columns (2)-(3) show the categorisation applied for the groups in which partial information on Jurisdictional Hierarchy was provided by Murdock's Atlas. Specifically, in column (2), Mam, Mixtec and Zapotec were downgraded to one level in their Jurisdictional Hierarchy, whereas in column (3), these same 3 groups were assigned the average Jurisdictional Hierarchy from the groups in Panel A that reported a complete categorisation.

SCT (1988) and "Carta de Comunicaciones de 1895-1896 (Von Glümer, 1896), which together contain maps showing the entire extension of the railways until 1920 (see figures A.10a and A.10b). For our georeferenced base map we used another source, which comes from the National Statistics Office INEGI: "Conjunto de datos vectoriales de la serie topográfica".



(A) Railways in Mexico in the 1890s



(B) Railways in Mexico by 1911

FIGURE A.10: Cartography of the railway network in Mexico by the 1910s
A.9

Notes: Subfigure A.10a shows the cartography of the railway network in Mexico by 1895-96, while subfigure A.10b shows the map of the network by 1911. Sources: SCT (1988) and Von Glümer (1896)

Colonial roads. Unlike today's roads and railways, colonial roads were digitised. For this purpose, the map originally created by Alexandre Von Humboldt and published by Arrowsmith in 1810 (see Figure A.11) was used, which originated from the National Archives of Mexico (Arrowsmith, 1810). The georeferencing of the roads was done by drawing polylines across the intersections of all the places the roads crossed.



FIGURE A.11: Cartography of colonial roads in Mexico

Notes: This figure shows the main towns and roads of Mexico during the colonial period. Specifically, the map shows the main roads before the Mexican Independence in 1810. Colonial roads are represented in thin dark continuous lines. Source: Arrowsmith (1810)

Counterfactual road network (supply-side control). We have constructed a counterfactual road network. We assume that a social planner would be interested in connecting pairs of cities that are already economically active or have the potential to become active. To determine where these cities (urban settlements) are in relation to the road network, we use the road map for 2021 and the 1960 urban system or urban settlements with more than 15,000 inhabitants. In

our counterfactual simulation, we assume the actual total length of roads built in 1960. In that year, 44,982 kilometres were built. However, we know that there are many potential bilateral links between urban settlements in that period. By using the current road network, we take advantage of the possibility that social planners would have connected these urban settlements via alternative routes based on an optimisation function, in our case minimising the distance between two points.

For this, we use the 136 urban settlements with more than 15,000 inhabitants that existed in Mexico. This information comes from the Housing-Urban section of the Historical Statistics of Mexico (Estadísticas Históricas de México), published by the National Statistics Office of Mexico (INEGI, 2015). It contains the names of the localities (cities) and the state and divides them into five categories according to the size of the settlement: i) 15,000 and 50,000 inhabitants, ii) 50,000-100,000 inhabitants, iii) 100,000-250,000 inhabitants, iv) 250,000-500,000 inhabitants and v) more than 500,000 inhabitants. In the last category, there are only three cities: Guadalajara, Monterrey and Mexico City. The latter is the only city with more than 1 million inhabitants this year.

We georeferenced the urban settlements using the Catálogo Único de Claves de Áreas Geoestadísticas Estatales, Municipales y Localidades provided by INEGI to identify each of the 136 urban settlements, which we matched with the "Localidades urbanas" shapefile that georeferenced each point in our list and processed the shapefile using the category described earlier.

The street mapping and optimisation of the connections were done with QGIS and the API openrouteservice. The API openrouteservice uses user-generated and collaboratively collected free geographic data directly from OpenStreetMap. In the case of Mexico, this information is consistent with the Mexican road network for 2021, the same source used to determine the development of roads per decade by INEGI (2015). We confirm this by contrasting the two layers in QGIS.

The wayfinding service openrouteservice covers the entire globe and allows you to calculate routes and all kinds of navigation information. It offers a wide range of travel options for different modes of transport. You can choose between car, different types of bicycle, walking, wheelchair and heavy vehicle. For each of these modes of transport, a carefully compiled road network is used that meets the requirements of the profile in question. We restrict our analysis to paved roads and determine the optimal connections between two points based on the route that minimises the distance between them. Using efficiency criteria, we rank the paved roads according to the population size of each urban settlement. This means that the cities with greater market access, greater population and greater distance between them. Joining the 136 points gives a network of 42,888 kilometres. We divided the remaining 2,094 kilometres by ranking the towns based on their population size. The end points of the city pairs connecting all potential road sections were connected solely on the basis of an efficiency criterion of population size and shortest distance. Priority is also given to a direct connection between two nodes. Figure B.5 shows the counterfactual road network between 1930 and 1960.

Ancestral land (%).Ancestral land is the total ancestral land redistributed divided by the land area of municipalities between 1930 and 1990. Source: *Padron e Historial de Nucleos Agrarios* (PHINA), *Registro Agrario Nacional* (RAN).

Population density was calculated by dividing the total population at each period by the municipality land area in square km. Source: *Instituto Nacional de Estadistica y Geografia*

Share of Indigenous population.The share of Indigenous population measures the percentage of the Indigenous population with respect to the total population at each period. Source: *Instituto Nacional de Estadistica y Geografia*

Latitude. Absolute latitude for each municipality. Source: Elizalde (2020).

Elevation. Average elevation (km) for each municipality. Source: Elizalde (2020)

Municipalitiy area. Total surface land area (sq. km.) for each municipality.Source: Elizalde (2020).

Suitability.Index measuring land suitability in each municipality. The index takes values between 0 and 1, capturing the probability of the land area that is served for cultivation. Higher values denote better. Source: Elizalde (2020)

Pueblos de Indios. Total number of Pueblos within each municipality as reported in Atlas Ilustrado de los Pueblos de Indios. Source: *Atlas Ilustrado de los Pueblos de Indios* (Tanck de Estrada, 2005).

Ethnolinguistic fractionalisation. The index measures the probability that two randomly selected persons from a given municipality do not belong to the same ethnolinguistic group, according to Alesina et al. (2003). Two different indices were created. One index considered all Indigenous groups and the non-Indigenous group, and the other considered only Indigenous groups. Source: *Instituto Nacional de Estadistica y Geografia*

Polarisation index. This index measures how widely individuals in a population are distributed among different ethnic groups, following Montalvo and Reynal-Querol (2005). The index predicts the prevalence of inter-group disputes. Source: *Instituto Nacional de Estadistica y Geografia*

B Figures and tables in the appendix

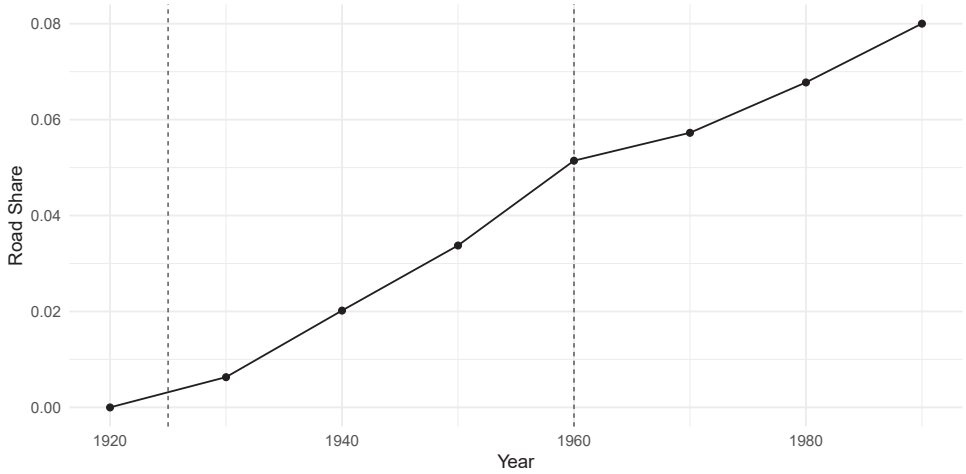


FIGURE B.1: Road share in Mexico, 1920-1990

Notes: This figure shows road share evolution between 1920 and 1990

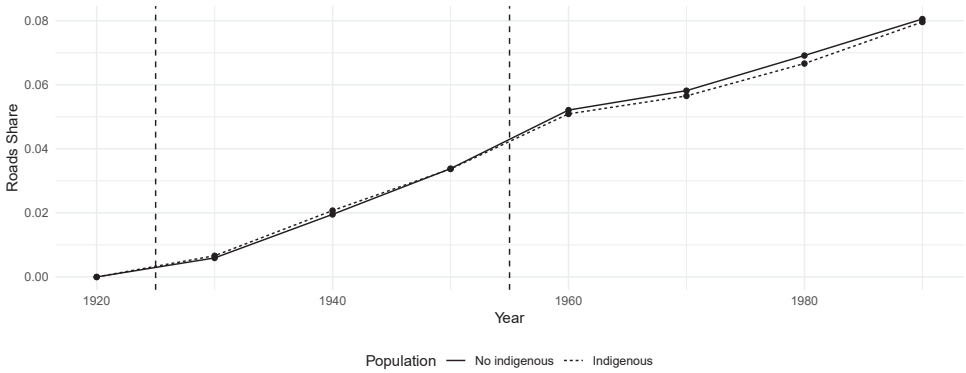


FIGURE B.2: Road share: Indigenous vs Non-Indigenous

Notes: This figure shows the development of road share from 1920 to 1990 in municipalities with Indigenous and non-Indigenous population in 1930.



FIGURE B.3: Spatial distribution of Indigenous Institutions Index

Notes: This figure shows the spatial distribution of our $IndInst$ index in Mexico. Darker colors represent a higher Indigenous institution index at the municipality level.

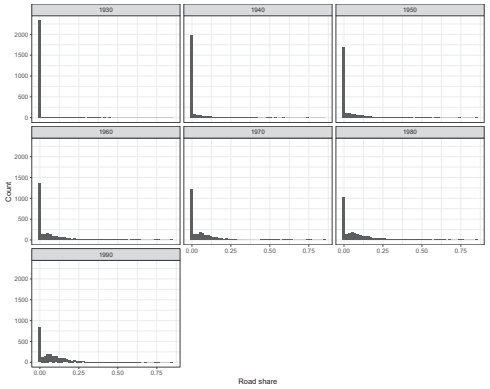
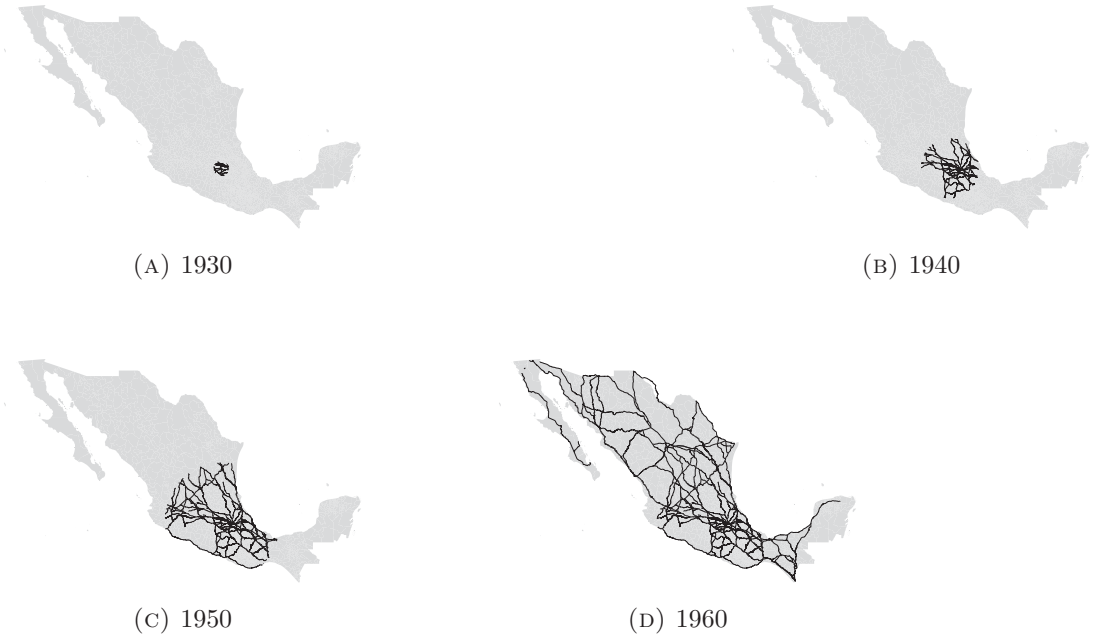


FIGURE B.4: Histogram on road share by year

Notes: This figure shows the histogram of road share in each time period from 1920 to 1990



(A) 1930 (B) 1940

(C) 1950 (D) 1960

FIGURE B.5: Counterfactual Road infrastructure in Mexico between 1930-1960.

Notes: This figure shows the development of counterfactual road infrastructure in Mexico between 1930 and 1960.

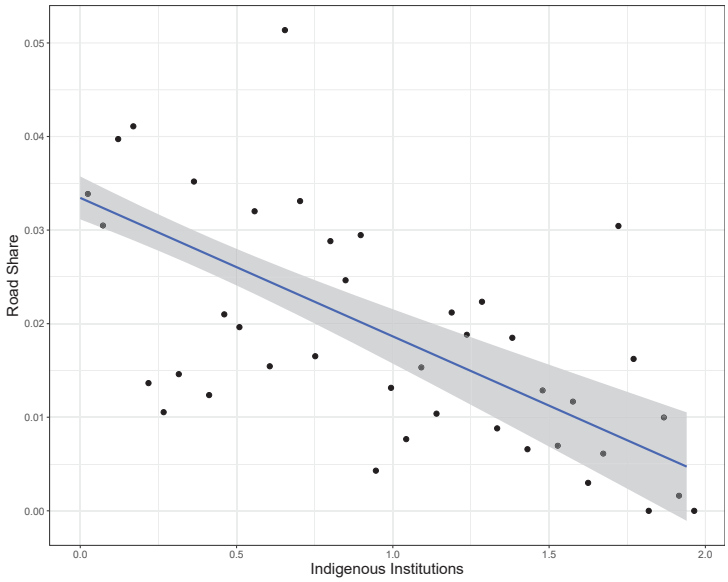


FIGURE B.6: Road Share and Indigenous institutions

Notes: This figure shows the correlation between Indigenous institutions and road share during the nation-building process in Mexico (1920-1960).

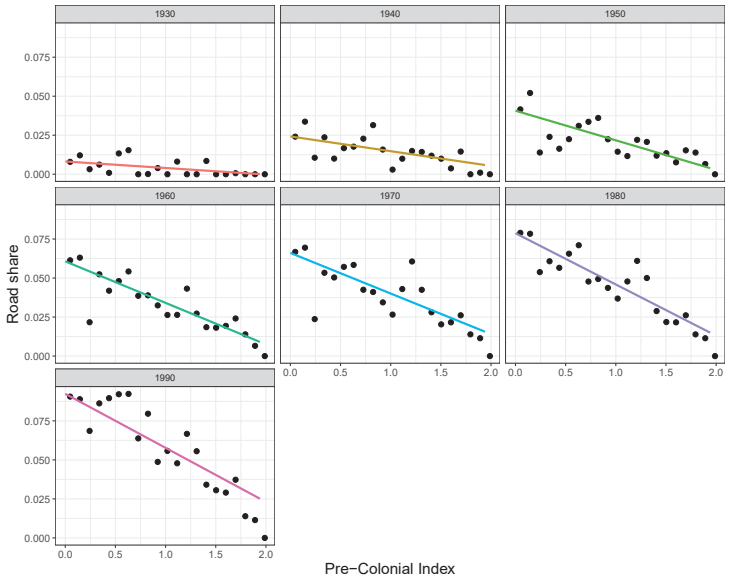


FIGURE B.7: Road Share and Indigenous institutions by year

Notes: This figure shows the correlation between Indigenous Institutions and road share by year from 1920 to 1990.

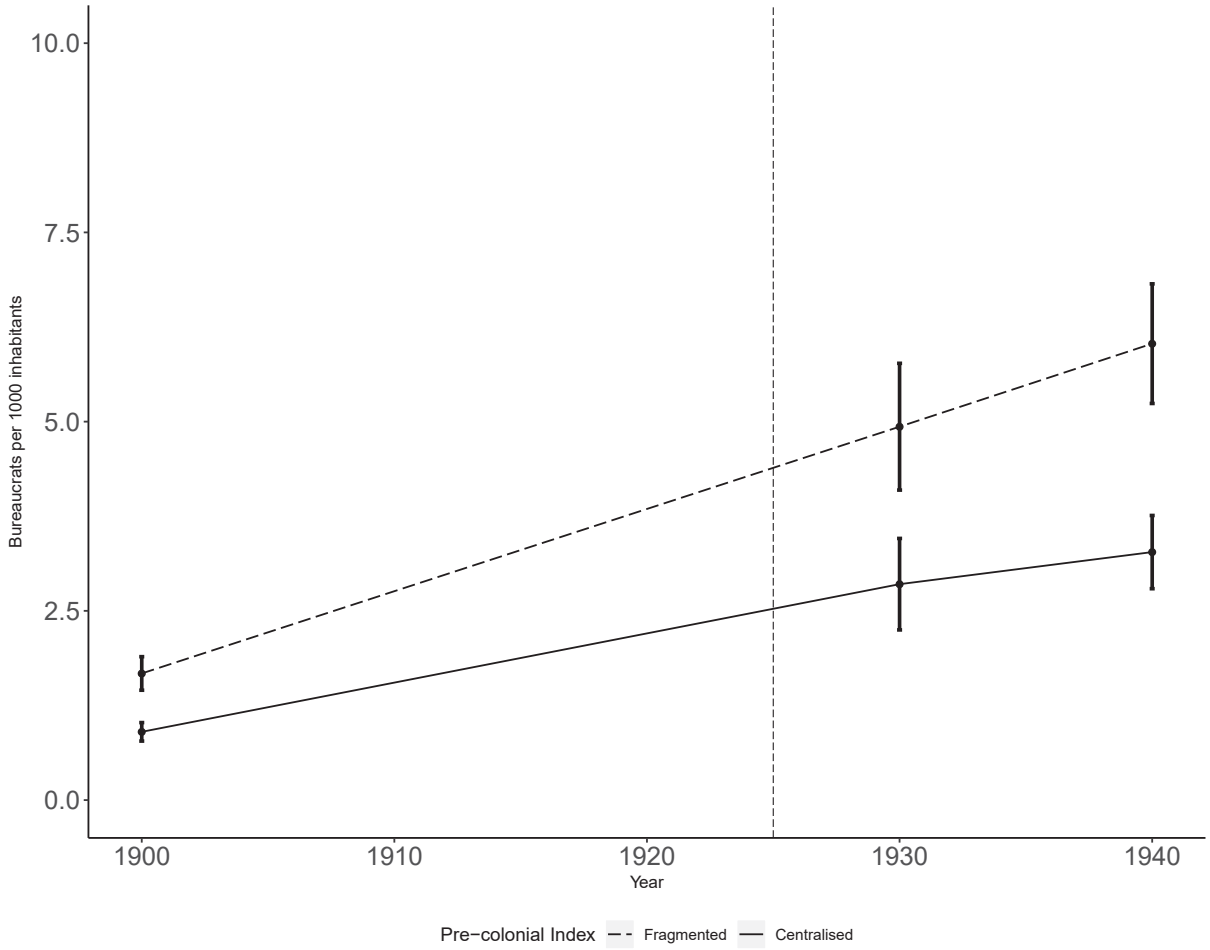
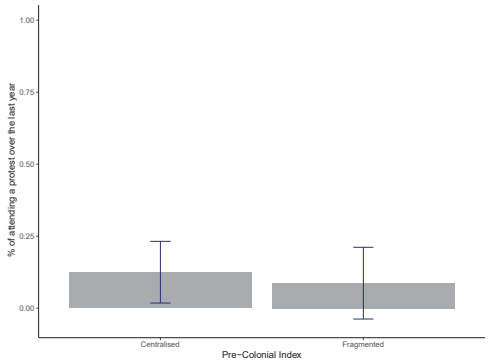
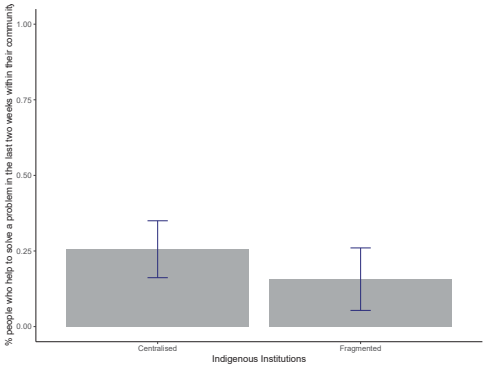


FIGURE B.8: Bureaucrats per 1000 inhabitants: fragmented vs centralised

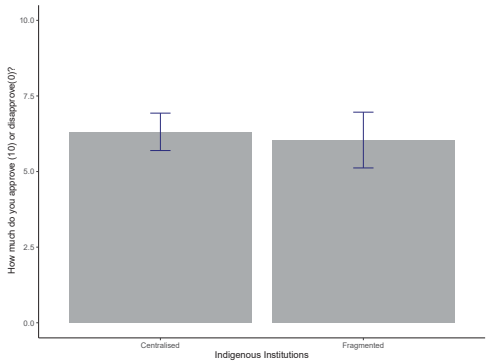
Notes: This figure shows the unconditional mean of bureaucrats per thousand inhabitants (from:Garfias, 2018) in politically centralised and politically fragmented municipalities from 1990 until 1940. The error bars show the confidence intervals at the 95% level.



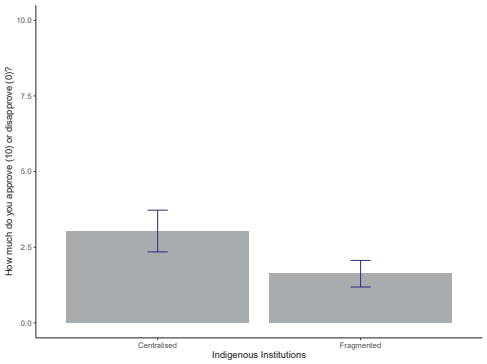
(A) In the last 12 months, have you participated in a demonstration or protest march?



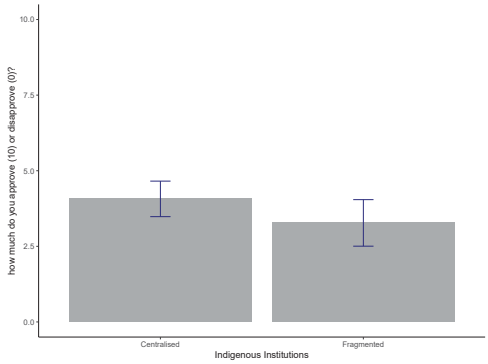
(B) In the last 2 weeks have you tried to help to solve a problem in your community or your neighbourhood?



(C) Of people participating in legal demonstrations. How much do you approve or disapprove?



(D) Of people participating in an organization or group to try to solve community problems. How much do you approve or disapprove?



(E) Of people seizing private property or land in order to protest. How much do you approve or disapprove?

FIGURE B.9: Survey evidence: collective action

Notes: These figures show the mean comparison between centralised and fragmented individuals regarding their attitudes towards collective action. The bars show the mean with the 95% confidence intervals. Subfigure B.9a shows the answer to question Q1: (*Prot3*) In the last 12 months, have you participated in a demonstration or protest march?. Subfigure B.9b shows the answer to question Q2: (*cp5**) In the last 2 weeks have you tried to help to solve a problem in your community or your neighbourhood?. Subfigure B.9c shows the answer to question Q3: (*E5*) Of people participating in legal demonstrations. How much do you approve or disapprove?. Subfigure B.9d shows the answer to question Q4: (*E14*) Of people seizing private property or land in order to protest. How much do you approve or disapprove?. Subfigure B.9e shows the answer to question Q5: (*E15*) Of people participating in the blocking of roads to protest. Using the same scale, how much do you approve or disapprove?. Questions Q1 and Q2 are Yes/No questions. Therefore, the mean shows the share of individuals who answered *yes*, by ethnic group. Whereas questions Q3, Q4, and Q5 asked individuals how much they disapprove or approve in a scale from 1 to 10. Hence, the mean shows how much an ethnic group agrees or disagrees with each statement. Survey data corresponds to waves 2010, 2012, 2014 drawn from the Latin American Public Opinion Project (LAPOP).

TABLE B.1: Flexible DiD

	Road Share	
	(1)	(2)
IndInst x 1930	−0.002	
	(0.001)	
IndInst x 1940	−0.012***	
	(0.004)	
IndInst x 1950	−0.018***	
	(0.004)	
IndInst x 1960	−0.026***	
	(0.005)	
Centralisation x 1930		−0.001
		(0.002)
Centralisation x 1940		−0.011**
		(0.005)
Centralisation x 1950		−0.016***
		(0.006)
Centralisation x 1960		−0.022***
		(0.006)
Municipality FE	✓	✓
Time FE	✓	✓
State x time FE	✓	✓
Time Invariant Controls	✓	✓
Time Variant Controls	✓	✓
N	6,297	6,297
R^2	0.083	0.076

Notes: This table shows the coefficients of the flexible difference-in-differences approach embedded in equation 11. Further, the table shows the coefficients plotted in figure 3. The dependent variable is road share. In column (1), we use a continuous measure of Indigenous institutions. In column (2), we use our binary dummy discrete variable on Indigenous institutions: *centralisation*. All regressions include time-variant control variables, such as population density, share of Indigenous population, ethnic fractionalisation and ethnic polarisation; and time-invariant control variables, such as the number of *Pueblos Indios*, latitude, longitude, municipality area, elevation, and soil suitability; and municipality, time and state-by-time fixed effects. Standard errors are clustered at the municipality level are in parentheses. Statistical significance at the 99%, 95%, and 90% confidence level denoted: ***, **, and *.

TABLE B.2: Parallel trend: pre-treatment period

	Road Share	
	(1)	(2)
IndInst x 1920	0.027***	
	(0.005)	
IndInst x 1930	0.025***	
	(0.005)	
IndInst x 1940	0.014***	
	(0.003)	
IndInst x 1950	0.009***	
	(0.003)	
IndInst x 1970	0.004*	
	(0.002)	
IndInst x 1980	0.0001	
	(0.002)	
IndInst x 1990	−0.004	
	(0.003)	
Centralisation x 1920		0.023***
		(0.007)
Centralisation x 1930		0.021***
		(0.006)
Centralisation x 1940		0.012**
		(0.005)
Centralisation x 1950		0.007**
		(0.004)
Centralisation x 1970		0.005*
		(0.002)
Centralisation x 1980		0.0003
		(0.003)
Centralisation x 1990		−0.001
		(0.004)
Municipality FE	✓	✓
Time FE	✓	✓
State x time FE	✓	✓
Time Invariant Controls	✓	✓
Time Variant Controls	✓	✓
N	10,258	10,258
R^2	0.082	0.076

Notes: This table shows the coefficients of the flexible difference-in-differences approach embedded in equation 13. Further, the table shows the coefficients plotted in figure 4. The dependent variable is road share. In column (1), we use a continuous measure of Indigenous institutions. In column (2), we use our binary dummy discrete variable on Indigenous institutions: *centralisation*. All regressions include time-variant control variables, such as population density, share of Indigenous population, ethnic fractionalisation and ethnic polarisation; time-invariant control variables, such as the number of *Pueblos Indios*, latitude, longitude, municipality area, elevation, and soil suitability; and municipality, time and state-by-time fixed effects. Standard errors are clustered at the municipality level are in parentheses. Statistical significance at the 99%, 95%, and 90% confidence level denoted: ***, **, and *.

TABLE B.3: Bureaucrats and Indigenous institutions (DiD)

	Bureaucrats per 1000 inhabitants			
	(1)	(2)	(3)	(4)
IndInst	−2.147***			
	(0.224)			
IndInst x postPR		−0.986***	−1.437***	
		(0.324)	(0.357)	
Centralisation x postPR				−1.342***
				(0.465)
Municipality FE		✓	✓	✓
Time FE		✓	✓	✓
State x time FE		✓	✓	✓
Time Invariant Controls			✓	✓
N	2,758	2,758	2,758	2,758
R^2	0.020	0.124	0.142	0.141

Notes: This table presents the estimates examining the effects of Indigenous institutions on Bureaucrats per 1000 inhabitants from Garfias (2018). Column (1) shows the correlation between Indigenous institutions and Bureaucrats per 1000 inhabitants. In columns (2) and (3) the independent variable is the interaction between the continuous Indigenous institutions index and the post treatment variable, postPR. Column (2) includes municipality, time and state-by-time fixed effects. Column (3) includes all fixed effects and time-invariant control variables. In column (4), our independent variable of interest is the interaction term between our binary dummy variable of Indigenous institutions and the post treatment indicator, postPR. Standard errors are clustered at the municipality level are in parentheses. Statistical significance at the 99%, 95%, and 90% confidence level denoted: ***, **, and *.

TABLE B.4: Different specification: IndInst

	Road Share		
	(1)	(2)	(3)
IndInst all pop x postPR	-0.022^{***}		
	(0.003)		
IndInst avg X postPR		-0.018^{***}	
		(0.004)	
IndInst time-variant x postPR			-0.013^{***}
			(0.003)
Municipality FE	✓	✓	✓
Time FE	✓	✓	✓
State x time FE	✓	✓	✓
Time Invariant Controls	✓	✓	✓
Time Variant Controls	✓	✓	✓
N	6,297	6,297	6,281
R^2	0.072	0.070	0.070

Notes: This table presents the estimates examining the effects of different Indigenous institutions index on road share. In column (1), we use as denominator of equation 7, the total population in municipality i. In Column (2), we use the average $IndInst$ between 1930 and 1960. Finally, in column (3), we use the time-variant $IndInst_{it}$ index. All columns include municipality, time and state-by-time fixed effects and time-variant and time-invariant controls. Standard errors are clustered at the municipality levels in parenthesis. Statistical significance at the 99%, 95%, and 90% confidence level denoted: ***, **, and *.

TABLE B.5: Different specification: dependent variable

	Road density	Buffer 10km^2	Buffer 0.5 km^2
	(1)	(2)	(3)
IndInst x postRP	-0.013^{***}	-0.044^{***}	-0.004^{***}
	(0.005)	(0.009)	(0.001)
Municipality FE	✓	✓	✓
Time FE	✓	✓	✓
State x time FE	✓	✓	✓
Time Invariant Controls	✓	✓	✓
Time Variant Controls	✓	✓	✓
N	6,297	6,297	6,297
R^2	0.048	0.116	0.056

Notes: This table presents the estimates examining the effects of $IndInst$ on different specification of our dependent variable. In column (1), the dependent variable is road density. In column (2) and (3), the road share buffer is 10 km^2 and 0.5 km^2, respectively. All columns include municipality, time and state-by-time fixed effects and time-variant and time-invariant controls. Standard errors are clustered at the municipality levels in parenthesis. Statistical significance at the 99%, 95%, and 90% confidence level denoted: ***, **, and *.

TABLE B.6: Outliers

	Road share < 0.4	ihs Road share
	(1)	(2)
IndInst x postPR	-0.009^{***}	-0.013^{***}
	(0.002)	(0.003)
Municipality FE	✓	✓
Time FE	✓	✓
State x time FE	✓	✓
Time Invariant Controls	✓	✓
Time Variant Controls	✓	✓
N	6,282	6,297
R^2	0.081	0.071

Notes: This table presents the estimates examining the effects of $IndInst$ on road share. In column (1), we remove all municipalities with a road share larger than 0.4. In column (2), we use the inverse transformation sine of our dependent variable. All columns include municipality, time and state-by-time fixed effects and time-variant and time-invariant controls. Standard errors are clustered at the municipality levels in parenthesis. Statistical significance at the 99%, 95%, and 90% confidence level denoted: ***, **, and *.

TABLE B.7: Specifications using different forms of IndInst

	Road share		
	(1)	(2)	(3)
IndInst dropping JH level x postRP	−0.015***		
	(0.003)		
IndInst avg x postRP		−0.013***	
		(0.004)	
IndInst dropping others x postRP			−0.014***
			(0.003)
Municipality FE	✓	✓	✓
Time FE	✓	✓	✓
State x time FE FE	✓	✓	✓
Time Invariant Controls	✓	✓	✓
Time variant Controls	✓	✓	✓
N	6,297	6,297	6,297
R^2	0.068	0.067	0.069

Notes: This table presents the estimates examining the effects of $IndInst$ on road share using a more conservative approach in the construction of $IndInst$ when groups had a partial Murdock's categorisation on jurisdictional hierarchy. Column (1) shows the coefficient on $IndInst$ in which the groups with a partial categorisation in their jurisdictional hierarchy were downgraded one level. Column (2) presents the results using an index of Indigenous institutions in which these same groups with a partial categorisation were assigned the average level of jurisdictional hierarchy from the groups that reported a complete categorisation. Column (3) shows the coefficient on $IndInst$ in which the Indigenous population corresponding to the groups classified as "others" was excluded. All columns include municipality, time and state-by-time fixed effects and time-variant and time-invariant controls. Standard errors are clustered at the municipality levels in parenthesis. Statistical significance at the 99%, 95%, and 90% confidence level denoted: ***, **, and *.

TABLE B.8: Questions: collective action preferences

Column	Question	Answer and coding
Q1	In the last 12 months, have you participated in a demonstration or protest march?	0=No / 1=Yes
Q2	In the last 2 weeks have you tried to help to solve a problem in your community or your neighbourhood?	0=No / 1=Yes
Q3	Of people participating in legal demonstrations. How much do you approve or disapprove?	0=dissaprove; ... ; 10=approve
Q4	Of people seizing private property or land in order to protest. How much do you approve or disapprove?	0=dissaprove; ... ; 10=approve
Q5	Of people participating in the blocking of roads to protest. how much do you approve or disapprove?	0=dissaprove; ... ; 10=approve

TABLE B.9: Mean comparison

	Q1	Q2	Q3	Q4	Q5	Q6
	(1)	(2)	(3)	(4)	(5)	(6)
centralisation	0.038	0.099	0.272	−0.318	1.411***	0.794*
	(0.080)	(0.070)	(0.553)	(0.399)	(0.408)	(0.408)
Constant	0.087	0.157***	6.042***	8.432***	1.622***	3.275***
	(0.060)	(0.051)	(0.457)	(0.277)	(0.216)	(0.216)
Mean dependent variable	0.111	0.219	6.214	8.235	2.500	3.775
SD dependent variable	0.317	0.415	2.954	2.045	2.369	2.766
N	63	137	131	98	98	138
R^2	0.003	0.013	0.002	0.006	0.084	0.019

Notes: This table presents the unconditional mean comparison between centralised and fragmented individuals of our selected questions in table B.8. In all columns, constant shows the unconditional mean of fragmented groups and centralisation the differences between politically centralised and politically fragmented individuals. Standard errors are clustered at the municipality level in parenthesis. Statistical significance at the 99%, 95%, and 90% confidence level denoted: ***, **, and *.

TABLE B.10: Identity preferences: survey evidence

	proud	costum	feel
	(1)	(2)	(3)
centralisation	0.106*	0.167**	0.103*
	(0.056)	(0.077)	(0.058)
Demographic controls	✓	✓	✓
Municipality FE	✓	✓	✓
Mean dependent variable	0.884	0.565	0.843
SD dependent variable	0.320	0.496	0.364
N	484	497	472
R^2	0.194	0.223	0.293

Notes: This table presents mean comparison between politically centralised and politically fragmented individuals of our selected questions in section 5.3. In column (1), we use question *mi3*: "How proud do you feel of your tradition and heritage". In column (2), we use question *mi2*: "Do you preserve some of the custom or traditions of your ancestors?". In column (3), we use question *mi4*: "Do you feel... []...more [*ethnicity i*] than Mexican or []...as [*ethnicity i*] as Mexican"[...] or "...more Mexican than [*ethnicity i*]" . In all columns we control for demographic controls and municipality fixed effects. Standard errors are clustered at the municipality level in parenthesis. Statistical significance at the 99%, 95%, and 90% confidence level denoted: ***, **, and *.