Forced Coexistence and Economic Development - Evidence from Native American Reservations*

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Abstract

There are large differences in economic development across Native American reservations today. This paper asks whether these differences can be in part explained by the forced integration of historically autonomous sub-tribal bands in the 19th century. To measure forced integration, I combine anthropological data on intra-tribal political integration in pre-reservation times with historical information on the constituent bands of each reservation. Exploring variation in how politically integrated tribes were before reservations and variation in how politically integrated reservations were at the time of their formation, I find that forced integration lowers per capita incomes today by about 30 percent. To account for potential selection into forced integration, I exploit historical mining rushes as a source of exogenous variation in the government's incentive to combine bands onto reservations. The IV strategy confirms the baseline results. I provide quantitative evidence on the channels through which forced integration affects incomes today.

Keywords: Economic Development, Population Heterogeneity, Institutions, Social Capital, Polarized Politics

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1 Introduction

Native Americans on reservations are the poorest group in the US today, but there are substantial differences in economic outcomes across reservations which are not well understood.[1] A body of qualitative research has argued that these differences are in large part attributable to variation in the quality of local governance on reservations which in turn hinges on whether reservation members and politicians identify themselves with the reservation as a whole or only with a faction on the reservation (Cornell and Kalt 1991, 1993, 1995, 2008). Starting with this idea, this paper asks whether cross-reservation differences in per capita incomes today can be explained by the forced integration of historically autonomous sub-tribal bands during the period of reservation formation in the 19th century. Bands of the same tribe were often integrated into shared reservations because the US government pursued a policy of minimizing the number of reservations per tribe (Fahey 1986). This was done without regard for the organizational structure of the tribes, which often consisted of politically autonomous sub-tribal bands rather than one politically integrated unit. I define a reservation as forcibly integrated if it combined bands that had been politically autonomous before the reservation was formed. This captures the idea that political factions today may have formed along traditional political boundaries so that a polarized political equilibrium was more likely to evolve under forced integration (Cornell and Gil-Swedberg 1992).[2]

To measure on-reservation political integration at the time of formation, I use historical information on the number of sub-tribal bands integrated into individual reservations. To measure the pre-reservation political integration of each reservation's constituent tribe, I use anthropological data from Murdock's 1967 Ethnographic Atlas (EA). Forced integration is an indicator variable for whether a reservation's constituent bands had been politically separate in pre-reservation times. Using reservation-level data from the 2000 US Census, I find that forced integration reduces per capita incomes on reservations by about 30 percent on average. This effect is very precisely estimated and robust to controlling for the economic environment, geographic remoteness, demographic structure, resource endowments, size and casinos, as well as for potentially important

[1]In the 2000 US Census, Native Americans p.c. income was 12,893 USD which is the joint lowest among racial groups together with Hispanics. On-reservation Native Americans are even poorer with a p.c. income of 10,357 USD. In terms of variability, the coefficient of variation of reservation-average p.c. incomes was 0.47. This is in between that for US states, 0.15, and that for a global comparison of country-averages, which is 1.1.

[2]This idea of forcibly integrated reservations is closely related to the concept of artificial states in cross-country studies (Alesina, Easterly and Matuszeski 2008).

tribal characteristics. The coefficient on forced integration remains qualitatively unchanged and highly significant when I flexibly control for unobserved tribal characteristics with tribal fixed effects.[3]

An important concern for identification is selection into forced integration. If some bands had characteristics that increased their chances of obtaining separate reservations and also made them economically more successful during the later reservation years, then the OLS estimates will be biased because part of the estimated effect of forced integration reflects traits that may have been less suitable for reservation life.[4] To address this concern, I pursue an instrumental variable (IV) strategy based on variation in the value of land of each reservation's constituent bands' *ancestral territories*.[5] The logic of the IV rests on the salient trade-off the US government faced in forming reservations. On the one hand, it strove to minimize the number of reservations per tribe in order to free up more land and reduce administrative costs. On the other hand, it had to overcome resistance against this by local bands, who generally preferred separate reservations on their ancestral territories (Fahey 1986). Whether bands obtained separate reservations depended critically on the government's incentive to free up their land. Among the important determinants of land values, mineral deposits were plausibly exogenous because, unlike the Aztec and Inca, North American tribes did not mine.[6] I construct the instrument by matching maps of pre-reservation tribal boundaries to maps of historical mining activity from the 1860 to 1880 Censuses to measure each reservation's constituent bands' exposure to mining activity on their ancestral territory.[7] Controlling for potentially endogenous land characteristics that correlate with mineral deposits, the IV estimates are qualitatively identical to the OLS coefficients. One possible explanation for this is that historical mining rushes had a direct negative effect on outcomes today, for example because they led to disease and starvation. I test for this in anthropometric data on the height of a sample of 12,000 Native Americans in the 1890s. I find some weak evidence for a negative mining shock but the effect is very small and only marginally significant.

Turning to mechanisms, the institutional design of reservations, set in the 1934 Indian Reor-

[3]Many larger tribes obtained several reservations so that cross-reservation variation is cross-tribe *and* within-tribe.

[4]Pertinent examples of such characteristics are adoption of European language, legal customs and technology, group coherence, military capacity and differences in the attitudes in negotiating with the US government.

[5]A band's ancestral territory is the area it occupied in pre-reservation times.

[6]Other major determinants of land values were the suitability for agriculture and grazing as well as lumber stocks.

[7]Historical mineral deposits would be the ideal instrument, but this data can not be reconstructed. Mining activity will satisfy the same conditions as mineral deposits as long as tribal characteristics could not deter mining rushes.

ganization Act (IRA), suggests that the political equilibrium is of primary importance because traditional checks and balances on government were foregone by combining executive power, legislative control over reservation laws and judicial control over reservation courts in the hands of reservation councils. The economics literature suggests a number of channels through which a polarized political equilibrium may impact economic outcomes on reservations. For instance, it may be that voters with a strong own-group bias elect politicians with lower ability (Banerjee and Pande 2010) or that politicians choose policies that cater to only certain groups on the reservation if this can ensure their re-election (Besley 2006, ch.3.4.5). Of course, there are also a number of non-political channels through which polarization may matter.[8]

Consistent with the view that forced integration is associated with polarized politics, I find quantitative evidence that forced integration is associated with contemporary political conflict on reservations. Using newspaper article counts, I show that forced integration leads to more *reported* episodes of on-reservation conflict, after controlling for the total press coverage of a reservation. Additional evidence on the importance of the political channels can be gleaned from the timing of the economic divergence between reservations, using a panel combining the 1990 and 2000 Censuses.[9] From the mid-1980s to early 1990s, federal regulation transferred responsibility for self-government into the hands of reservation governments. If forced integration reduces the quality of local governance, reservations without forced integration should have benefitted more during this period. Consistent with this, I find that differences between reservations with and without forced integration were muted in 1990. Differential growth rates from 1990 to 2000 explain two-thirds of the cross-sectional difference in 2000.[10]

On the economic channels, the qualitative evidence suggests that polarized politics reduce incomes primarily through creating uncertainty in the contracting environment on reservations and impacting the management of reservation-owned enterprises (Jorgensen and Taylor 2000, Cornell 2006, Cornell and Kalt 2008, ch.7). To disentangle between these and other possible channels, I turn to a variety of auxiliary data-sources. I first show that most of the income differences across

[8] In Tabellini (2008a), social norms sustain trust and cooperation in private production between individuals who are "socially close." In Alesina and La Ferrara (2000) community participation is lower in heterogenous populations. In Vigdor (2004), not caring about members from other groups increases free-riding in more heterogeneous populations. In Miguel and Gugerty (2005), the threat of social sanctions only binds from members of one's own group. In Alesina *et al.* (2000) preference heterogeneity across groups reduces public goods provision.

[9] These are the only two Censuses for which reservation-aggregate outcomes are available.

[10] Importantly, this pattern is robust to allowing for a separate growth trend for reservations with casinos.

reservations are accounted for by differences in wage-income. Consistent with this being driven by on-reservation business, I show that Native American enterprises can more than account for total Native American wage income in the aggregate. While this data is not available at the reservation level, I can use other data sources to rule out a number of alternative channels through which forced integration may lower incomes. In particular, federally funded programs and public good provision, losses from direct corruption, off-reservation employment opportunities and selective out-migration do not drive the results.

This paper speaks to the literature on polarization and social norms of cooperation (Easterly and Levine 1997, Guiso *et al.* 2005, Alesina *et al.* 2003). It also complements a growing body of research on the historical roots of these forces; in particular Gennaioli and Rainer (2007), who use the same EA data I use to show that African countries with stronger legacies of pre-colonial political integration have better public good provision today, and Jha (2007), who traces regional variation in contemporary religious tolerance in India back to exogenous variation in medieval trade relations.[11] The present study extends this literature by providing additional evidence on the persistence of social identities and the effects of polarization and the relationship between these two forces. In conditioning present-day political integration on historical political integration, it also relates to work by Fearon (2003) that attempts to condition ethnic fractionalization on the linguistic distance between ethnic groups. In comparison with cross-regional or cross-country settings, American Indian reservations offer the advantage that there is a clear one-to-many mapping from tribes as bearers of cultural traits to reservations as political entities, which avoids aggregation issues. In addition, many of the omitted variable concerns associated with cross-country or cross-regional studies are mitigated here because all reservations operate within the same historical and institutional framework.

The remainder of the paper proceeds as follows: Section 2 provides background information on the formation of reservations, the reasons for forced integration and the potential selection bias. Section 3 describes the sample and the construction of the measure of forced integration and of the instrument. Section 4 presents the results. Section 5 provides evidence on the mechanisms through which forced integration works and Section 6 concludes.

[11] See Nunn (2009) for a recent survey on the importance of history for economic outcomes today.

2 Background

2.1 Motivation

The idea that forced integration in the 19th century could have an appreciable effect to the present day is motivated by a body of sociological literature that has argued for the quality of *local* governance as a key determinant in reservations' success. A salient argument in this literature is that political boundaries that existed within tribes in pre-reservation times are transmitted to the present day in the form of social norms over who to cooperate with on a reservation. Social norms of cooperation are more likely to be sustained between groups that were politically integrated in the pre-reservation past. A reservation is more successful if social norms sustain cooperation between all reservation members (Cornell and Kalt 1991, 1993, 1995, 2008 ch.1). This view has been articulated in particular by a group of scholars at the Harvard Project on American Indian Economic Development at the Kennedy School of Governance, but similar reasoning can be found in many studies of individual reservations. Holm (1985) for example stresses that factionalism on the Pine Ridge reservation, which culminated in the famous Wounded Knee events in 1975, originates in the traditionally band-based political organization of the Lakota Sioux. Fahey (1986, p.135) describes how the decentralized traditions of the Kalispel led to factionalism and rivalries when the tribe that was brought together on one reservations. Stern (1965, p.75) describes how the Klamath Reservation combined diverse tribal bands and how band cleavages have dominated politics since the formation of the reservation in 1864.

This postulated link from tribal structures to social norms of trust and cooperation is consistent with models of the transmission of social norms and cultural beliefs in the economics literature (Guiso, Sapienza and Zingales 2008b, Tabellini 2008a). In particular, there is a close connection to the model in Tabellini (2008a), which combines the framework of preference transmission under imperfect empathy in Bisin and Verdier (2001) with a spatial model of cooperation to endogenize the evolution of norms of *generalized* vs *limited morality*. The notion of a spatial differentiation of norms of trust and cooperation maps intuitively into the concept of forced integration. Integration is forced if a political entity is formed at a level above the level of morality.[12]

[12] Unlike in Tabellini (2008a) limited morality does not have negative consequences here if the political entity is of correspondingly limited degree of centralization.

2.2 The Formation of Reservations and Forced Integration

After the American War of Independence and the war of 1812, Native Americans lost their importance as strategic allies of the US government. At the same time, accelerating European immigration increased settler pressure on the frontier (Prucha 1970). By the 1820s, US policy towards Native Americans had become increasingly hostile, culminating in President Jackson's 1830 Indian Removal Policy, which aimed at removing eastern tribes to land west of the Mississippi. In the late 1840s, the annexation of Texas (1845), Oregon (1846) and California (1848) made further west-ward removal an untenable policy and, according to Nichols (2003, p.128), "changed the situation in the West almost overnight". This marked the beginning of the period of reservations formation (Castille and Bee 1992, Fahey 1986 (p.12)). The majority of reservation were formed between the shift of the management of Indian affairs from the War Department to the Department of the Interior (DOI) in 1849 and the end of the *Indian Wars* in 1890.[13]

The US government's objective in forming reservation was to maximize the amount of land that was freed up for settlement and to keep down administrative costs associated with governing reservations. It therefore strove to minimize the number of reservations per tribe while not integrating separate tribes on the same reservation in order to avoid outbreaks of inter-tribal hostilities on reservations (Fahey, 1986). This policy did not consider the varying degree of political integration *within* tribes. However, the anthropological literature makes a clear distinction between tribes as cultural-linguistic entities and tribes as political entities (Diamond 1997, ch.14). Large indigenous societies united by common culture, language and clan lineages could be very decentralized politically, with each band forming an autonomous unit within a tribe. A lack of appreciation by the US government for this distinction meant that reservations often combined bands that had been historically politically autonomous. I refer to this as *forced integration*.

2.3 Endogeneity of Forced Integration

The key concern when testing for an effect of forced integration on economic outcomes is that tribes or bands self-selected into being put on more integrated reservations. The following very simple model of the process of reservation formation highlights the nature of this selection bias.

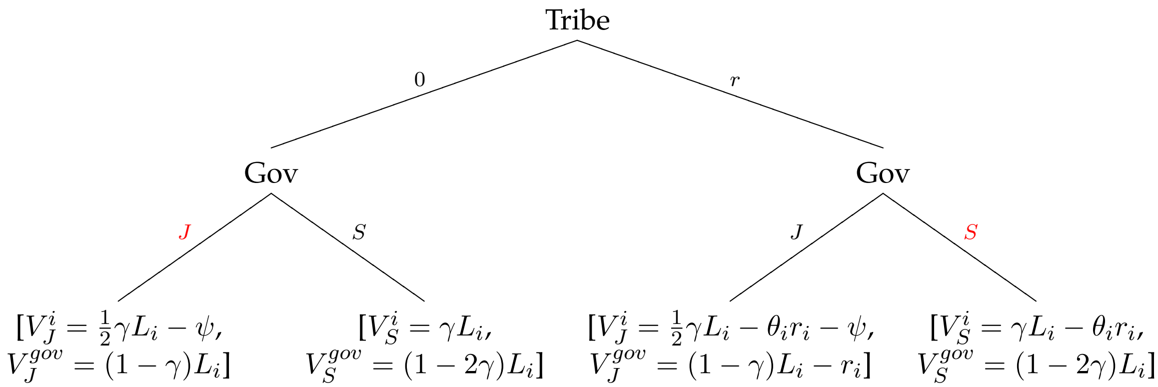
[13] In more remote areas some new reservations were formed as late as the 1920s.

The model is highly stylized but captures the main trade-offs in the formation of reservations that are salient in the historical record (Fahey, 1986). The US government strove to free up more land for settlers and to reduce administrative costs by reducing the number of reservations per tribe. But integrating previously autonomous bands was associated with increased resistance by these bands as they wanted to retain their independence and remain on their ancestral homelands. I model the process of reservation formation as a simple two-stage game in which two bands making up a tribe i first determine the level of resistance they put up against being integrated on a joint reservation. Then the government makes a binary decision on whether to create separate reservations for each band or one integrated reservation for the tribe as a whole. In the model, there is no conflict in equilibrium, but band strength matters through the off-equilibrium threat of violence. Let the total value of the whole tribe's land be L_i and let each reservation take up size γL_i.[14] Bands jointly choose resistance r_i against being moved on one integrated reservation. Resistance to being put on separate reservations is normalized to 0. The government's payoff from forming two separate reservations is $V_S^{gov} = (1 - 2\gamma)L_i$ and the payoff from forming one joint reservation is $V_J^{gov} = (1 - \gamma)L_i - r_i$. Forming one integrated reservation frees up more land but is also associated with increased resistance. The threshold amount of resistance is $\hat{\mathbf{r}}_i = \gamma L_i$ at which $V_J^{gov} = V_S^{gov}$. If resistance is weakly higher than $\hat{\mathbf{r}}_i$, the government optimally grants two separate reservations to the bands. When the value of tribal land is higher, the government is willing to overcome more resistance. If bands resist, they obtain separate reservations if the resistance they put up is at least $\hat{\mathbf{r}}_i$. Resistance below $\hat{\mathbf{r}}_i$ is futile. Tribes therefore optimally either do not resist or put up resistance $\hat{\mathbf{r}}_i$. Tribes trade off resistance costs θ_i against a cost ψ of sharing a joint reservation.[15] Cross-tribal variation in the strength of resistance is conceptualized as variation in θ_i. Stronger tribes have a lower θ_i. Each band's population is normalized to 1 so that the average tribal member's payoff is $V_S^i = \gamma L_i - \theta_i r_i$ when obtaining separate reservations and $V_J^i = \frac{1}{2}\gamma L_i - \theta_i r_i - \psi$ when obtaining an integrated reservation. This is because separate reservations are associated with more land and no cost of having to cooperate with other bands but there is a resistance cost to achieving this. The payoffs are shown in the tree-diagram below where the tribe takes actions 0 or $r = \hat{\mathbf{r}}_i$ and the

[14] One integrated reservation is therefore half the size of 2 separate reservations which captures the returns to more centralized reservations to the government. This is isomorphic to introducing a fixed administrative cost to the government for each reservation.

[15] This cost reflects the fact that tribal members from separate bands do not cooperate as well as tribal members from the same band.

government chooses whether to create one integrated or two separate reservations, $\{J, S\}$. Payoffs to the tribe are listed first and payoffs to the government second on each path.



Bands optimally do not resist (and consequently receive a joint reservation) if $V_J^i(r_i = 0) = \frac{1}{2}\gamma L_i - \psi \geq V_S^i(r_i = \hat{\mathbf{r}}_i) = \gamma L_i - \theta_i r_i$. Substituting $\hat{\mathbf{r}}_i = \gamma L_i$, this is equivalent to $\frac{1}{2}\gamma L_i - \psi \geq (1-\theta_i)\gamma L_i$ which implies that tribes select into forced integration $\mathbf{C}_i$:

$$\mathbf{C}_i = \begin{cases} 1 & \text{if} \quad (\theta_i - \frac{1}{2})\gamma L_i > \psi \\ 0 & \text{otherwise} \end{cases} \tag{1}$$

Forced integration was more likely if groups were weaker or if they occupied more valuable land. This is consistent with the historical record. This selection could be at the tribal level (as in the model) or at the band level. Velarde Tiller (1983) for example suggests that the Jicarilla Apache were the only Apache group band that obtained a separate reservation because they were the most resistant. There is also much historical evidence to support the view that more valuable land induced the government to form more fewer and more integrated reservations (Fahey 1986, p.14-18; Nichols 2003). Selection on observable characteristics of tribal territories L_i can be controlled for, but selection on unobservable θ_i will bias the OLS estimate of the effect of forced integration if θ_i has an independent effect on long run reservation outcomes. In the model, θ_i is military strength but it also proxies for other important characteristics that are salient in the historical record on reservation formation. Internal group coherence, the willingness to learn European language and legal procedures and the willingness to adopt European technologies all mattered to the process of reservation formation and would be expected to impact long run economic outcomes on reservations. An IV strategy can be based around an instrument that shifts this selection equation and that is exogenous to tribal characteristics and has no direct effect on long run outcomes. Characteristics of tribal territories that were orthogonal to tribe and band characteristics at the time of formation but that raised the value of their land to the US government satisfy this criterion if they did not impact long run economic outcomes on reservations other than through forced integration.[16]

2.4 Mining Rushes as an Instrument

The historical record is clear on the role that the value of land played in the formation of reservations. For example, Warren (1984) and Wedll (1985) describe how pressure from lumbermen and farm settlers induced the government to pressure the bands of Mississippi and Pillager Chippewa to move to the integrated Leech Lake, Mille Lacs and White Earth Reservations while the bands of the Lake Superior Chippewa on the colder and less fertile lands further north retained separate band-based reservations. The main determinants of land value were the suitability of land for grazing and agriculture, the availability of lumber and mineral deposits (Fahey 1986). Of these, mineral deposits are the only one that was plausibly independent of tribal characteristics because North American tribes did not have mining. One concern is that mineral deposits were spatially correlated with other land characteristics such as ruggedness and the suitability of land for agriculture. I can account for this in the empirical work.[17] Because historical mineral deposits can not be reconstructed, I use historical mining activity during the key years of reservation formation instead. Mining activity is a valid instruments if tribal characteristics did not impact the extent of discovery and extraction of mining deposits. The historical record suggests that this condition is satisfied because the potential profits from mining were so big that tribal hostility was not a deterrent to potential miners. Mining rushes had a major influence of on the formation of reservations. Fahey (1986, p.14-18) and Nichols (2003, p.50 and p.132) describe how the Pend d'Oreille gold rush of 1854 influenced the governor of Washington State to pursue a policy of fewer and more central-

[16] Adding a dimension of land values $\mathbf{Z}_i$ to the government payoff functions but not the tribal payoffs, the threshold level of resistance is then given by solving $\tilde{V}_S^{gov} = (1-2\gamma)(L_i + \mathbf{Z}_i) = (1-\gamma)(L_i + \mathbf{Z}_i) - r_i = \tilde{V}_J^{gov}$ for $\tilde{\mathbf{r}}_i = \gamma(L_i + \mathbf{Z}_i)$ and the selection equation becomes

$$\mathbf{C}_i = \begin{cases} 1 & \text{if} \quad (\theta_i - \frac{1}{2})\gamma L_i + \theta_i \gamma \mathbf{Z}_i > \psi \\ 0 & \text{otherwise} \end{cases} \tag{2}$$

[17] An additional condition is that bands that were removed from their land were selectively integrated with the weakest neighboring bands that could least resist this. If this was the case, then no instrumental variable strategy could work. However, I have not found any evidence that supports this view. The process of reservation formation seems to have been governed by expediency and logistical constraints.

ized reservation for the local Kalispel, Pend d'Oreilles, Spokane and Flathead tribes. McGovern (1995,p.66-68 and 74-76) describes how DOI Commissioners in 1850s California negotiated reservations treaties primarily with a view of removing Indians from mining districts while California tribes such as the Dieguenо and Luiseno who inhabited areas south of the mining districts were largely unaffected by the California Gold Rush. Consequently, local bands of these tribes received several smaller more decentralized reservations in the 1870s. Cole (1988, p.89-92, p.118) describes how the Santa Rita gold mining boom of 1860 led to armed conflict between miners and Cochise's Chiricahua Apache. Knack (2001, ch.6) describes how miners in Arizona and Nevada lobbied for military intervention to place Southern Paiute bands on reservations during the local 1870 silver and copper rush. The Black Hills Gold Rush of 1874 led to the breaking up the Great Sioux Reservation, where each Sioux band had a separately governed parcel, and the amalgamation of bands onto fewer integrated reservations (Fritz 1963, ch VI).

To be a valid instrument, in addition to being independent of band characteristics, mineral deposits also not satisfy the exclusion restriction of having had no direct effect on present-day economic outcomes. There are three potential threats to the exclusion restriction. The first is that mineral deposits on tribal territories were correlated with mineral deposits on reservation lands in later years because tribes were rarely removed very far from their homelands. I attack this problem directly by controlling for resource endowments on reservations today. Reservation were usually located near their constituent bands' tribal territories. This gives rise to the second concern, that mineral deposits on tribal territories had a positive effect on economic activity in a reservation's environment. I control for this with measures of remoteness and the affluence of a reservation's economic environment. A third concern is that the sudden increase in settler populations induced by mining rushes led to negative health shock through disease and depleted food sources. In Section 4.3.2 I use anthropometric data on Native American heights from the early 1890s to test whether Native populations whose reservations were formed under mining pressure experienced more severe negative health shocks during the period of reservation formation.

3 Sample and Data Construction

3.1 Data Sample

The 2000 US Census reports reservation aggregates data for 210 reservations.[18] I drop 12 reservations that are state but not federally recognized because they operate within a different institutional framework. Further, I drop 9 reservations that were founded after 1934 because tribes had to go though a lengthy application process to obtain reservations after this date.[19] There are also 7 reservations which combined more than one tribe. I drop these because they can not be clearly mapped to one set of pre-reservations political traditions.[20] This leaves a sample of 182 reservations, covering over 90% of the on-reservation Native American population, for which I observe Census variables averages such as per capita incomes, educational attainment and the percentage of residents under the poverty lines.

3.2 Measuring Forced Integration

To measure forced integration I need to measure for each reservation the degree of political integration of its constituent tribe and the degree of political integration on the reservation. To measure pre-reservation intra-tribal political integration, I use the *level of jurisdictional hierarchy* from the Ethnographic Atlas (EA).[21] This variable tells me for each tribe whether it was politically integrated or consisted of autonomous local bands. I code this as an indicator $\mathbf{pre}_i = \{0, 1\}$. I map each reservation to its constituent tribe to get a measure of pre-reservation political integration associated with each reservation. I then use historical information on the formation of reservations

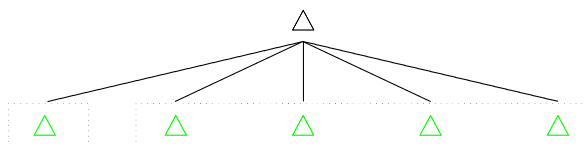
[18]There is a total of 304 reservations today but the Census censors the sample by only reporting aggregates for reservations above a population threshold of 100 (National Park Services 2010). The reservations under this population threshold are fundamentally different from the reservations as described in the previous section. Their origin lies in the 1887 General Allotment Act (the "Dawes Act"). The Dawes Act was designed to reduce reservation lands and to break up communal ownership of reservation lands by allotting each Indian family an area of 16 acres and putting the (substantial) remainder up for sale. An unintended side-effect of this law was the formation of clusters of 16-acre plots by non-reservation Native Americans who took advantage of the Dawes Act. Some of these clusters were turned into reservations by presidential executive order after the turn of the century. The majority of the reservations under the 100 population threshold are the "Rancherias" in Northern California. Northern Californian tribes had no reservations at all in 1887 because the U.S. Senate had refused to ratify treaties for 18 reservations which were made during the peak of the California Gold Rush in the 1850s, leaving Northern California's tribes landless (McGovern, 1995).

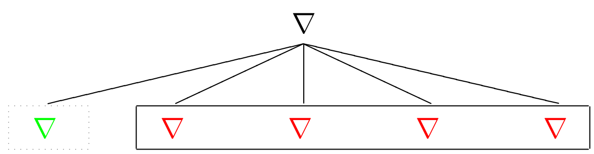
[19]As described in the final section, the 1934 IRA implemented the present-day institutional framework on reservations and gave considerable independence to reservation governments.

[20]These reservations have higher than average p.c. incomes in 2000, indicating that the unusual decision to combine different tribes on the same reservation was taken because these tribes had particularly friendly ties.

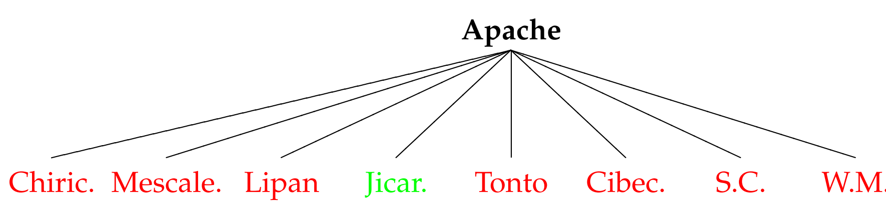
[21]This data was used in previous economic applications in Gennaioli and Rainer (2007), Nunn (2008), Nunn and Wantchekon (2010) and Fenske (2010)

to code for each individual reservation whether it was formed for one local band or integrated several bands. I label this variable $\mathbf{post}_i = \{0, 1\}$. I then define Forced Integration to occur when a reservation integrated local bands that had been previously autonomous. This is a dummy variable $\mathbf{C}_i = 1(\mathbf{post}_i - \mathbf{pre}_i > 0)$.[22] The following tree-diagram depicts this coding graphically for an integrated and a non-integrated tribe. The upper node is a tribe and the lower nodes are local bands. Boxes around nodes are reservations. A solid box denotes forced integration. If a tribe is politically integrated (△), the integration of local bands is not coded as forced integration. If a tribe consists of autonomous local bands (▽), the integration of local bands is coded as forced integration.



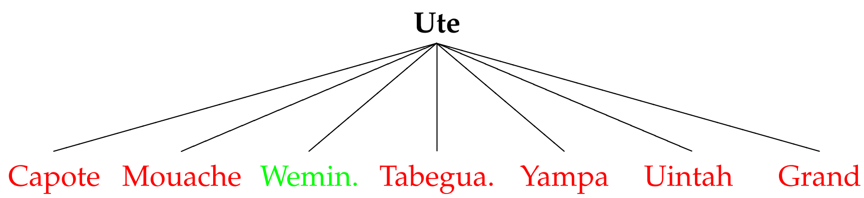


This implies that tribes that were integrated in pre-reservation times are by construction never coded as forcibly integrated. Within-tribe variation in forced integration therefore only comes from tribes that consisted of politically autonomous bands in pre-reservation times. For illustration, I use the Apache and Ute tribes as examples of of how local bands of non-integrated tribes were integrated onto reservations.



[22]The measure $\mathbf{C}_i$ might seem coarser than it needs to be. A reservation that integrated 4 bands could be seen as more fractionalized than one that integrated 2 bands. However, such finer codings can not be made consistent over the whole sample because there are some reservation for which the best information available is that they were formed out of a collection of bands but no historical reference to the exact identity of these has survived.

The Apache consisted of autonomous local bands. Every Apache reservation is therefore associated with $\mathbf{pre}_i = 0$. The Chiricahua, Mescalero and Lipan Apache bands were integrated onto the Mescalero Reservation. The Mescalero Reservation is therefore coded as $\mathbf{post}_i = 1$ and as being forcibly integrated, $\mathbf{C}_i = 1$. The San Carlos Reservation integrated the Tonto, Cibecue, San Carlos and White Mountain Apache Bands and is equally coded as $\mathbf{post}_i = 1$ and $\mathbf{C}_i = 1$. By contrast, the Jicarilla Reservation was formed for the Jicarilla Apache alone and is coded as $\mathbf{post}_i = 0$, $\mathbf{C}_i = 0$.



Like the Apache, the Ute consisted of autonomous bands. Southern Ute Reservation integrated the Capote and Mouache Bands. The Uintah and Ouray Reservation integrated Tabeguache, Yampa, Uintah and Grand Bands. Both are coded as $\mathbf{post}_i = 1$, $\mathbf{C}_i = 1$. By contrast, the Ute Mountain Reservation was formed out of only the Weminuche Band and is coded as $\mathbf{post}_i = 0$, $\mathbf{C}_i = 1$.

In terms of measuring pre-reservation political integration, the coding in the EA accords very well with anthropological studies of individual tribes. For example, Spier (1923, p.298) argues that for the Diegueno, coded as politically non-integrated in the EA, the "real unit is the local group." For the Apache, Opler (1983, p.369) argues that "the notion of tribe in Apachean cultures is very weakly developed. Essentially it was only a recognition that one owed a modicum of hospitality to those of the same speech, dress, and customs." Basso (1996) similarly argues that the Apachean bands had no political unity. Colson (1953, p.4) describes how the Makah and other North-Western tribes, coded as non-integrated in the EA, traditionally consisted of politically autonomous villages and notes that the idea of one Makah tribe governed by a single tribal council is regarded by the Makah themselves as "a recent development resulting from the reservation." By contrast, Alfred (2002, p.25) stresses the strong tribal identity prevalent in the Iroquois heritage, coded as politically integrated in the EA, and juxtaposes this to the local group identity still prevalent among North-Western fishing tribes. In terms of measuring on-reservation political integration, it is surprisingly clear how the original constituent tribes and bands map to individual reservations. The three principal sources of information are online profiles of reservations themselves, individual reservation studies and treaties. Most reservation maintain websites with

Table 1: Frequency Table

	$\mathbf{post}_i = 0$	$\mathbf{post}_i = 1$	Total
$\mathbf{pre}_i = 0$	64	80	144
$\mathbf{pre}_i = 1$	3	35	38
Total	69	113	182

historical information on their origins and I usually started with this information. Where information was ambiguous or missing, I searched for information in the large secondary literature of individual reservation studies. Lastly, I could glean information from a complete online database[23] of all treaties between Native Americans and the US. These treaties laid the foundations of many of the earlier reservations[24] and because they were legal documents the signatory bands which would form a reservation were carefully recorded. A complete list of reservation to tribe mappings including the $\mathbf{pre}_i$ and $\mathbf{post}_i$ measures and the sources used will be available in an online appendix to this paper by December 2010. Table 1 displays the frequencies of $\mathbf{pre}_i$ and $\mathbf{post}_i$. The 80 reservations with $\mathbf{pre}_i = 0$ and $\mathbf{post}_i = 1$ are coded as forcibly integrated. Figure 1 shows the spatial distribution of reservations with and without forced integration. Several clusters are noticeable. In Southern California, the Luiseno and Diegueno tribes consisted of autonomous bands, but they inhabited relatively barren land south of the gold rush areas and obtained a cluster of separate reservations. In Washington State, the many north-western fishing cultures consisted of autonomous villages but were sitting on valuable fertile land and ended up being integrated on joint reservations. In New Mexico, the Pueblo tribes had built their politically autonomous villages into the rock. In this barren desert landscape, the US government simply turned the villages into reservations.

3.3 Construction of the Instruments

To measure exposure to mining activity I constructed 2 geographic databases, one for tribal territories and one for the location of historical mining activity. Combining these two, I calculate the value of mining activity on ancestral homelands for each reservation. To construct a database of

[23]http://digital.library.okstate.edu/kappler/Vol2/Toc.htm

[24]In 1871, Congress stopped making treating and from thereon reservations were created by presidential executive order.

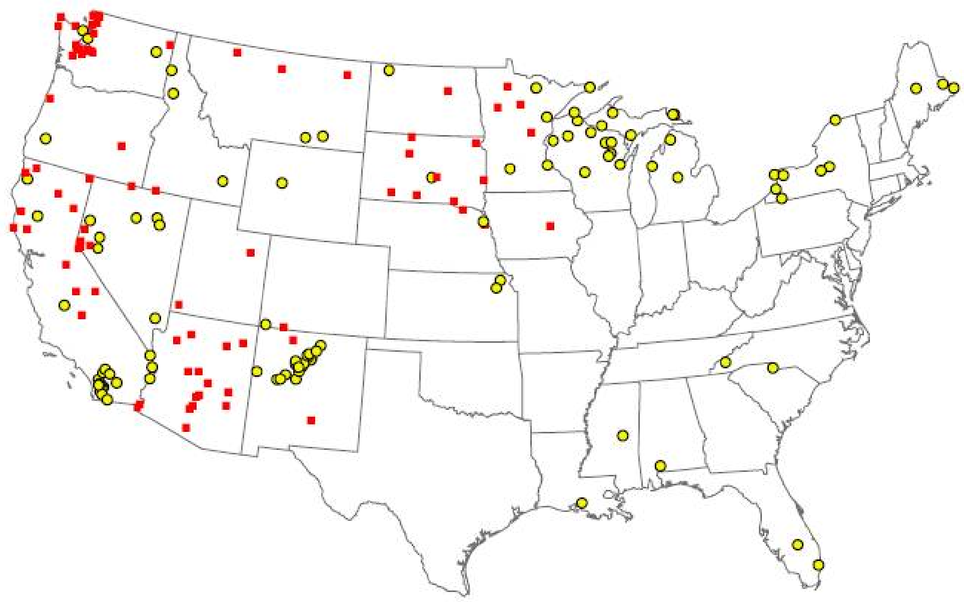


Figure 1: Reservations with (red square) and without (yellow circle) Forced Integration

tribal territories, I digitized the "Map of Early Indian Tribes, Culture Areas, and Linguistic Stocks" in the *National Atlas of the United States* (1970) to construct a baseline map and supplemented this in places with the slightly more detailed local maps from the *Smithsonian Handbook of Native Americans* (1981). Figure 2 displays the National Atlas Map.[25]

To link historical mining activities to tribal homelands, I digitized maps of historical mining activities from the 1880 Census.[26] There were three separate maps for gold, silver and copper and coal. Figure 3 displays one of these maps from the 1880 Census. Underlying the state-specific shading, which represents state-level values, are small circles which represent mining-clusters.[27] I

[25]For areas in and west of the rockies, the map shows pre-reservation territories which correspond to pre-contact. For the Plains, the map represents pre-reservation rather than pre-contact boundaries because permanent settlement in the Plains only became possible with the introduction of the horse in the mid-1700s. In the East, the map represents pre-contact. Many Eastern tribes were moved to *Indian Territory*, roughly corresponding to Oklahoma today, during the *Indian Removal* that preceded the 1850s, which raises the concern that the instrument is measured in the wrong place for Eastern tribes. However, when Oklahoma declared statehood in 1907, all tribes in Oklahoma lost their reservations. They now live on so-called (OTSAs), statistical regions with high Indian population densities but that are not in my data. For the Eastern bands that did not move to Indian Territory and which obtained reservations the pre-reservation maps are located correctly. (See Prucha (1970 ch.9), Satz (1975) and Unrau (2007) for accounts.

[26]Ideally, I would have liked mining data going back as far as 1850 when the first reservations were formed. However there is no systematic statistical documentation of the very early mining activity in the 1850s.

[27]These are clearly visible only at resolutions that are too high to include in a printable pdf. Clusters of mining activity are in principle a less precise measure than maps of actual mines. But for coverage of the entire U.S. they are far superior to the fragmentary record of local mining maps which were collected at different times, to different standards of data collection and that were drawn with different projections or curvatures, which makes it difficult to geo-reference them to each other.

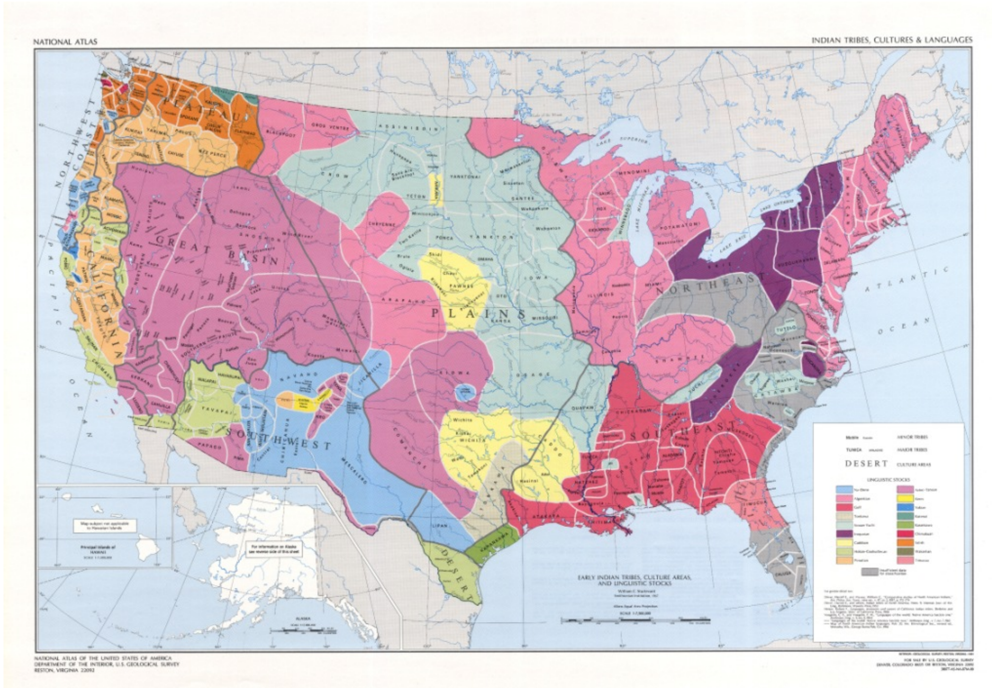


Figure 2: 1970 National Atlas Map

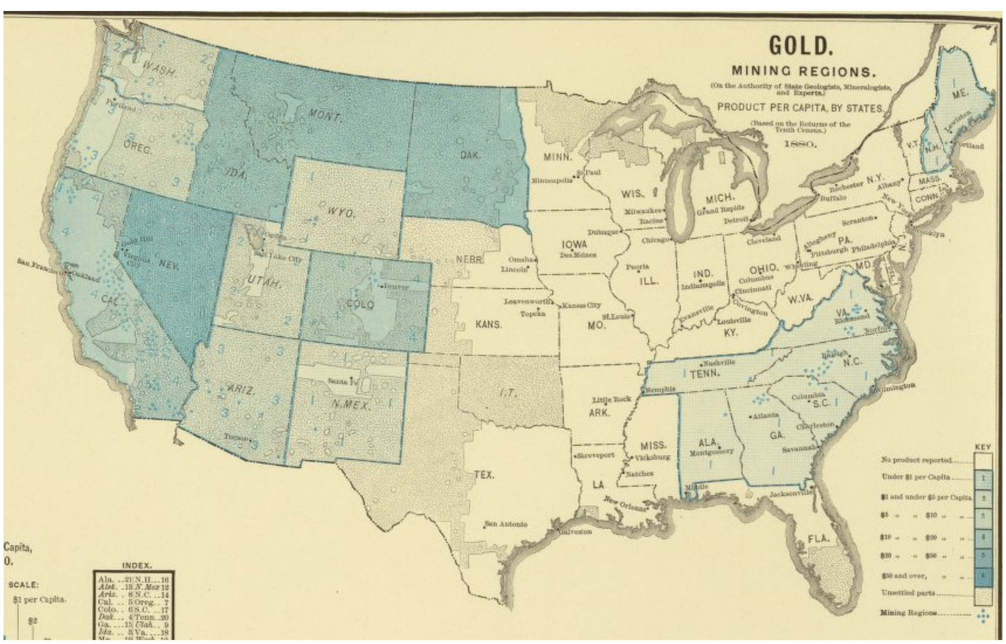


Figure 3: Gold Mines (1880 Census)

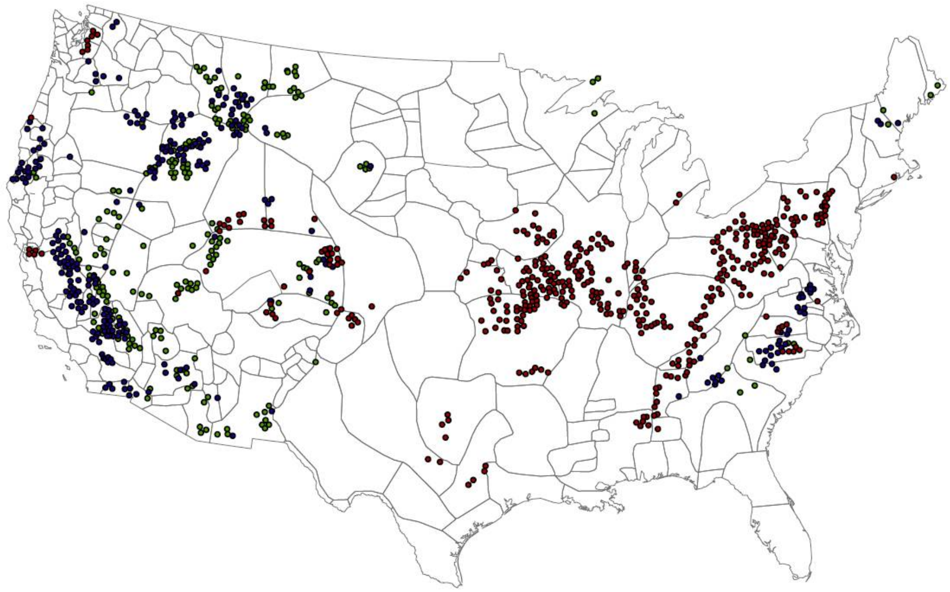


Figure 4: Geo-database on Mining Clusters in Precious Metals and Coal

digitize these clusters as raster points and then assign a value to each raster point by dividing state level estimates of average total mining activity from 1860 to 1890 by the number of raster points in a state.[28] While I only have maps from the 1880 Census, I have additional data on state-level mining activity the 1870, and 1890 Census which gives me yearly data for 1860 to 1889, covering almost the entire key period of reservation formation. I then overlay the mining clusters with the maps of tribal homelands as in Figure 4, where the 3 different colors represent gold, silver (plus copper) and coal mines. The value assigned to raster-points varies by mining type as well as by state, although this latter variation is not visible in figure 4. Finally, I calculate the value of mining exposure of a reservation's constituent bands by aggregating over the raster-points that fall inside their territory.

4 Results

4.1 Descriptive Statistics

Table 2 Panel A presents means of outcome variables and Table 2 Panel B presents means of economic control variables for reservation size, geographic features and the economic environment.

[28]Higher densities of mining activity are represented by a higher density of raster points so that this should not lead to downward biased estimates of more valuable areas and upward biased estimates of less valuable areas.

Table 2: Table of Means - Outcomes and Controls

Panel A: Socio-Economic Outcomes				**Panel B:** Control Variables			
	$\mathbf{C}_i = 1$	$\mathbf{C}_i = 0$	(2)=(3)		$\mathbf{C}_i = 1$	$\mathbf{C}_i = 0$	(2)=(3)
p.c. Income	8195	12198	5.74	Land-Quality, Res	50	41	-2.18
	(2322)	(5678)			(31)	(25)	
HH Income	24092	31795	4.01	Ruggedn., Res.	0.65	0.60	-0.19
	(7430)	(15326)			(1.49)	(2.12)	
% in poverty	36.27	27.02	-5.20	Res.-Area(sqkm)	2504	623	-2.48
	(12.70)	(11.02)			(7568)	(1617)	
Unempl-rate	19.49	14.17	-4.31	Surr. p.c. Income	18239	18477	0.53
	(8.97)	(7.53)			(3022)	(2895)	
% Adults w. high-school	34.26	33.62	-0.54	Dist. Major City (Mil.)	59	50	-1.29
	(7.48)	(8.26)			(48)	(41)	
% Adults w. coll-degree	3.27	4.76	2.97	$\mathbf{pre}_i$	1.03	1.49	3.81
	(2.29)	(3.88)			(0.16)	(0.73)	
% English 1st lang.	60.75	60.17	-0.14	%(Agriculture)	11.49	23.58	2.39
	(25.45)	(29.12)			(18.80)	(28.89)	
Res.-Population	4276	1345	-1.53	% Freemen	68.92	90.57	3.48
	(19546)	(1784)			(47.00)	(29.00)	

N = 80 for $\mathbf{C}_i = 1$, N = 102 for $\mathbf{C}_i = 0$

The differences in outcomes between reservations with and without forced integration are pronounced. Reservations without forced integration do better along all economic dimensions and also have higher shares of post-secondary education. On the other hand, secondary educational attainment and the share of households whose main spoken language is English, a potential proxy for present-day economic integration, do not not differ with forced integration.[29] Panel B shows that other characteristics appear to be fairly balanced across the two groups. Reservations with forced integration are somewhat bigger and have slightly better land[30] but there are no differences in the economic environments surrounding reservations. Figure 5 shows kernel density estimates of the distribution of the log of per capita incomes on reservations without and with forced integration. The horizontal lines depicts the 2 group means.

[29]Secondary educational attainment is also uncorrelated with economic outcomes. Given the emphasis on education in the development literature this seems surprising but it can be explained by the fact that most education on reservations is provided by the BIA.

[30]This could be because tribes on ancestral homelands more suitable for agriculture were more likely to be moved onto shared reservations. The correlation coefficient between the suitability for agriculture of ancestral homeland and reservation lands is 0.4.

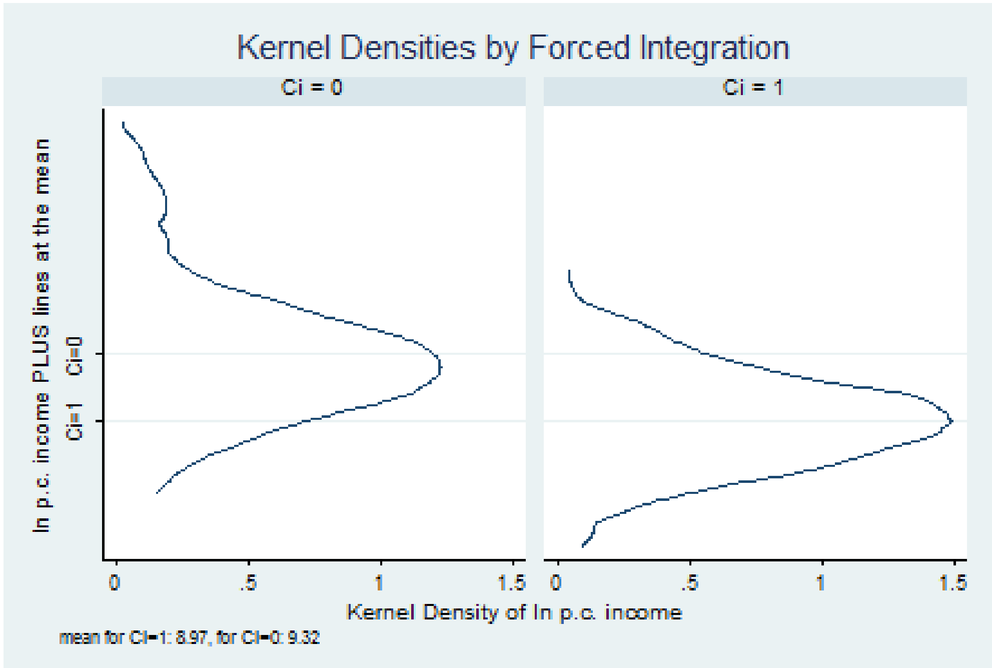


Figure 5: Raw Data Densities

4.2 Baseline Results

The baseline estimating equation is:

$$\mathbf{y}_i = \alpha_0 + \beta \mathbf{C}_i + \alpha_1' \mathbf{X}_{i,1} + \alpha_2' \mathbf{X}_{i,2} + \epsilon_i \quad (3)$$

The outcome variable $\mathbf{y}_i$ is the log of the average per capita income on reservation i. $\mathbf{C}_i$ is the measure of forced integration, $\mathbf{X}_{i,1}$ are reservation level controls and $\mathbf{X}_{i,2}$ are tribal characteristics I control for.

The first concern I address is to disentangle the effect of forced integration, measured by $\mathbf{C}_i$, from potential effects of unforced integration on reservations, measured by $\mathbf{post}_i$, and from pre-reservation integration, measured by $\mathbf{pre}_i$. Population heterogeneity, as measured here by $\mathbf{post}_i$, has been shown to have a direct negative effect on incomes in many settings (Easterly and Levine, 1997; Alesina *et al.*, 1999, 2000). Similarly, Bockstette *et al.* (2002), Gennaioli and Rainer (2007) and Tabellini (2008b) provide evidence that state antiquity or more centralized historical state organization, as measured by $\mathbf{pre}_i$, may have a direct positive effect itself. account for these direct effects. In table 3 column (1) I first show that, not controlling for anything else, forced integration

Table 3: Simple Integration and Early Start vs. Forced Integration Hypotheses

	Dependent: log(per capita income)					
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbf{C}_i$	-0.354***				-0.366***	-0.310***
	(0.05)				(0.06)	(0.07)
$D(\mathbf{pre}_i = 1)$		0.142**		0.278***	-0.037	
		(0.07)		(0.07)	(0.07)	
$D(\mathbf{post}_i = 1)$			-0.284***	-0.358***		-0.065
			(0.05)	(0.06)		(0.07)
Constant	9.328***	9.143***	9.349***	9.337***	9.342***	9.349***
	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)
Observations	182	182	182	182	182	182
R-squared	0.21	0.02	0.13	0.21	0.22	0.22

Standard errors: * significant at 10%; ** significant at 5%; *** significant at 1%

has a significant negative effect on incomes today. In columns (2) and (3) I show that $\mathbf{pre}_i$ and $\mathbf{post}_i$, when included on their own, are significant and have coefficients that are consistent with existing studies. The results are stronger when both measures are included together in column (4). However, when I include either $\mathbf{pre}_i$ or $\mathbf{post}_i$ together with $\mathbf{C}_i$ in columns (5) and (6), only $\mathbf{C}_i$ is significant. In other words, having been more integrated in the past is good but only to the extent that it makes forced integration less likely. And being more integrated is bad but only to the extent that it is forced. It is not possible to include all three measures together because they are perfectly collinear by construction.

Moving to the baseline regression, I regress incomes on forced integration and a variety of controls for the economic conditions of a reservation as well as for possibly confounding tribal characteristics as coded in the EA. I control for the following reservation-level control variables $\mathbf{X}_{i,1}$: Because reservations are relatively small, their opportunities depend heavily on the economic environment, both as an opportunity to participate in off-reservation labor markets and as a customer base for selling reservation products and services. I control for both remoteness from and thickness of the surrounding economic environment by including the log of the distance from the reservation centroid to the nearest major city, defined by a population of more than 50'000, as well the log of per capita income of surrounding counties.[31] To account for different shares

[31]To calculate the latter measure, I consider all counties whose borders fall within 30 kilometers of the reservation boundaries but exclude counties for which more than 25% of the land area overlaps with reservation land to avoid

Table 4: Baseline With Reservation Characteristics

	Dependent: log(per capita income)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\mathbf{C}_i$	-0.354***	-0.344***	-0.344***	-0.312***	-0.309***	-0.308***	-0.303***
	(0.051)	-0.048	(0.046)	(0.047)	(0.048)	(0.048)	-0.047
log(Surrounding pc Income)		0.707***	0.485***	0.438***	0.425***	0.348**	0.429***
		-0.149	(0.155)	(0.154)	(0.156)	(0.165)	-0.161
log(Distance to Major City)			-0.094***	-0.102***	-0.110***	-0.100***	-0.075***
			(0.024)	(0.024)	(0.024)	(0.025)	-0.025
Pop-Share Adult (0-100)				0.010**	0.013***	0.012***	0.014***
				(0.004)	(0.004)	(0.004)	-0.004
log(Land Quality, Reserv.)					0.046**	0.045**	0.045**
					(0.021)	(0.021)	-0.02
log(Ruggedness, Reserv.)					-0.004	-0.001	0.009
					(0.018)	(0.018)	-0.018
log(Population, Reserv.)						-0.012	-0.028
						(0.025)	-0.025
log(Area, Reserv.)						-0.009	-0.008
						(0.011)	-0.011
D(Casino)							0.194***
							-0.05
Observations	182	182	182	182	182	182	182
R-squared	0.21	0.31	0.36	0.38	0.39	0.41	0.45

Distance to major city is measured from reservation-centroid to the centroid of the nearest city with population over 50’000. Standard errors: * significant at 10%; ** significant at 5%; *** significant at 1%

of population of working age, I include the share of the population above age 16. To control for possible returns to scale in reservation size, I control for both the log of population size and the log of the reservation area. To control for geographic endowments, I use an index for the suitability of reservation lands for agriculture and an index for ruggedness, both from the Global Agro-Ecological Zones (GAEZ) project of the United Nations Food and Agriculture Organization (FAO).[32] In addition, I control for gambling, which is possibly the most important and certainly the most publicized economic shock to reservations in the recent past. Data on tribally run enterprises including casinos is not public but Taylor and Kalt (2005) have constructed a dummy-variable for every reservation, denoting whether it has a gambling operation in the period 1990-2000 which I use here.

The results of estimating equation (3) are displayed in Table 4. Column (1) regresses per capita incomes only on forced integration. Columns (2) and (3) introduce controls for the economic

regressing reservation level outcomes on themselves. I then take a population-weighted average of per capita incomes of the surrounding country-side.

[32]To calculate these indices, I overlay a geographic database of reservations, available from the US Census bureau, with the FAO databases and average land-attributes by reservation.

environment. The controls for the economic environment are highly significant and reasonably large. A one standard deviation increase in surrounding per capita income (2954 USD) raises on-reservation incomes by about 12% at the mean, circa 1200 USD. A one standard deviation increase in distance to the nearest major city (44 miles) reduces incomes by about 8% at the mean or circa 800 USD. In column (4) I include the share of the population at working age, which is mechanically linked to per capita incomes and therefore has an important effect. In column (5), I control for resources endowments, the suitability of reservation lands to agriculture and ruggedness. Land quality on reservations also matters, which is consistent with the view that agriculture and grazing are still important activities on reservations. However, this effect is relatively second-order. A one-standard deviation increase in land quality (28 on an index from 0 to 100) increases incomes by only 1.2% at the mean. In column (6) I add controls for possible scale effects. These do not seem to matter. This is consistent with theoretical arguments made by Alesina, Spolaore and Wacziarg (2000b) that economies of scale disappear if smaller entities are fully integrated and can source things like public goods from elsewhere. In column (6), I include a casino dummy although this is obviously endogenous and might over-control. Having a casino increases incomes by about 20% on average. The casino dummy changes the coefficients on the economic environment. The cost of remoteness gets smaller, suggesting that remoteness partly worked though a lower likelihood of opening a gambling facility if the potential customer base is too far away. The benefits from higher surrounding income levels actually get larger, suggesting that gambling revenues may actually be lower in more affluent areas.

In table 5, I control for tribal characteristics $\mathbf{X}_{i,2}$ from the EA in addition to the reservation characteristics. There are two variables in the EA that are available for Native Americans and that could have potential long run effects: historical subsistence patterns and historical social stratification of Native societies. Pre-reservation subsistence patterns could matter because reservation life forced hunting, fishing and gathering tribes to change their subsistence patterns towards agriculture and this adjustment could have been difficult. Ballas (1987, p.18-21) for example suggests that hunting tribes had difficulty adjusting to the lifestyle of sedentary agriculturalists imposed on them on reservations.[33] Historical social fragmentation could matter if individuals retain their

[33]Subsistence patterns might also help to partly control for unobserved regional characteristics or shocks because they exhibit clear spatial patterns. The spatial distribution of subsistence patterns depended on geographic endowments: The North-East and South-East were largely agricultural. The Plains tribes were predominantly hunting tribes.

Table 5: Pre-Reservation Characteristics and Regional Fixed Effects

	Dependent: log(per capita income)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\mathbf{C}_i$					-0.333***	-0.326***	-0.297***	-0.304***
					(0.055)	(0.090)	(0.061)	(0.059)
$\mathbf{pre}_i$	0.187***	0.008		0.173***	0.008		-0.073	-0.113
	(0.063)	(0.066)		(0.066)	(0.066)		(0.107)	(0.086)
%(hunt)		0.091		-0.012	0.141		-0.388	-0.405
		(0.228)		(0.231)	(0.211)		(0.369)	(0.319)
%(fish)		-0.103		0.104	0.117		-0.793***	-0.627***
		(0.190)		(0.232)	(0.211)		(0.252)	(0.237)
%(agriculture)		-0.052		-0.148	-0.204		-0.287	-0.476**
		(0.167)		(0.166)	(0.151)		(0.252)	(0.191)
D(Social Stratification)			-0.149**	-0.132	-0.049		-0.027	0.017
			(0.069)	(0.085)	(0.078)		(0.099)	(0.097)
8 Reservation Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
79 Tribe Fixed Effects	No	No	Yes	No	No	Yes	No	No
28 State Fixed Effects	No	No	No	No	No	No	Yes	No
11 BIA Fixed Effects	No	No	No	No	No	No	No	Yes
Observations	182	182	182	182	182	182	182	182
R-squared	0.34	0.32	0.33	0.37	0.48	0.67	0.55	0.48

%(hunt) denotes the percentage share of nutritional intake from hunting. Subsitence shares add up to 1 with %(gathering) omitted. D(Social Stratification) is an indicator for Wealth Distinctions or Hereditary Aristocracy. Standard errors: * significant at 10%; ** significant at 5%; *** significant at 1%

historical social identities within political entities. Banerjee *et al.* (2005) find supporting evidence for this in India, where regions that were historically more socially fragmented are found to have lower public good provision today. The EA codes historical subsistence patterns as the share of total food intake coming from four sources of subsistence: fishing, gathering, hunting and agriculture. The EA further codes historical social stratification in 3 categories for whether a society was completely egalitarian, made any distinctions based on wealth or had a hereditary nobility. To conserve space, I simply include a dummy for either distinctions based on wealth or had a hereditary nobility.

In columns (1)-(4) I do not include $\mathbf{C}_i$ to focus on how tribal characteristics impact incomes today. As before, having been more integrated in the past has a significant positive effect. Subsistence patterns, defined as shares of nutritional intake by source with the category gathering omitted, are not significant. Having had a form of social stratification in the past has a signifi-

The North-Western tribes were fishing tribes. Tribes in California, the Great Basin (Utah and Nevada) and the Plateau (Wyoming and Idaho) were mostly nomadic gatherers and hunters. The South-West was characterized by small agricultural islands of the Pueblo Nations (sometimes viewed as a separate geographic sphere labeled Oasis) in a sea of Apachian nomadic hunter-gatherers (Smithonian Handbook 1981).

cant negative effect.[34] When I include forced integration in column (5), both historical integration and historical social stratification become insignificant. In column (6) I pursue the most stringent strategy for dealing with confounding tribal characteristics by including tribal fixed effects, thus identifying only off within-tribal variation. The estimated magnitude of the effect of forced integration hardly changes at all and while standard errors roughly double, the coefficients are still significant at the 1% level. Figure 6 displays the distribution of reservations per tribe. 26% of reservations are mapped to only one tribe. Having 79 tribal fixed effects therefore conceptually amount to dropping these 46 reservations/tribes altogether and identifying the effect of forced integration off the remaining 136 reservations with 33 tribal fixed effects. Two tribes, the Chippewa and Sioux, have particularly many reservation, but the results are robust to dropping either of those tribes. (Not reported.) The chloropleth map in Figure 1 suggests that some regions could have a substantial influence on the results. That is why in column (7) I include state fixed effects. This does not alter the results. Finally, I test whether the most relevant administrative region for reservations is the BIA-office-region rather than the state. Including BIA- office instead of state fixed effects also does not alter the results. The robustness of the results suggest that there might be some very influential observations that drive these results. However, a residual regression plot, reported in Figure 7, does not suggest that this is the case. I test more formally for the influence of outliers in the robustness checks in Section 4.4.

4.3 IV Results

The key threat to the validity of the preceding results is selection into forced integration. This selection is only imperfectly accounted for by tribal fixed effects because selection may well have also occurred at the band level. In section 2.4, I argue that mining rushes should be exogenous to tribal characteristics, conditional on other land characteristics. In Table 6, I inspect the relationship between the mining instruments, land characteristics and other the control variables.[35]

In table 6, each row represents a separate regression. Row (1) shows that the most important tribal characteristic in the preceding regressions, historical political integration, is negatively correlated with precious metal deposits. Rows (2) and (3) show that mining deposits were sig-

[34]When I split this dummy into two separate dummies for wealth distinction and a hereditary aristocracy, the latter is significant and the former marginally insignificant.

[35]To conserve space, I aggregate the value of gold and silver mining into one variable called precious metals.

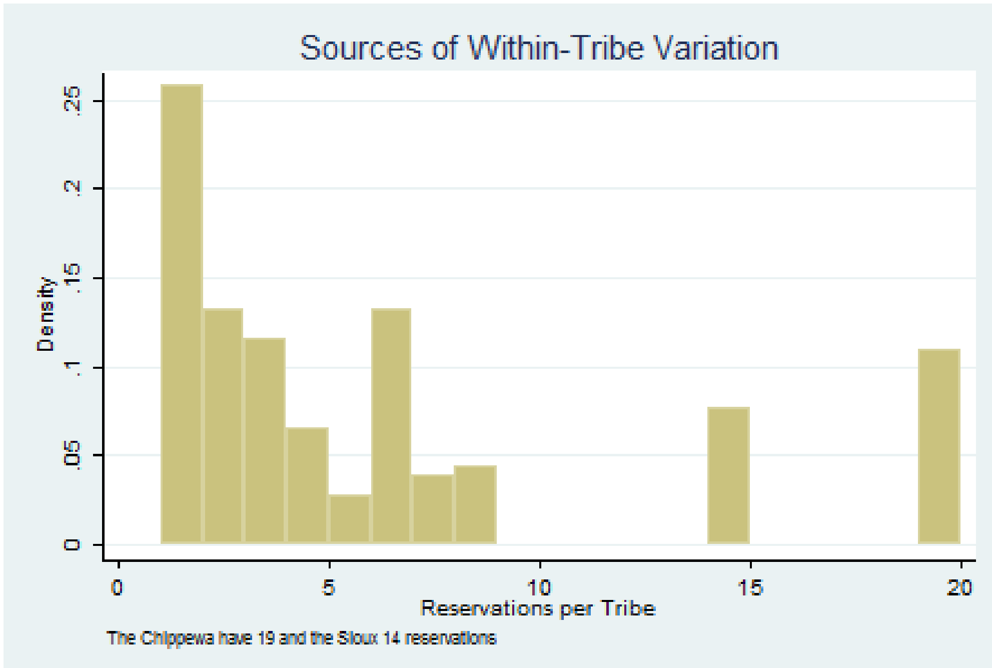


Figure 6: Sources of Within-Tribe Variation in Forced Integration

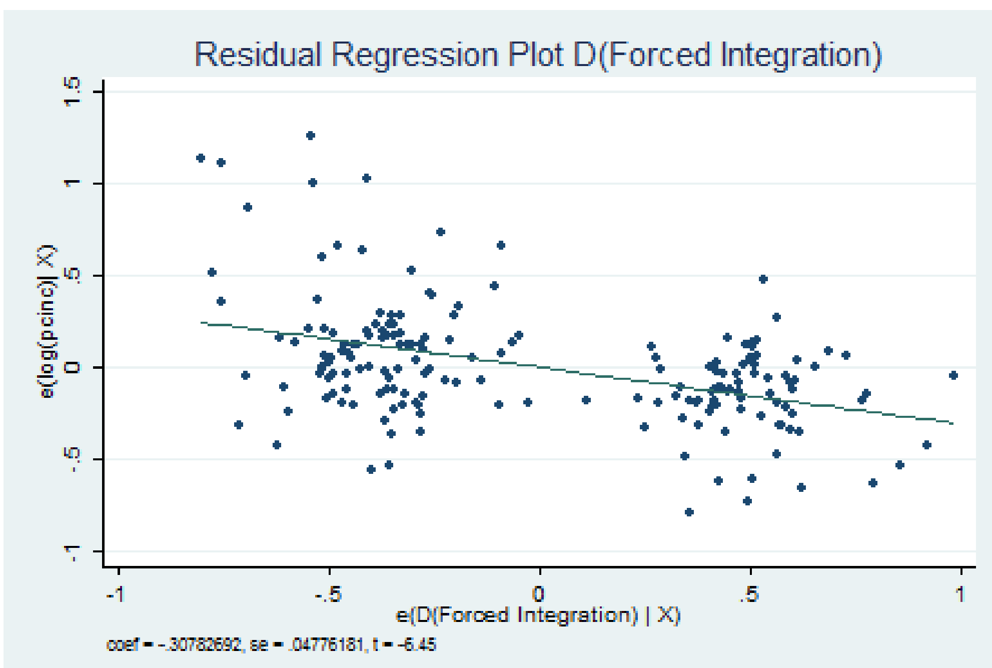


Figure 7: Residual Regression Plot for Table **??**

nificantly correlated with other land attributes on tribal territories. This turns out to be driving the relation in row (1). Row (4) shows that when other land characteristics are controlled for, the relation between mining and political integration disappears. This is driven by the negative correlation between precious metal mines and the suitability of land for agriculture, which is positively correlated with more political integration because of returns to scale in agriculture (Driver, 1961). Rows (5) and (6) show that coal mining deposits are correlated with the present day economic environment. This is consistent with the literature on 19th century industrialization which stresses the importance of industrial resources for the location of early industrialization and the formation of cities (Wright 1990, Mitchener and McLean 2003). The validity of coal mines as an instrument is not affected as long as direct effects of coal mines on the present-day economic environment are adequately controlled for with surrounding county income and distance to the nearest major city. If there is a positive effect of coal mines that is not controlled for, this will bias the IV estimates against finding a negative effect of forced integration. Row (7) shows that in addition, mining deposits are correlated with the ruggedness of reservation lands. While this is less of a concern because on-reservation ruggedness was not significant in any specifications, row (8) also shows that this correlation disappears once ruggedness of tribal territories is controlled for. In addition, it is possible that resources on tribal territories are positively correlated with later resource findings on reservations. In row (9) I check whether having had more minerals in the past makes a reservations more likely to be a member of the council of energy producing tribes (CERT).[36] This is not the case. This might be because the government was more careful to select reservation lands that were unlikely to contain resources when there were valuable resources in the proximity. Overall, this evidence clearly shows the importance of controlling for observable land characteristics of ancestral homelands but does suggest that conditional on these, the location of mineral deposits was exogenous. In addition to these correlations, I also statistically test for the validity of the instruments with over-identification tests.

Table 7 displays results for the first and second stage regressions. Columns (1)-(3) display results for the first stage regressions. Columns (4)-(6) display results for the second stage reduced form without conditioning on potentially endogenous land characteristics that could be correlated. Columns (7)-(9) report results for the same regression but conditioning on other charac-

[36] Taken from http://www.certredearth.com/aboutus-memberTribes.html

Table 6: Balancing Tables: Correlation of Included and Excluded Instruments

	Rows: Dependent	$\frac{\text{Avg Mining Value (Coal)}}{\text{homeland-sqkm}}$	$\frac{\text{Avg Mining Value (Prec. Metals)}}{\text{homeland-sqkm}}$	log(Land Quality,HL)	log(Ruggedness,HL)	R^2
(1)	$D(\mathbf{pre}_i > 1)$	-0.196	-0.326***			0.05
		(0.160)	(0.115)			
(2)	log(Land Quality,HL)	0.715	-1.660***			0.09
		(0.600)	(0.431)			
(3)	log(Ruggedness,HL)	1.171***	1.163***			0.13
		(0.377)	(0.270)			
(4)	$D(\mathbf{pre}_i > 1)$	-0.188	-0.178	0.059***	-0.043	0.13
		(0.163)	(0.117)	(0.022)	(0.035)	
(5)	log(Surr. pc Income)	0.214***	-0.026			0.07
		(0.062)	(0.045)			
(6)	log(Dist. Major City)	-1.262***	-0.047			0.05
		(0.401)	(0.288)			
(7)	log(Ruggedness, Res.)	1.511***	1.014***			0.08
		(0.505)	(0.363)			
(8)	log(Ruggedness, Res.)	0.015	0.065		0.738***	0.35
		(0.032)	(0.043)		(0.084)	
(9)	CERT	-0.0013854	0.0012246			0.01
		(0.016)	(0.012)			

Abbreviation HL stands for "tribal homelands;" s.e.: * significant at 10%; ** significant at 5%; *** significant at 1%

teristics of tribal territories, which were potentially endogenous to tribal characteristics. The first stage results in columns (1)-(3) are only reported conditional on the endogenous land characteristics because excluding them had no discernible effects in the first stage regressions. Because of potential finite sample bias of the IV, the number of instruments becomes an important choice. I therefore report each regression for 3, 2 or 1 instrument where I first consider gold, silver and coal mines separately, then aggregate silver and gold mines into precious metal mines and finally aggregate all three types of mines into just one measure.

For the first stage regression, column (3) implies that a one standard deviation increase in mining values per square km (39 USD) raises the probability of forced integration by 14%. Pre-reservation integration is mechanically linked to forced integration. Having been more integrated in the past makes forced integration on a reservation 40% less likely. Other tribal characteristics had no correlation with forced integration and are not included. The only other control variables that correlate with forced integration are demographics. Reservations under forced integration are larger and have younger populations.

The second stage reduced form regressions are reported both with and without controlling for endogenous homeland-characteristics because the comparison of the regression results is informative. The first notable difference is the change in the coefficient on coal mines and precious

Table 7: First and Second Stage Results

Dependent:		$\mathbf{C}_i$			log(per capita income)			log(per capita income)	
# of Instruments	3	2	1	3	2	1	3	2	1
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\frac{\text{Avg Mining Value (Gold)}}{\text{homeland-sqkm}}$	0.021***			-0.002***			-0.002**		
	(0.007)			(0.001)			(0.001)		
$\frac{\text{Avg Mining Value (Silver)}}{\text{homeland-sqkm}}$	0.055***			-0.003*			-0.001		
	(0.012)			(0.002)			(0.002)		
$\frac{\text{Avg Mining Value (Coal)}}{\text{homeland-sqkm}}$	0.051***	0.052***		-0.013	-0.013		-0.024**	-0.024**	
	(0.018)	(0.018)		(0.009)	(0.009)		(0.011)	(0.011)	
$\frac{\text{Avg Mining Value (Prec. Metals)}}{\text{homeland-sqkm}}$		0.051***			-0.025***			-0.017**	
		(0.012)			(0.008)			(0.008)	
$\frac{\text{Avg Mining Value (All Mines)}}{\text{homeland-sqkm}}$			0.034***			-0.013***			-0.011**
			(0.007)			(0.004)			(0.004)
log(Land Quality,Homel.)	-0.025	-0.045	-0.029				0.068***	0.066***	0.057***
	(0.032)	(0.032)	(0.028)				(0.019)	(0.018)	(0.017)
log(Ruggedness,Homel.)	0.008	0.004	0.007				-0.015	-0.016	-0.021
	(0.050)	(0.050)	(0.048)				(0.050)	(0.049)	(0.049)
CERT	-0.135	-0.12	-0.12				0.087	0.088	0.086
	(0.083)	(0.085)	(0.083)				(0.057)	(0.056)	(0.056)
$D(\mathbf{pre}_i > 1)$	-0.408***	-0.404***	-0.410***	0.144**	0.145**	0.146**	0.092	0.092	0.097*
	(0.066)	(0.066)	(0.066)	(0.057)	(0.057)	(0.057)	(0.057)	(0.056)	(0.056)
log(Surround. pc Income)	-0.147	-0.109	-0.038	0.359*	0.352*	0.352*	0.346*	0.354*	0.320*
	(0.225)	(0.231)	(0.222)	(0.198)	(0.195)	(0.187)	(0.195)	(0.191)	(0.184)
log(Distance to Major City)	0.043	0.042	0.034	-0.109***	-0.109***	-0.109***	-0.125***	-0.126***	-0.121***
	(0.033)	(0.034)	(0.033)	(0.030)	(0.030)	(0.030)	(0.029)	(0.029)	(0.028)
Pop-Share Adult (0-100)	-0.026***	-0.026***	-0.026***	0.020***	0.020***	0.020***	0.021***	0.021***	0.021***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
log(Land Quality, Reserv.)	0.025	0.036	0.024	0.041**	0.042**	0.042**	0.003	0.004	0.01
	(0.033)	(0.033)	(0.031)	(0.020)	(0.020)	(0.020)	(0.022)	(0.022)	(0.021)
log(Ruggedness, Reserv.)	-0.004	-0.009	-0.006	0.001	0.002	0.002	0.028	0.028	0.025
	(0.030)	(0.030)	(0.030)	(0.028)	(0.028)	(0.028)	(0.035)	(0.035)	(0.034)
log(Population, Reserv.)	0.069**	0.070**	0.076***	-0.035	-0.036	-0.035	-0.043*	-0.043*	-0.045*
	(0.029)	(0.029)	(0.029)	(0.025)	(0.025)	(0.025)	(0.024)	(0.024)	(0.025)
log(Area, Reserv.)	-0.013	-0.012	-0.012	-0.005	-0.005	-0.004	-0.001	-0.001	-0.002
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.016)	(0.016)	(0.016)
F-Test(Instruments)	12.49	13.57	25.39	3.51	5.23	9.79	2.99	3.85	5.93
Observations	182	182	182	182	182	182	182	182	182
R-squared	0.39	0.37	0.37	0.31	0.31	0.31	0.36	0.36	0.35

The first 6 regressors are calculated at the level of the ancestral homeland associated with a reservation. The first 4 regressors are the instruments. For easier reading, the instruments are defined in units of 10 USD. Not reported but included are the 6 reservation level controls for reservation size, land characteristics and economic environment. Standard errors: * significant at 10%; ** significant at 5%; *** significant at 1%

metal mines from column (5) to (8). When endogenous land characteristics are not included the effect of coal mines is insignificant while the effect of precious metal mines is significant and large. Including endogenous land characteristics turns the coefficient on coal significant and large while reducing the coefficient on precious metal mines. The partial correlations reported in Table 6 suggest that this change can be explained by the positive correlation between precious metal mines and ruggedness which may have a direct negative effect on reservation through its effect on the economic environment (provided reservations are not too far removed from homelands) or may proxy for unobserved characteristics of bands that ended up on the most rugged land. Coal mines on the other hand are positively correlated with the land quality of ancestral homelands and with the economic environment today. This suggests that if the land quality of ancestral homelands is not adequately controlled for that coal mines pick up some positive characteristics of the economic environment. A second notable difference is that $\mathbf{pre}_i$ becomes insignificant when land characteristics are included. An intuitive interpretation is that $\mathbf{pre}_i$ proxies for other important band characteristics that are now better captured by the land quality on tribal territories. A third notable difference is that the coefficient on reservation land quality, very significant in the previous regressions, turns insignificant when the quality of ancestral homelands is included. This suggests that the land quality of reservations also partly proxied for land characteristics of tribal homelands.

The F statistics show that the instruments are clearly stronger if they are aggregated up. The trade-off is that at least 2 instruments are needed to test the validity of the instruments with over-identification tests. I therefore continue to report results for 3, 2 and 1 instrument in Table 8, which displays the IV results, with the OLS benchmark in column (1). Columns (2)-(4) and (5)-(7) show the TSLS estimates with and without controlling for endogenous land characteristics. Because of its better properties in handling finite sample bias with weak instruments (Murray 2006a, 2006b), I also report LIML estimates in columns (8)-(10). Consistent with the discussion on Columns (4)-(9) in Table 7, the IV results are smaller when endogenous land characteristics are controlled for and are in fact not significantly different from the OLS results. The over-identification tests are passed in all specifications. The Weak Identification F Statistics together with the Stock-Yogo Critical Values give a sense of how reliable these results are. The Stock-Yogo Critical Values (10%) gives the value that the Weak Identification F Statistic needs to pass for us to be confident that true

Table 8: IV Results

	Dependent: log(p.c. income)									
	OLS		TSLS			TSLS			LIML	
# of Instruments		3	2	1	3	2	1	3	2	1
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$\mathbf{C}_i$	-0.333***	-0.370***	-0.411***	-0.390***	-0.316**	-0.380**	-0.317**	-0.319**	-0.381**	-0.317**
	(0.053)	(0.137)	(0.149)	(0.142)	(0.138)	(0.149)	(0.144)	(0.142)	(0.149)	(0.144)
log(Land Quality,HL)					0.048**	0.046**	0.048**	0.048**	0.046**	0.048**
					(0.020)	(0.021)	(0.020)	(0.020)	(0.021)	(0.020)
log(Ruggedness,HL)					-0.019	-0.016	-0.019	-0.019	-0.016	-0.019
					(0.035)	(0.036)	(0.035)	(0.035)	(0.036)	(0.035)
CERT					0.048	0.041	0.048	0.048	0.041	0.048
					(0.065)	(0.065)	(0.065)	(0.065)	(0.066)	(0.065)
$D(\mathbf{pre}_i > 0)$	0.02	-0.015	-0.035	-0.025	-0.033	-0.062	-0.033	-0.034	-0.062	-0.033
	(0.064)	(0.089)	(0.094)	(0.091)	(0.085)	(0.089)	(0.087)	(0.086)	(0.089)	(0.087)
Previous Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
p-value(Hausman)		0.292	0.215	0.250	0.453	0.285	0.452	0.446	0.283	0.452
p(Over-Id Test)		0.684	0.632		0.422	0.663		0.422	0.663	
Weak Instr. F Test		9.256	11.67	25.941	8.641	11.21	23.531	8.641	11.21	23.531
SY Crit.Value(10%)		22.3	19.93	16.38	22.3	19.93	16.38	6.46	8.68	16.38
SY Crit.Value(15%)		12.83	11.59	8.96	12.83	11.59	8.96	4.36	5.33	8.96
Observations	182	182	182	182	182	182	182	182	182	182

Standard errors: * significant at 10%; ** significant at 5%; *** significant at 1%. The Over-Identification Test-Statistic is the Hansen J Statistic. Weak Identification Test-Statistic is the Kleibergen-Paap Wald F statistic. Stock-Yogo Crit.Value(X%) gives the critical value that the Weak Identification Test has to lie above to reject that true significance is below X% when it is reported at 5%. Not reported but included are the 6 reservation level controls for reservation size, land characteristics and economic environment.

significance is not below 10% when it is reported at the 5%. For TSLS, this threshold is only passed when the instruments are aggregated up to one instruments, in which case the over-identification test is not identified. LIML's better finite sample properties mean that the Stock-Yogo Critical Values are lower so that we can be confident in the results even with 2 or 3 instruments, which allows for over-identification tests. In addition, because Stock-Yogo Critical Values are by default provided for the case of 5% reported significance level (Stock and Yogo 2005), they can be directly interpreted here as making us confident that the results are at least significant at the 10% level.

4.3.1 Heterogenous Treatment Effect

Surprisingly, the Hausman tests suggest that the IV estimates are not significantly different from the OLS results. An obvious explanation is that the OLS bias is simply not quantitatively important. However, this seems unlikely given the emphasis that the narrative puts on differences in unobservable band characteristics. An alternative explanation is that there were varying historical ties between bands that did not respect the boundaries coded in the EA. If bands that had strong unobservable ties between them were more likely to agree to shared reservations with forced integration and if such ties also made it easier to cooperate on the reservation, then the treatment effect of forced integration is heterogenous. In that case, IV estimates the local average treatment effect (LATE) on only those bands which would not have agreed to shared reservations had it not been for increased government pressure due to a mining rush. By comparison, the treatment effect on the treated (ToT) estimates the effect on these bands plus those bands that would have agreed to a shared reservation even without the mining shock. The ToT is therefore likely to be smaller than the LATE. Comparison of OLS and IV estimates amounts to a comparison of the ToT plus a negative selection term with a consistent estimate of the LATE. It is therefore possible that IV estimates are identical to OLS estimates even when IV is consistent and OLS is biased. Appendix A makes these points more formally. This interpretation of the comparison of OLS and IV is consistent with the narrative. Cornell and Gil-Swedberg (1992) for example suggest that White Mountain and Mescalero Apache Reservations do better than the San Carlos Apache Reservation — all three of them living under forced integration in my coding — because White Mountain's constituent bands (the White Mountain and Cibeque Apache) and Mescalero's constituent bands (Mescalero and Lipan Apache and some parts of the Chiricahua Apache) were historical allies while San Carlos's constituent bands (Tonto Apache and White Mountain) were not. Consistent with this, Cole (1988, p.84) argues that these historical ties explain why the Mescalero and Lipan bands on Mescalero Reservation actually welcomed the newly arriving Chiricahua band when they were re-located there.

4.3.2 Testing the Exclusion Restriction

A third explanation for the IV and OLS results being qualitatively identical is that the exclusion restrictions are not satisfied because mining shocks had an independent negative long run effect. The historical narrative suggests that the creation of reservations was often associated with famine created by the tighter food supply associated with settler influx preceding the formation of many reservations and possibly because violent conflict may have drastically reduced the time available for food collection (Stammel 1989).[37] The exclusion restriction would be violated if these health

[37] Another important channel worked through European diseases which certainly had a big impact on Native American populations (Jared Diamond 1997, pp. 77-78; Mann 2006). However, because diseases traveled faster than explorers and certainly much predated large settler movements, their effect had largely played itself out by the 19th century and any differential disease effects would be captured by tribal fixed effect s in this exercise.

shocks were sufficiently severe to have had independent long run effects. For instance, it is possible that tribes weakened by health shocks were more vulnerable to corrupt Indian agents or have developed a persistent hostile attitude towards European settlers which hindered subsequent economic integration. Another channel could be the destruction of much of a group's coherence and knowledge embedded in its older people if these had differentially higher mortality rates.

One piece of evidence that can be brought to bear on this issue is anthropometric data on the height of Native Americans that was collected by Franz Boas between the years 1890 and 1901 (Jantz 1995). This dataset contains information on the height of around 16000 Native Americans collected at more than 300 locations across the Unites States and Canada. While many of these sampling locations were either in cities or in Canada, I was able to map 64 of them — accounting for almost 6000 individuals — to reservations which are in my data. Using this data, I can test whether individuals whose youth overlapped with the years just preceding the formation of a reservation were shorter in the long run.[38] The logic underlying this is that variations in adult height are a measure of an individuals cumulative health during their key growth years (Voth and Leunig 1996, Steckel and Prince 2001). I take the formative years of human growth to be ages 0 to 19. To test for a negative shock to health associated with the formation of a reservations, I construct a measure $\mathbf{s}_i^\tau$ that denotes the share of individual i's formative growth years from age 0 to 19 that overlapped with the τ-year-window leading up to the formation of i's reservation, where I experiment with different time-windows, setting τ between 1 and 10 years. To test for differentially more severe shocks in the presence of mining activity, I interact $\mathbf{s}_i^\tau$ with the aggregate of the instruments $\frac{\text{Avg Value all Mining}}{\text{homeland-sqkm}}$. I estimate the following model:

$$\mathbf{h}_{ir} = \alpha \mathbf{s}_i^\tau + \mathbf{u}_r + \beta \mathbf{s}_i^\tau \cdot \mathbf{Z}_r + \Psi_i^{'} \delta + \epsilon_i \tag{4}$$

where $\mathbf{h}_{ir}$ is individual i's anthropometric health status on reservation r, $\mathbf{s}_i^\tau$ is the share of i's formative growth years that overlapped with the τ-year period leading up to reservation formation, $\mathbf{Z}_r$ is the aggregated instrument, $\mathbf{u}_r$ is a reservation fixed effect and Ψ_i is a vector of gender-specific age fixed effects. $\mathbf{Z}_r$ is not included as a separate regressor because it is fully explained by the reservation fixed effects which also soak up more variation than $\mathbf{Z}_r$. I drop children under

[38] The year of formation is a date specific to a reservation.

the age of 4 and include yearly age fixed effects for ages 5 to 23 but follow Steckel and Prince (2001) in assuming that there are no systematic height changes for ages between 23 and 48 and include only one age fixed effect for that bracket. For the age-bracket above 48 the number of observations decreases rapidly so that age fixed effects are not feasible. Instead, I include a linear trend on $\phi(age_i)$, where $\phi(age_i) = \min\{0, age_i - 49\}$. If the years leading up to the formation of a reservation were generally unfavorable to the indigenous populations' health, I expect $\alpha < 0$. If this effect was selectively more severe for populations who experienced mining pressure, then I expect $\beta < 0$. Replacing $\mathbf{Z}_r$ with $\mathbf{C}_r$ in equation (4), I can also test whether forced integration was associated with a differential health shock, which could be a potential explanation for the negative impact on outcomes today.

Table 9 Panel A reports the average of $\mathbf{s}_i^\tau$ for the different time windows that been the relevant period of reservation formation. The population average of one's youth spent during reservation formation increases mechanically when the time window is defined more widely, it is 1.2% when the formation period is defined only the one year before a reservation was formed. The remaining panels report the results of estimating equation (4), letting the reservation-formation time-window τ range from 1 to 7 years across columns. In Panel B, the $\mathbf{s}_i^\tau$ coefficient is significantly negative for all time-windows which suggests that the years leading up to the formation of a reservation were indeed associated with a negative health shock for the affected populations. The coefficient gets smaller with a larger time-window as the effect of growing up in the years leading up to reservation formation is spread over more years. In Panel C, I first check whether reservations with forced integration were exposed to more negative health shocks. While the sign of the interaction is consistent with this view, it is not statistically significant. In Panel D, I check for a differential health shock associated with mining rushes. With this interaction, the direct effect of $\mathbf{s}_i^\tau$ disappears and the interaction is marginally significant at the 10% for most time windows.

Individuals who grew up in the one-year window before a reservation was formed are about $109.6 \cdot 1/19 = 5.68$ millimeters shorter in adulthood. For those same individuals, a one standard deviation increase in $\mathbf{Z}_r$ (39.90 USD) seems to reduce long run height by less than 4 millimeters $(-1.83 \cdot 1/19 \cdot 39.90 = 3.84)$. We do not have a guideline as to how severe a health shock needs to be to have appreciable effects on a population's attitude or human capital stock 150 years later, but some contextualization can be gleaned from comparisons with stunting in other studies of health

Table 9: Testing for a Differential Health Shock from Mining Rushes

Formation-Years-Window τ:	1	2	3	4	5	6	7
Panel A:							
mean($\mathbf{s}_i^\tau$)	0.012	0.023	0.034	0.045	0.056	0.066	0.075
	Dependent Variable: Height in millimeters						
Panel B:							
$\mathbf{s}_i^\tau$	-109.675**	-58.064**	-40.593**	-33.273**	-29.123**	-26.314***	-24.400***
	(41.90)	(22.30)	(16.06)	(13.03)	(11.18)	(9.82)	(8.86)
Panel C:							
$\mathbf{s}_i^\tau$	-3.429	-3.315	-3.168	-3.161	-3.016	-2.958	-2.917
	(8.62)	(8.59)	(8.64)	(8.62)	(8.63)	(8.64)	(8.63)
$\mathbf{s}_i^\tau \cdot \mathbf{C}_r$	-52.707	-30.966	-25.441	-20.145	-19.026	-17.358	-15.88
	(155.41)	(80.13)	(54.70)	(42.00)	(34.79)	(29.86)	(26.41)
Panel D:							
$\mathbf{s}_i^\tau$	-62.129	-32.303	-22.471	-16.841	-14.886	-12.516	-11.516
	(58.02)	(30.68)	(21.80)	(17.54)	(15.23)	(13.31)	(12.01)
$\mathbf{s}_i^\tau \cdot \mathbf{Z}_r$	-1.833*	-0.963*	-0.663*	-0.537*	-0.447	-0.419*	-0.388*
	(1.08)	(0.55)	(0.39)	(0.31)	(0.27)	(0.24)	(0.21)

Variable $\mathbf{s}_i^\tau$ is the share of individual i's formative growth years from age 0 to 19 that overlapped with the τ-year-window leading up to the formation of i's reservation. Age-Gender Fixed Effects, the control $\phi(age_i)$ and Reservation Fixed Effects are included in all regressions. Because most explanatory power comes from the age-gender structure, R2 = 0.89 in all regressions reported. N = 5072. s.e.: * significant at 10%; ** significant at 5%; *** significant at 1%

shocks. Chen and Zhou (2007) and Meng and Quian (2006) estimate an effect of the Great Chinese Famine of 1959 on long run height between 2 and 3 centimeters, at least 5 times as much. Looking at a different health shock, Voth and Leunig (1996) estimate that having survived smallpox in one's youth reduces adult height by 2.6 inches, almost 20 times as large as the effect I find.[39] The differential effect of mining rushes therefore seems small by comparison.

4.4 Robustness Checks

As seen in figure 1, there are relatively concentrated clusters of reservations in Southern California, Washington State and New Mexico. Dropping one state at a time and replicating the results shows that California and New Mexico are indeed the most influential states. The estimated effect of forced immigration stays within a a narrow bandwidth of between -.322 and -0.297 when dropping any other state except these two. In addition, the IV results are qualitatively unaffected by dropping any other state. In table 10, I report results when either California or New Mexico are

[39] An alternative strategy would be to consider the demographics of the one-reservation population directly to test whether a larger share of the older population had died in the presence of mines. Unfortunately, for most reservations in the sample, the early 1890s are already too far removed from the year of reservation formation to allow for this.

Table 10: Outlier Tests

	Drop California			Drop New Mex.			D Fits		Cook's D	
	OLS	TSLS		OLS	TSLS		OLS	TSLS	OLS	TSLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$\mathbf{C}_i$	-0.226***	-0.19	-0.422*	-0.368***	-0.562**	-0.599**	-0.197***	-0.242*	-0.185***	-0.312**
	(0.049)	(0.210)	(0.223)	(0.049)	(0.233)	(0.252)	(0.037)	(0.137)	(0.037)	(0.137)
Observations	150	150	150	161	161	161	169	169	166	166
R-squared	0.44			0.47			0.48		0.48	

Columns (3) and (6) use mining-dummies instead of mining-values as an instrument. Column (7)-(8): Omit if $dfits > 2(k/n)^{0.5}$. Column (9)-(10): Omit if $Cooksdistance > 4/n$. n is the number of observations and k is the number of regressors. The OLS replicates column (4) of Tables **??** so that n = 182 and k = 8.

dropped. Dropping California reduces the OLS result to -0.226 and dropping New Mexico raises it to -0.368. California is also the only state that impacts the IV results. Dropping California makes the IV results turn insignificant.

However, when I replicated the IV strategy using dummies for mining activity rather than the value of mining activity, the IV results are robust to the exclusion of California because less weight is given to the very high value of mining activity in California.

Results for the IV strategy based on mining dummies give very similar results to those reported for mining values. Dropping one state at a time, the average coefficient estimate using mining dummies is -0.447 compared to -0.376 using the mining values. In columns (7)-(10) I test for influential outliers using two more general criteria , DFits and Cook's Distance. The DFITS criterion is a measure of the influence of an observation on its own predicted value. Cook's distance on the other hand measures an observation's global influence on all the predicted values (Belsley *et al.* 1980, Welsch 1982). Columns (7)-(10) report OLS and IV results when influential observations according to these two criteria are omitted. In addition to influential regions, figure 6 suggests that some tribes may have a large influence on the results. But dropping one tribe at a time had no effect on any of the results including those with tribe fixed effects. (Results not reported.)

5 Mechanisms

The economics literature suggests a number of channels through which the forced coexistence of heterogenous groups could impact economic outcomes. Trust and cooperation in production and exchange as in Tabellini (2008a) is one possibility. Collective action problems are probably a more focal mechanism in many heterogenous populations (Alesina *et al.* 1999, 2000; Alesina and LaFerrara 2000; Vigdor 2004; Miguel and Gugerty 2005). Alternatively, population heterogeneity might work through the political channel. In Banerjee and Pande (2010), lower-quality politicians are elected in heterogenous populations because ethnic voters have stronger biases towards own-group candidates. In Aghion *et al.* (2008) heterogenous populations will see majorities try to implement policies to dominate minorities. Evidence from US cities is consistent with this. Swee (2010) finds similar evidence for majority-domination in Bosnian municipalities.

To disentangle between these mechanisms, I first provide background information on the institutional framework on reservations to argue that the political channel, be it through the quality of policies or politicians, is likely to be the salient mechanism on reservations. I then provide quantitative evidence that forced integration is indeed associated with reservation-internal political conflict. I use counts of newspaper articles to show that forced integration leads to more *reported* episodes of on-reservation conflict, after controlling for the total press coverage of a reservation. Additional evidence can be gleaned from the timing in the divergence of economic outcomes, using a panel combining the 1990 and 2000 Censuses, the only two Censuses for which reservation-aggregate outcomes are available. Changes in federal regulation in the late 1980s to mid-1990s transferred responsibility for self-government into the hands of reservations. If forced integration leads to parochial politics and if local governance started to matter only in the late 1980s, then reservations without forced integration should have benefited differentially during this period.

Turning to economic mechanisms, I provide quantitative evidence on direct corruption, public good provision, federal transfers and off-reservation employment opportunities to argue that these channels cannot generate the large income differences across reservations we see. Revenues from direct entrepreneurial activity on reservations, by privately and reservation-owned Native enterprises as well as on-reservation non-Native enterprises are by far the most important income source. I provide qualitative evidence on the channel through which parochial politics impact entrepreneurial activity on reservations.

5.1 Institutional Background

During the early reservation period, the legal status of Native American tribes shifted from autonomous "domestic dependent nations" to "wards", governed by so-called *Indian Agents* of the Bureau of Indian Affairs (BIA) (Fahey 1986, p.50). This situation changed with the Indian Reorganization Act (IRA) in 1934 (the "Indian New Deal"). The IRA placed decision making power on reservations directly with the reservation councils, elected by all reservation members. Because reservations lacked the resources to maintain such separate institutions, the usual separation of judicial, executive and legislative powers was forgone in this process (Holm 1985). Reservation council members combine executive control over reservation-owned enterprises and the provision of public goods, legislative control over reservation laws and judicial control of the implementation of these laws in reservation courts.[40] This institutional arrangement has persisted to the present day.

The power of reservation politicians remained toothless however because local BIA offices controlled all funding available to reservations. Cornell and Kalt (2008) argue that "from the IRA onwards, most reservations came to have the feel of branch offices of the federal government, [...] with tribal governments totally dependent on BIA programs and funds." This only changed in the 1980s through a series of changes in federal regulation which reduced reservations' dependency on the government by restricting federal spending on social programs on the one hand and at the same time facilitating access to federal block grants and allowing reservations to provide their own public goods and manage their own trust funds. Because I can only test for differential growth rates form 1990 to 2000 I do not provide a list of law changes and how they mattered. For reference, Castille Bee (1992), Nichols (2003) and Cornell and Kalt (2008) provide excellent accounts of the changes in federal policy towards reservations from the 1970s on.

5.2 Parochial Politics

Anecdotal evidence suggests that there is a great deal of political infighting on reservations. Quotes from reservation residents such as the following two are quite common: "reservation chief execu-

[40] These institutions are more commonly referred to as tribal councils, tribal courts etc. The ambiguity comes from the fact that reservations are called tribes in administrative terms while I reserve the term tribe for the historical ethno-linguistic entity.

tives and councils possess near dictatorial control over reservation members, control the reservation court, police and flow of money and which members get homes, jobs and healthcare services" (Lawrence, 2003). "The reservation council is employer, landlord and local government. Reservation members who oppose [their plans] are threatened with job loss. They lose their housing arrangements, phones are disconnected and lives are threatened. [...] We are living under a dictatorship" (McGovern 1995, p.47). Given the salience of reports on on-reservation political conflict, these constitute the best opportunity of quantitatively showing a relationship between forced integration and internal political conflict. If it is true that forced integration works through the political equilibrium, it should be associated with more frequent *reported* political conflict on reservations.

To test this, I ran search queries for key words proxying for political conflict for each tribe in the *ProQuest Newspapers Database*. Because news coverage on reservations is not extensive, I threw a wide net of search terms proxying for internal conflict in association with reservation councils. I excluded articles on issues surrounding gambling because this topic dwarfs all others in the newspaper counts. I used counts both for a narrow set of search items, Count_{ni}, and for a broad set of search items, Count_{wi}.[41] To control for total press coverage, I also collected the total number of articles on a reservation's council or chairman.[42]. I then estimate

$$\text{Count}_i = \alpha + \beta \mathbf{C}_i + \gamma \text{Count}_{0i} + \epsilon_i \tag{5}$$

where Count_i is the count of articles on internal reservation disputes on reservation i and Count_{0i} is the count of all articles relating to reservation government. Issues pertaining to internal reservation politics are not covered very well in the press and this is reflected in the counts. The median count for both Count_{ni} and Count_{wi} (over an unlimited time window) is only 1. Their distributions are quite skewed, with means of 3.16 and 3.24 respectively. The median and mean of Count_{0i} are 59 and 84.2. I also estimate equation (5) using a Poisson model to account for the count nature of the data.

Table 11 shows the regression results of this. In column (1), using the narrow count, $\mathbf{C}_i$ is just

[41] The narrow search was "(tribe X) AND (tribal council OR tribal chairman) AND (internal conflict* OR faction* OR embezzle* OR corrupt*) AND NOT (Casino* OR Gaming OR Bingo)", the wider search was " (tribe X) AND (tribal council OR tribal chairman) AND (internal conflict* OR faction* OR embezzle* OR corrupt* OR improper* spen* OR improper* disburs* OR improper* interfer* OR tribal dispute) AND NOT (Casino* OR Gaming OR Bingo)". Searching embezzle* generates a hit for any word starting with the letters embezzle, i.e. embezzled, embezzlement etc.

[42] I searched "(tribe X) AND (tribal council OR tribal chairman)"

Table 11: Newspaper-Counts

Dependent:	Count_n		Count_w	
Model:	OLS	Poisson	OLS	Poisson
	(1)	(2)	(3)	(4)
$\mathbf{C}_i$	1.345	0.198**	1.379*	0.201**
	(0.826)	(0.085)	(0.832)	(0.084)
Count_0	0.047***	0.006***	0.048***	0.006***
	(0.004)	(0.001)	(0.004)	(0.001)
Observations	182	182	182	182
R-squared	0.46		0.46	

Count_n is a count of a narrow search of words relating to internal disputes. Count_w is a count for a wider search. See footnote in text for details. Count_0 is the count of all articles pertaining to a tribe's tribal council. Standard errors: * significant at 10%; ** significant at 5%; *** significant at 1%.

short of having a significant effect. Broadening the count turns $\mathbf{C}_i$ significant at the 10% level in column (3). Forced integration is associated with roughly 1.4 more articles associated with internal conflict after controlling for all articles on that tribe's affairs in the press. In columns (2) and (4) estimate the same equation with a Poisson model, which accounts for the count variable nature of the data and gives stronger results. The coefficients of a Poisson regression is the difference in the logs of the expected values of the dependent count variable generated by an incremental increase in the regressor. Here, the expected count of newspaper reports of internal conflict is 1.22 times as high for a reservation with forced integration ($\frac{\mathbb{E}[\text{Count}_{ni}|\mathbf{C}_i=1]}{\mathbb{E}[\text{Count}_{ni}|\mathbf{C}_i=0]} = e^{0.198} = 1.22$).

5.3 Take-Off and Great Divergence

Aside from the 2000 Census, the only other Census for which reservation level data is available is 1990. One notable feature of the data is that average incomes on reservations have grown a lot in the decade from 1990 to 2000 but that the variation in incomes has grown even more. While average reservation incomes have increased by by 37% (from 7,565 USD to 10,357 USD), their variance has increased by 56% during the same period.

If this growth take-off is driven by changes in the regulatory environment which put governance responsibility with reservation politicians and if reservations with forced integration suffer from parochial politics, then reservations without forced integration should have grown more during this period. To test this, I run a simple Diff-in-Diff estimation of the form:

Table 12: 1990-2000 Diff in Diff

	Dependent: log(per capita income)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\mathbf{C}_i$	-0.114**	-0.108**			-0.114**	-0.115**	-0.115**
	(0.048)	(0.043)			(0.048)	(0.047)	(0.047)
2000	0.388***	0.391***	0.375***	0.145**	0.378***	0.255***	0.181**
	(0.045)	(0.040)	(0.035)	(0.062)	(0.045)	(0.064)	(0.070)
$\mathbf{C}_i \cdot 2000$	-0.240***	-0.242***	-0.229***		-0.239***	-0.248***	-0.082
	(0.067)	(0.060)	(0.052)		(0.067)	(0.066)	(0.093)
D(Casino)				-0.090*		-0.091*	-0.091*
				(0.054)		(0.050)	(0.049)
D(Casino) $\cdot$ 2000				0.214***		0.213***	0.324***
				(0.076)		(0.070)	(0.082)
D(Casino) $\cdot 2000 \cdot \mathbf{C}_i$							-0.249**
							(0.098)
1990	8.940***	9.634***	8.894***	8.948***	8.939***	9.001***	9.001***
	(0.032)	(0.113)	(0.019)	(0.044)	(0.032)	(0.046)	(0.045)
Observations	357	357	357	355	349	355	355
R-squared	0.28	0.44	0.79	0.17	0.27	0.31	0.32

Col (1) is Diff-in-Diff only. Col (2) includes the set of previous controls. Col (3) includes tribal FE. Col (4) test for positive Casino growth-effect. Col (5) excludes the 6 reservations which earn by far the highest Casino Revenues. Standard errors: * significant at 10%; ** significant at 5%; *** significant at 1%.

$$y_{it} = \alpha_0 + \gamma \mathbf{C}_i + \lambda 2000 + \delta 2000 \cdot \mathbf{C}_i + \mathbf{X}_{it}\beta + \epsilon_{it} \tag{6}$$

Table 12 shows the results of this Diff-in-Diff strategy. Column (1) shows that reservations with forced integration were on average only about 12% poorer in 1990. The bulk of the observed difference of 35% in the 2000 data comes from a differential growth rate from 1990 to 2000. While average incomes on reservations without forced integration have grown by almost 40%, those on reservations with forced integration have grown by a mere 16% ($e^{0.388-0.244} - 1$).

Columns (2) and (3) show that these results are robust to the inclusion of the previous set of control variables as well as to the inclusion of tribal fixed effects. A major concern with this specification is that a differential growth rate for reservations with a casino might confound the results, in particular because the Indian Gaming Regulatory Act was passed just before the 1990 Census data. Casino revenues or casino opening dates are not public knowledge but I can again use the simple casino-dummy from Taylor and Kalt (2005). Column (4) shows that incomes on reservations with a casino grew by about 20% more than incomes on those without. It is well-known that casino revenues are heavily skewed towards a small set of 6 reservations.[43] Column (5) shows that excluding those from the regression does not impact the results. Another strategy is to allow a differential casino growth rate together with the differential growth rates for reservations under forced integration. The coefficients from including two differential growth rates in column (6) are qualitatively identical to running these regressions separately in columns (1) and (4). This is because casinos are almost perfectly uncorrelated with forced integration. Another interesting thing to ask is whether, among those reservations with gambling facilities, reservations without forced integration were able to benefit more from their casinos. We would expect this if part of the detrimental effect of forced integration runs through parochial politics impacting the efficacy of reservation owned enterprises. Column (7) confirms that this is indeed the case.

5.4 Economic Mechanisms

While there is strong evidence linking forced integration to economic outcomes and parochial politics, the economic mechanisms has remained as a black box so far. However, it is key for policy recommendations. The qualitative evidence suggests that parochial politics impact reservation incomes mostly through their detrimental effect on the contracting environment and on the efficacy of reservation-owned businesses. Parochial politicians may aggravate contract imperfections through their influence over the law-making as well as judicial procedure in reservation courts. This reducing the willingness of residents and non-Native companies to invest into a reservation. It also leads to a deSoto-effect, where private Native residents have difficulty collateralizing their assets to borrow from banks (Cornell Kalt 2008, ch.7).[44] In addition, reservation-owned enterprises are run inefficiently if politicians influence their managers to make decisions for political ends, for instance by hiring political supporters who are not needed or qualified (Jorgensen and Taylor 2000). Cornell (2006) for instance argues that "direct control [of reservation enterprises] offers reservations council members resources such as jobs and revenues that can be handed out to relatives or supporters."

Ideally, I would like to be able to test these channels in data on enterprises that are owned by

[43] http://www.nigc.gov/Reading_Room/

[44] Frazier (2001) argues that on-reservation Native Americans have a very high proportion of mobile homes, which can be liquidated if mortgages are not paid back, because of this.

or located on reservations. This data is in principal available from the Native American Strata of the Survey of Small Business Owners (SMOBE). Aggregate SMOBE data shows that revenues from Native-owned enterprises are economically large enough to be driving the observed income differences on reservations. The 2002 wave shows that a total of 201,387 private Native-owned enterprises generated almost 26 billion in revenues and a total wage bill of about 5.2 billion.[45] This does not include any reservation-owned enterprises, which are excluded from SMOBE. Of the reservation-owned enterprises, casinos alone generated 14.5 billion in revenues in 2002 and assuming a similar relation of revenues to wage-bill, this would amount to another 3.2 billion in wage income alone.[46] There is no information on the share of the wage-bill that goes to Native employees, but an aggregate wage-bill of 8.4 billion, not counting non-gambling reservation-owned enterprises, by itself covers 1.2 times the entire income on all reservations in 2000. This strongly suggests entrepreneurial activity as the main driver of cross-reservation income differences. Unfortunately, the SMOBE data is both aggregated and censored in a way that makes it impossible to use for statistical tests.[47] Instead, I can do two things using auxiliary data-sources. First, I can show that most of the cross-reservation income differences are explained by differences in wage-income. Secondly, I can rule out several alternative explanations for these income differences: off-reservation employment, federal programs, direct theft though embezzlement and selective out-migration.

Table 13 Panel A breaks per capita incomes on reservations down into different sources. The first three rows show that wage income accounts for more than two-thirds of the income differences from forced integration while transfer income is a mere fraction of this. The next next two columns show that this is driven both by less employment and lower wages on reservation with forced integration. I next consider four explanations for the pattern in Panel A that provide potential alternatives to the view that the contract environment and the efficacy of reservation enterprises drive the results. First, it is possible that off-reservation employment opportunities vary because reservations without forced integration are more willing or better able to hire out

[45] 2002 is the most recent available wave, available at http://www.census.gov/econ/sbo/

[46] http://www.nigc.gov/Reading_Room/Press_Releases

[47] The SMOBE data is reported in 5 year waves at the county level. The first problem is the mapping of counties to reservations: The average reservation overlaps with 3.6 counties and the average county, conditional on overlapping with any, overlaps with 3.4 reservations. The second, even more severe, problem is that data is not reported for counties with less than 100 Native-owned enterprises. This threshold is so high that on average more than half of all Native enterprises in a state are not allocated to counties.

Table 13: Table of Means - Income Sources

Panel A: Income Sources	$\mathbf{C}_i = 1$	$\mathbf{C}_i = 0$	(2)=(3)	**Panel B:** Other Data	$\mathbf{C}_i = 1$	$\mathbf{C}_i = 0$	(2)=(3)
p.c. wage-income	6415	8811	6.43	Travel to work (min.)	20	20	-0.07
	(2041)	(2843)			(7)	(7)	
p.c. transfer-income	731	765	0.66	% work in county of resid.	0.89	0.83	-3.06
	(331)	(343)			(0.12)	(0.16)	
p.c. total income	8464	12087	5.70	BIA p.c. Receipts	998	688	-1.30
	(3033)	(5196)			(1981)	(869)	
% Adults full-time work	0.27	0.34	4.44	USD Embezzled p.c.	39.91	6.12	-1.20
	(0.08)	(0.11)			(250.64)	(25.05)	
Average salary	26511	32187	3.02	$\frac{\text{Tribal Population on Reservation}}{\text{Tribal Population}}$	0.45	0.47	0.66
	(7126)	(16795)			(0.19)	(0.28)	

Data on BIA receipts calculated from *BIA Greenbook*. Data on Embezzlements calculated from *OIG Reports to Congress*. All other data calculated from *Census AIAN Summary File*.

workers. Secondly, it could be that reservations without forced integration have a higher ability to lobby the BIA for programs that provide income and employment opportunities. Thirdly, it could be that a large part of the income difference is explained by direct corruption in the form of embezzlement of reservation funds.[48] Lastly, it could be that the results are driven by more severe of more selective out-migration from reservations with forced integration. This was hinted at in 2 Panel A which that reservations without forced integration have a higher share of residents with post-secondary education.

All previous results controlled for the economic environment. However, it is possible to test for off-reservation employment directly using more detailed data from the Census 2010 AIAN Summary file. If off-reservation employment opportunities drive the results, then average travel time to work should be longer on reservations without forced integration. The first row in Panel B of table 13 shows that this is not the case. Average travel times to work are practically identical. In the second row, I also check whether workers on reservations without forced integration are more likely to work outside their county of residence. This is indeed the case. However, because the average reservation overlaps with 3.6 counties, this could easily be measuring more within-reservation rather than off-reservation labor mobility.

Secondly, I check whether part of the results can be explained by reservations without forced integration being better able to attract BIA funding. I compiled data from a per-tribe breakdown

[48]This is not really an alternative explanation because parochial politics are likely to also lead to corruption (Banerjee and Pande 2010).

of the BIA budget for 2002, the earliest year available, from the BIA Greenbook.[49] The third column in Panel B shows that reservations with forced integration receive slightly more BIA funds in per capita terms. This suggests that BIA funds are distributed according to need rather than tribal lobbying.[50] Clearly, the magnitude of BIA receipts is also too small to account for the cross-reservation income differences. Thirdly, to measure corruption on reservations, is use information from regular ongoing audit-activity by the Office of Inspector General (OIG) which audits the spending activity of all government agencies, including the BIA and reservations. The OIG furnishes semi-annual reports to Congress listing all occasions of embezzlement, fraud and theft of both BIA and reservation funds. I coded these episodes for all available issues, from 1999 to 2008 and report the aggregate per-reservation USD-amounts that were embezzled in this period. Reservations without forced integration look to suffer from more corruption but this difference is not significant and overall very weak. In addition, the magnitudes are again very small.[51] Combining Census AIAN Summary Files on tribes and on reservations, I can do a back-of-the-envelope calculation of the total number of members of a reservation and calculate the share of reservation-members that live on the reservation.[52] If out-migration was driving the results, we would expect a larger share of reservation members to live off reservations with forced integration. The last row in panel B shows that this is not the case.

6 Conclusion

This paper tests whether the forced integration of historically autonomous bands can explain the significant differences in economic outcomes across Native American reservations today. The empirical results suggest that forced integration has a significant, very robust and economically large effect on incomes on reservations today. An IV strategy suggests that this result is not driven by selection into forced integration. Investigating mechanisms, data on reported political conflicts suggests that forced integration is associated with more parochial politics today. Data on the timing of cross-reservation economic divergence suggests that this divergence occurred when local

[49] http://www.bia.gov/WhoWeAre/AS-IA/OCFO/TBAC/BDDoc/Greenbook/index.htm

[50] A breakdown of BIA funds shows that the difference is largely driven by schooling expenses and the younger demographics on reservations with forced integration.

[51] Comparisons of counts of episodes of corruption and a dummy for any corruption gave equally weak results.

[52] Actual numbers on reservation-enrollment are not publicly available information.

governance started to really matter because of changes in the regulatory environment. Turning to economic channels, a breakdown of sources of income on reservations suggests that the key economic channel is entrepreneurial activity. Alternative drivers of income differences can be ruled out. The qualitative evidence suggests that entrepreneurial activity is reduced by parochial politics because politicians can create an uncertain legal environment by intervening in legal proceedings and interfere directly with the management of reservation-owned enterprises. In combination, this evidence suggests that forced integration in the 19th century leads to a factional political equilibrium to the present day. On reservations without forced integration, parochial behavior seems to be constrained. This suggests that informal social rules can substitute for the lack of formal institutional rules limiting the power of politicians on reservations.

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Appendix A: Interpreting OLS and IV estimates

I use a continuous measure of $\mathbf{Z}_i$ in most of the empirical work but the IV strategy also delivers robust and qualitatively similar results with mining-dummies. In this appendix, I treat $\mathbf{Z}_i$ as a dummy variable because it simplifies the discussion of biases and comparisons of OLS and IV in the language of treatment evaluation using the Holland-Rubin notation for the evaluation of treatment effects.[53] The observed difference in outcomes conditional on treatment is $E[Y_i|\mathbf{C}_i = 1] - E[Y_i|\mathbf{C}_i = 0]$ and we are interested in estimating $E[Y_{1i} - Y_{0i}]$, the average treatment effect (ATE) of $\mathbf{C}_i$.[54]

The observed difference in outcomes is equal to the treatment effect on the treated (ToT), $E[Y_{1i} - Y_{0i}|\mathbf{C}_i = 1]$, plus a selection term.

$$E[Y_i|\mathbf{C}_i = 1] - E[Y_i|\mathbf{C}_i = 0] = E[Y_{1i} - Y_{0i}|\mathbf{C}_i = 1] + (E[Y_{0i}|\mathbf{C}_i = 1] - E[Y_{0i}|\mathbf{C}_i = 0]) \qquad (7)$$

This observed difference is an estimator of the ATE but it is biased if either the treatment effect is heterogenous (so that the ToT is different from the ATE) or if the selection term is non-zero. In the following I consider two cases: First, selection on unobservable group strength θ_i only and, secondly, a heterogenous treatment effect ψ_i without selection. In the first case, I allow unobserved group strength (lower θ_i) to have a positive long run effect reservation outcomes. In the second case, I allow friendly ties in the past (a smaller ψ_i) to reduce the long run cost of forced integration on reservations. The simplest way to operationalize this is to let θ_i enter the error term directly as a negative and to let ψ_i be the coefficient on forced integration.

In the first case, unobservable group strength (θ_i) varies across tribal groups but ψ does not. Then the observed difference between reservations with and without forced integration equals the ToT, which is identical to the ATE, plus a negative selection term:

$$E[Y_i|\mathbf{C}_i = 1] - E[Y_i|\mathbf{C}_i = 0] = \mathbf{ToT} - (E[\theta_i|\theta_i \geq \frac{1}{2} + \frac{\psi}{\gamma L}] - E[\theta_i|\theta_i < \frac{1}{2} + \frac{\psi}{\gamma L}]) \qquad (8)$$

[53]See Deaton (2009) and Angrist and Pischke (2008) for a discussion of the Holland-Rubin framework.

[54]Where Y_{1i} and Y_{0i} are defined as:

$$Y_i = \begin{cases} Y_{1i} & \text{if} \quad \mathbf{C}_i = 1 \\ Y_{0i} & \text{if} \quad \mathbf{C}_i = 0 \end{cases}$$

In the second case there is selection only on unobservable variation in the heterogenous effect of treatment with forced integration, ψ_i. In this case, the observed difference in outcomes equals the ToT but the ToT is not the ATE because treated groups are selectively less negatively affected by the treatment than non-treated groups would be:

$$E[Y_i|\mathbf{C}_i = 1] - E[Y_i|\mathbf{C}_i = 0] = E[\psi_i|\psi_i < (\theta - \frac{1}{2})\gamma L] \tag{9}$$

IV gives consistent estimates of the causal effect in both cases but the interpretation varies. An IV based on mining-dummies identifies the causal effect of those groups that would have received separate reservations had it not been for mining. In the first case, when the treatment effect is homogenous, this population is not different from the rest so that IV gives a consistent estimate of the ToT and the ATE. In the second case, when the treatment effect is heterogenous, IV gives a consistent estimate of the local average treatment effect (LATE) on those groups for which the treatment effect falls in the range $(\theta - \frac{1}{2})\gamma L + \theta\gamma\mathbf{Z}_i > \psi_i > (\theta - \frac{1}{2})\gamma L$ (Angrist and Pischke 2008, ch.4).

In the first case, IV estimates should be smaller in absolute terms than OLS estimates. In the second case, they should be larger because there was no bias in the OLS to begin with. When there is both selection and heterogenous treatment effects, IV can be both smaller or larger than OLS.