Ethnic Concentration and Public Goods Provision: A Study of Spatial Patterns and Streetlight Imagery

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Abstract

The nighttime streetlight imagery has been used as a viable measure of economic activities and level of infrastructure. The satellite snapshots of brightly lit areas are especially useful for analyzing patterns of public goods provision in states where it is difficult to obtain unbiased socioeconomic data. Interpreting these images as representative of the level of public goods provision, this paper presents findings based on a set of spatial data of China between 1990 and 2000. It shows that counties which saw an increase in the ethnic minority fraction in total population also experienced a small decrease in the level of streetlights provided in their areas, after controlling for factors such as urbanization and demographic changes. The paper argues that the variation in the level of provision may be an inadvertent outcome of China's policy on economic development.

1 Introduction

In July 2009, China witnessed a bloody uprising in Urumqui, the capital of the Xinjian region between Uighurs and the dominant Han Chinese community. The incident left 197 people dead and more than 1700 injured in the violence. In the previous year, ethnic Tibetan areas witnessed one of the largest waves of protest and social unrest in recent decades. Protests spread from Lhasa, the capital city of Tibet Autonomous Region, to other ethnic Tibetan areas in Sichuan, Gansu, and Qinghai, and continued for several months from March well into the summer of 2008, right before the start of the Beijing Olympic Games. These events unleashed by the minority group uprisings led to a big surge of nationalism among Chinese people, presumably the majority Han Chinese, both domestically and internationally, and showcased the collision of different visions of the relationship between the Chinese nation and its minorities. These incidents also show the state's constant struggle to integrate its 56 minority population groups, who continue to raise grievances about ethnic discrimination and regional autonomy.

One particularly salient policy issue in which the government is directly involved and the minority group is potentially discriminated, is public goods provision. Local variations in the level of public goods provision can often be attributed to the region's differential economic growth. However, when both economic and ethnic factors are involved, it is often unclear why certain regions of minority groups may receive less public goods despite public policies against discrimination. Numerous studies have suggested that the provision of public goods, ideally provided for all citizens to meet their most basic needs, are also driven by ethnic politics (Cutler & Glaeser 1997, Goldin & Katz 1998, Alesina & Easterly 1999). These studies tend to focus on the dynamics of ethnic concentration on the level of public goods in democracies, in which the government is accountable to the people and often lead to ethnic majority taking away the resources from the minority. Investigating public goods provision in non-democracies faces several problems. The subnational data are harder to come by in general, but scholars also face various measurement biases. The government often has the power to ensure that publicly available performance measures favorably reflect the government's performance; that is, one would expect a non-democratic government directing both economic growth and ethnic policies to also have more control over data disclosure. Despite these problems, a study of these states potentially offers new valuable insights into the relationship between public goods provisions and minority groups. For example, in non-democratic states the majority group can have absolute control in allocating resources and the minority has only limited channels to influence even local policies. The local government may not be held accountable to the people but only to the central government. Furthermore, policies dictated by the central government are more likely to be carried out with minimal intervention at local levels. These non-democratic conventions and policies have direct impact on the way public goods get provided. This paper therefore proposes to investigate the relationship between minority groups and the local level of public goods provision in China between 1990 and 2000. The paper looks at the population of non-Han ethnic groups in China during the last decade, and the fraction of each county that had streetlights as an unbiased measure of the level of public goods provision. It also uses minority presence from neighboring counties in order to construct an instrumental variable for each county's minority concentration, recognizing the possibility that the movement of the population groups is endogenous to the level of infrastructure.¹

The main finding presented in the paper shows that counties populated with minorities do appear to receive lower provisions of public goods than those populated with the Han majority, after controlling for the county population density, urbanization and demographic factors. However, the finding also shows that the impact of the ethnic factor on public goods provision is very small. That is, the empirical evidence implies that while there appears to be Han-driven influence on the level of infrastructure that the government is willing to provide, its small magnitude suggests that the provision is mostly driven by factors unrelated to discriminatory treatment. The result is surprising, given the major grievances expressed by China's minority groups and ongoing tension between prominent ethnic groups (Tibetans and Uighurs, for example) and the Han majority. At least in the case of streetlight provision, the infrastructure level is only partly explained by how much minority presence there is in a given region. The finding is nonetheless statistically significant, and the paper gives an explanation based on the central government's policy on economic development. First, local officials encourage more industrialization by providing necessary infrastructure, because their performances are primarily measured by the regions' economic growth. Second, businesses that generate the most tax

¹Both ethnic concentration and identity are driving factors of policies, but they are also policy-driven. That is, expected gains from political process in increasing ethnic salience and concentration often explain how the concept of ethnicity is initially formed. For example, in a natural experiment study of the political salience of cultural difference between Chewas and Tumbukas in Zambia and Malawi, Posner (2004) shows how people with the same ethnic background choose to build alliances based on wanting to form a minimum winning coalition; political salience and ethnic identity thus may feed into each other. In the context of this paper, ethnic division may drive the level of public goods provision, but the provision level in turn forces the movement of groups of people and lead to polarization of ethnic groups.

revenue (large-scale industrial enterprises) are mainly established by the Han majority, the dominant economy group. The reinforcement of Han dominance and public goods provision necessarily means smaller minority group presence in developing areas. The marginalization is therefore a consequence of incentivizing county officials to promote economic development, thereby alienating regions of minority groups despite the government's official policies on protecting minority group rights and promoting their economic well-being.

This explanation differs significantly from arguments focusing on centralized ethnic politics and different levels of government accountability. For example, in the case where local officials directly follow policy initiatives of the central government, a lower level of provision may be an outcome of systematic discriminatory government policy against minority groups. Alternatively, in the case where local officials enjoy substantial power with little accountability, the provision of public goods is only implemented in areas where there exist sizable majority to monitor the officials through informal means. In both arguments public goods provision is interpreted as an outcome of ethnic politics, rather than a consequence of centralized economic development policy. The paper proceeds as follows: the next section discusses the issues of ethnic politics and public goods provision, and the implications drawn from the literature on the paper's empirical findings. The subsequent section describes the data, followed by a discussion on the identification strategy and the use of spatial statistics. The paper then introduces the empirical findings, and concludes with the main implications of the findings as well as ongoing extensions of the current research.

2 Public Goods Provision and Economic Development

The current literature on ethnic diversity and public goods provision covers both studies with emphasis on the role of the community, as well as those in which the government takes a more active role in providing the goods. In the former case, public goods provision can be seen as an outcome purely driven by communal initiatives. When the government has a weak democratic foundation, it may not be accountable at the local levels (Bardhan 2002) and lead to purely communal efforts to provide the means. Even in democracies, the provision level is often decided by the community without the involvement of upper authorities, and local citizens can decide for themselves to allocate public goods to certain areas. Public goods can thus be perceived as the products of civil societies in which there are norms of cooperation and active involvement by citizens in social organizations (Putnam, Leonardi & Nanetti 1993, Ostrom 1990, Platteau 2000). These organizations often face collective problems, however, when there are divisions within the communities. In such case, the division between the minority and the majority lead to differences in preferences (Alesina & Easterly 1999)² or a lack of coordination mechanisms (Habyariminana, Humphreys, Posner & Weinstein 2007) to hinder the appropriate level of provision.³ Different preferences may rise from providing goods that are more needed for one group than the other but paid for equally by the community. The majority is less willing to provide for the public goods that are shared with the minority, especially when the division between the two groups is clear geographically, and the nature of non-exclusivity of these goods prevents either group to commit to building what is often beneficial for the community as whole. These groups may also implement specific, credible punishment mechanisms for themselves in the cases of freeriding within the communities of their own, through social ties and shared norms. They are commonly delineated by ethnicities, such that when the groups come together, any coordination mechanism becomes difficult to implement.

Second, the relationship between ethnic groups and public goods provision can be driven by the government. When the government with an ethnic majority in power dictates the policy towards publics goods, the results can also be discriminatory towards ethnic minority groups. The autonomy of minority groups at the local level is likely undermined by appointed officials of the central authority. As a result, the policies by the government may exacerbate the tension between the minority and the majority. The local government can provide public goods responsibly only when there is significant majority population in the county. Local officials have control over public goods provision but are appointees of the central government dominated by the majority, and their policy preferences are aligned with the majority's. When the local officials are not directly accountable to the central authority, they are likely to have even more substantial power over the level of provision. Tsai (2007) for example addresses the potential problem of providing public goods in systems with weak formal democratic and bureaucratic

²Alesina & Easterly (1999) argues that different ethnic groups may have different preferences over which type of public goods to produce with tax revenues, and that each ethnic group's utility level for a given public good is reduced if other groups also use it.

³Cutler & Zeckhauser (1993) find that people may only care about others' welfare within their ethnic community, and that they discriminate against others based on ethnic origins. Similar to Easterly & Levine (1997)'s finding, the paper shows that the level of ethnic fractionalization has a strong negative correlation with the level of public goods provision in the case of the U.S. In an experimental study, Habyariminana et al. (2007) finds that a strategy selection mechanism, in which co-ethnics play cooperative equilibria with better understanding of the threat of social sanction, attributes to successful public goods provision in homogenous ethnic communities. From this perspective, the negative causal relationship between the non-Han population and the level of streetlight provision can be seen as a consequence of a polarizing division within counties.

institution. Under weak institutions with little accountability for their actions, officials may extract funds away from the public and fail to provide public goods responsibly. Tsai (2007) argues that one way to overcome this problem is through informal governmental accountability. In localities with "encompassing and embedding solidarity groups" such as village temples and village-wide lineages,⁴ citizens and officials are more likely to share a common set of ethical standards and moral obligations. By granting moral standings to local officials who perform above-average, the citizens give the officials incentives to act more as beneficent providers rather than extractive pillagers.

The presence of ethnic cleavages plays an important role whether the county officials are accountable for their actions to the upper authorities, or they enjoy power with little accountability. In the former case, the county officials act according to the majority preference, as the central government is dominated by the group. This would result in more provision for Han-dominated counties compared to those of the minority groups in China. In the latter case, the existence of the majority may help sustain at least some provision of public goods (even if only for the majority), due to the group's relative success in holding local officials accountable for their actions. Ethnic groups tend to form strong solidarity groups together; local officials, who are often Hans dispatched from the central government and become excluded members of the communities, consequently may become less motivated to act responsibly for the public. If the local officials are able to get away with poor provision of public goods because they happen to rule in the area with a dominant presence of minority groups, this may reinforce poor levels of public goods. In the end, it may be left for the local groups to have to provide for themselves, which is often difficult given the cost of infrastructure.

Given the arguments drawn from the literature above, this paper offers an alternative explanation based on China's economic policy. First of all, given China's official stance against ethnic discrimination (through a number of policies including affirmative action in school admission and higher employment benefits for minority groups), any centrally dictated discriminatory policy against minority groups seems unlikely. This is especially the case considering China's increasingly global presence, since any conflict that arises due to human rights issues is likely to directly impact the country's trade relations and economic development. The central govern-

⁴Tsai (2007) argue that people are more likely to use moral standing to reward local officials for good public goods provision when there are local solidary groups, or groups "based on shared moral obligations as well as shared interests." These groups need to be encompassing, or "open to everyone under the local government's jurisdiction," as well as embedding in that they "incorporate local officials into the group as members."

ment's official policy has been to lessen ethnic tension, mainly by promoting economic development in the western provinces with high minority group concentration since 2000. Another issue with assuming that officials are unaccountable is that, while they may not be accountable to the people, they are certainly accountable to the upper authorities. The officials are evaluated on their performance by the local economy, which to certain extent is reflective of the region's political stability and level of ethnic tension. If the chief concern for an official is promotion, as seems plausible, then he is likely to be more concerned about how to draw in more investment, rather than how he can discriminate against minority groups.

As mentioned above, a big part of the central government's policy towards reducing ethnic tension is improving the living standards of minority groups through the economic development of the West. For example, government-sponsored projects such as the "Big Development of the Northwest," or "the Great Opening up of the West" in 2000's saw Xinjiang, China's northwest "autonomous region," drawing the Han majority investment and labor to explore the province's natural resources such as petroleum and natural gas. Since the primary measure of success for local officials is based on the regional economic performance, there has been a strong push for attracting investors from abroad and setting up new industries. If minority group presence does lead to lower public goods provision, this emphasis on economic development may be the driving force behind such finding. One can argue that given the higher economic standings of the Han majority relative to the minority, they have been the main investors behind industrialization in each county. Since 2000, their stronghold in economy has been compounded by the massive Han migration, and the common-language, common-culture kin group effect has contributed even more to their dominance. What potentially perpetuates the Han dominance with public goods provision and further industrialization seems to be the way that counties collect tax for revenue generation. The majority of county revenue is generated by taxes collected from industries, not personal income tax. For example, Loo & Chow (n.d.) argues that consolidated industrialcommercial tax, which has been reclassified as value-added tax after the tax reform in 1994, has been one of the most important and stable sources of local tax. The author shows for example that in the province of Guangdong, value-added tax in 2000 made up 64.4% of total revenue, compared to 1.09% coming from individual income tax. Tsang & shing Cheng (n.d.) also argues that the fiscal system in the 1980s gave rise to regionalism, and to increase revenues, local government encouraged the development of industries, especially those yielding large amounts of product taxes. The Han majority provides more revenue for the local government because of their relative economic wealth and investments. More infrastructure leads to more economic development, as more investment flows in. For minority groups who have little means to bring in the capital to industrialize their areas, no public goods provision is provided even if they are necessary. The unintended result is that industrialized areas with higher levels of public goods provision witness increases of Han presence, while minority groups become marginalized. Furthermore, the areas that have no Han presence continue to receive little or no public goods provision. This outcome, however negligible and unintended, may be significant and perceived as discriminatory towards minority groups.

3 Background and Data Description

In the following analysis, this paper assumes that streetlights and other services catering to local communities, such as garbage collection, are provided by the county officials and not the upper tiers of government or the community members themselves. This assumption is reasonable given the level of authority that China's county officials have on local public goods provision. One way to estimate the responsibility of local governments, relative to the central government, is by referring to the country's fiscal policy during this period, especially in relation to capital investment. In a field research study of China's subprovincial fiscal policy during the 1990's, Wong (1997) finds that public goods provisions are meant to be supplied at the local levels with local revenues. Revenue-sharing arrangements in the PRC are bilateral, involving only two tiers of government at a time (that is, given the five tiers of government, there are four layers of revenue-sharing relationships): between the central government and the provinces, between provinces and cities, between cities and counties, and between counties and townships. At each layer, the superior level has authority over the setting of contracts (Wong 1997 Pg.28). However, concerns of city governments, such as provision of infrastructure and housing that the central government traditionally had controls over, have become part of the county's responsibilities as many counties have acquired city status and manufacturing has come to dominate the rural economy in many counties by 1994. Over the years, transfers in the form of remittances and subsidies have declined as a proportion of revenues in the counties that Wong investigated. Decentralization of budgetary control has also given local governments to shield local revenues from sharing them with higher levels. These findings suggest that county officials have gained their autonomy over expenditures from the upper authorities in the 1990's.

Given the above description, this paper considers streetlights as a public good that is consumed and funded at the local level. The nightime streetlight data, which the paper uses for the level of local public goods provision, may be interpreted as an unbiased measure of public goods provision (Min 2009). Streetlights in a particular county affects only the residents of that county, so the central government is rarely brought into decisions about the provision of these services. It is therefore reasonable to expect the local government to decide the details of the provision and the amount to allocate for each service. Furthermore, the private provision of streetlights is unlikely since the infrastructural development entails large overhead costs and often faces challenges in charging individuals for the usage.⁵ This measure of the level of public goods provision in China therefore captures the level of infrastructural developments determined by the local officials at the county level. In order to measure the amount of lights available for each county between the years 1990 and 2000, or the difference in the proportion of a county that is lit during the decade, the paper uses nighttime streetlight imagery maps and calculates the average lit fraction of each county area.⁶ The lights from human settlements are detected by the Defense Meteorological Satellite Program's Operational Linescan System (DMSP-OLS). The DMSP-OLS "nighttime lights of the world" images are then processed specifically for the detection of change, made available from NOAA's National Geophysical Data Center. The human settlements light images contain stable night lights from cities, towns, and other sites with persistent lighting, minus gas flares.⁷ The images are cloud-free composites made using all the available archived satellite images of DMSP-OLS during a calendar year, and are scaled onto a geo-referenced 30 arc-second grid (approximately 1 km^2). ⁸ Each satellite sends a a 6-bit scale digital number (DN), from 0 to 63. For each year, a grid cell with a value of zero can be interpreted as an area with zero nightime light. On the other hand, the value of 63 is the saturation value and indicates the brightest area for each year. Unfortunately, these are relative values and thus are not comparable between 1992 and 2000. The analysis of variation

⁵It is also unlikely that the nighttime imagery captures any lighting generated indoors for personal use, which are likely covered by roofs.

⁶The earliest digitized version of the streetlight imagery available is for 1992, and we take this year to be the proxy for 1990. China's population census was made available in 1990 and 2000.

⁷The OLS detects lights from human settlements, fires, gas flares, and heavily lit boats (primarily squid fishing boats). The four types of lights are separated based on location, brightness / persistence, and visual appearance. This paper uses only the lights from human settlements for empirical analysis.

⁸According to the DMSP group at National Geophysical Data Center, a number of constraints were used to select the highest quality data for entry into the composites. For example, the data excluded glare based on solar elevation angle, as well as moonlit data based on a calculation of lunar illuminance. Observations with clouds were excluded based on clouds identified with the OLS thermal band data and surface temperature grids. Furthermore, lighting features from the aurora were excluded in the northern hemisphere on an orbit-by-orbit manner using visual inspection. The data also removed ephemeral lights like fires and other noise.

therefore depends on a reclassified set of images, where each grid cell takes a value of zero or one, such that all areas that are lit, whether dim or bright, are coded with the value of one.⁹ This reclassification inevitably leads to loss of information, since urban areas with recorded saturation levels (63) are treated the same as the ones with the lowest detection of light (1). However it does allow one to make the intertemporal comparison and yields an interpretation of the light variable for each year as the lit fraction of a county.

For the minority and total population, urbanization and other control variables including immigration types (in/out of province), education attainment level (the fraction of county population with college diplomas), retired workforce population (population over 65 years of age), and household types (three generation households), this paper uses *Historical China County Population Census Data with GIS Maps (1953 - 2000)*, collected by the National Bureau of Statistics of China and distributed by the University of Michigan China Data Center. This Geographic Information Systems (GIS) database provides an index of geographic and demographic variables at the county level. The minority population for each county is defined as the total county population subtracted by the Han majority population, who on average take up 80% of the entire population. This paper uses only the counties that had no administrative boundary changes between the two years¹⁰; overall this means that there are about 1800 counties available for empirical testing, each with observed data for both 1990 and 2000.

4 Identification Strategy

This paper takes several steps to identify potential causal mechanisms between ethnic concentration and public goods provision. First in order to address potentially omitted time-invariant factors, the identification strategy uses a difference-in-differences estimation between the two time periods. Here the main variable of interest is the changes in the minority fraction of total population, and the dependent variable is the changes in the lit fraction of county. The basic equation is set up as follows:

$$\Delta light_i = \alpha + \beta light_{i1990} + \delta Urban_{i1990} + \Delta z_i \gamma + \Delta u_{it} \tag{1}$$

where $\Delta light_i$ is the difference in the proportion of county *i* that is lit, $light_{i1990}$ is the

⁹Elvidge (2009) provides an alternative with a set of intercalibration formulas

¹⁰The empirical analysis also omits counties that encountered missing values when calculating the total population figures and comparing them with the sum of total population groups including the Han majority.

lit fraction of county *i*'s area in 1990, and $Urban_{i1990}$ is the fraction of county *i*'s population living in urban areas in 1990. $light_{i1990}$ gives the year 1990 level of streetlight available in county *i*; having existing streetlight makes it cheaper to expand the extent to which additional lighting is provided during the decade, regardless of the ethnic factor. The census data reports urbanization measures for 1990 and 2000 under a set of different categories and therefore makes the comparison of the measure between the two years difficult. Since the streetlight measure may proxy for both the level of public goods provision and urbanization, $Urban_{i1990}$ is included separately in the regression as a control variable. Furthermore, cities and counties were originally conceived in China as urban and rural administrative units, respectively; cities are where industries, especially those owned by the state, are concentrated and where most of the government revenues are produced. Cities are the core of the "state sector," and thus receive most of the funds from the central government for infrastructure development, and industrial development. The urbanization measure would therefore also indicate those counties with a closer relationship to the upper tiers of government (Wong 1997 Pg. 39)

 Δz_{it} represents the set of observable variables that change across the two time periods for county *i*: these include a measure for the change in the minority fraction of total population and the change in total population. The current empirical works surrounding ethnic politics have often used both the ethnic fractionalization index (ELF) (Fearon & Laitin 1999) and polarization index(POLAR) (Reynal-Querol 2002, Montalvo & Reynal-Querol 2005), in order to understand the impact of ethnic group compositions in socioeconomic development and conflicts.¹¹ The two indices are highly correlated; in fact the China data shows that for both 1990 and 2000, the correlation coefficient is 0.97. Given that this paper only focuses on the

$$ELF = 1 - \sum_{i=1}^{N} \pi_i^2$$

POLAR is defined as:

$$POLAR = 4 \sum_{i=1}^{N} \pi_i^2 (1 - \pi_i)$$

¹¹ELF for a given county is defined as:

where where π_i is the proportion of people who belong to the ethnic (religious) group *i*, and *N* is the number of groups. It can be interpreted as the probability that two randomly selected individuals from a given county will not belong to the same ethnic group. The range of index value is from zero (complete ethnic homogeneity) to one (complete fractionalization).

The lower bound of POLAR is zero and the upper bound one, which occurs when there are only two ethnic groups with equal population in a county; the purpose of the index is to "capture how far the distribution of the ethnic groups is from the (1/2, 0, 0, ..., 0, 1/2) distribution (bipolar), which represents the highest level of polarization." (Reynal-Querol 2002 p.798).

cleavages between the Han majority and the non-Hans, it is more straightforward to directly use the minority fraction measure rather than using the indices.¹²

 Δz_{it} includes additional variables that change over the decade and are comparable across the period. The census data provides a list of variables including the immigrant fraction of total population, classified into two types: immigrants from the same province and ones from other provinces. Types of immigrants control for potential immigration impact on public goods provision, independent of Han presence. If more immigration means more tax revenue for the county, for example, the implication would be different from the Han-specific investment explanation from above. The data also classifies the population into three age groups (Aged 0-14, 15-65, 65 and over) and six education attainment groups. These classifications are meant to distinguish different workforce groups, and Δz_{it} includes the fraction of total population with college diplomas and those belonging to the ages 15 and 65 (working age group) as additional control variables. Furthermore, the data provides information on the changes in the type of family households; it classifies types of households into four groups: singles, first, second, and third generation. For the regression, Δz_{it} includes a control variable for the fraction of total households belonging to third generation households. The type of family households has direct relevance to the level of streetlight provision, since it is an indicator for the number of residences and the level of clustering.

In the case that there is only a small change between the two years, most of the variation that the paper seeks to explain may come from the cross-sectional variation of independent variables. Another way to investigate the relationship therefore is to focus on the year 2000 only. The main variable of interest in the analysis is then not the changes in the minority fraction of total population, but the absolute level of the minority population fraction. Similarly, the left hand side variable is the lit fraction of the county area in 2000. The equation is set up as follows:

$$light_{i2000} = \alpha + \beta light_{i1990} + \delta Urban_{i1990} + z_{i2000}\gamma + u_{i2000}$$
(2)

where $light_{2000}$ is the proportion of each county that is lit in 2000, $light_{i1990}$ and $Urban_{i1990}$ are variables as described above, and z_{i2000} is a set of control variables measured in 2000. The set now includes geographic variables, including the elevation, county area, latitude and longitude

¹²For example, the ELF index does not capture the amount of CHANGES that occurs between two periods when the majority and minority maintain the index value but switch their positions. This change on the other hand will have a significant impact in terms of the ethnic composition. Including the indices in addition to the fraction variable does not change the regression results.

of the county.

Given the geographical distribution of minority groups is potentially endogenous to any policy choice, including public goods provision, the next step in identifying the causal mechanism is to implement an instrumental variable estimation. Similarly, Han-driven economic activities lead to more urbanization, but the Han investors also may be motivated to move in to those areas that provide better infrastructure to support their businesses. To address this potential endogeneity problem, this paper introduces an instrument for the minority presence data based on the spatially weighted composition of the attributes in neighboring counties. This approach assumes that the light provision is decided at the county level and not at the upper administrative level, an assumption supported by Wong (1997)'s findings. It constructs a predicted minority fraction of a county, based on the idea that minority population is geographically clustered, and that the counties which are closer in distance share more ethnographic attributes than those which are farther apart.¹³

Figure 1 shows how the spatial weights are calculated in more detail with an example of the Zhengyuan county. Zhengyuan is in the city of Qingyangdiqu in Gansu province, and has an area of 3339.10 Km² with a perimeter of 347.38 Km. The small triangles in Figure 2 indicate geographic centroids of each county neighboring Zhengyuan, and the lines drawn between centroids have distance labels for each pair of counties. The spatial instrument for Zhengyuan's minority fraction for example is calculated by taking the weighted average minority fraction of all the county's neighbors, within a threshold distance between Zhengyuan's centroid location and other centroids. In the same way, a spatial weight index is created for other variables, such that all the neighboring counties with their centroids within the boundary of a given threshold distance have their attributes weighted and included in the prediction of Zhengyuan's attributes. For each pair of counties, divided by the sum of all the inverse distances taken within a threshold distance. When the threshold distance is set at 250Km, the Longxi county in the city of Dingxidiqu of Gansu province is included as part of the spatial statistics calculation. The distance between Zhengyuan and Longxi is 237.77Km, however, meaning that the weight

¹³Alesina & Zhuravskaya (2009) uses a similar approach to IV estimation in predicting a country's level of ethnic segregation; instead of including all the neighboring countries within a threshold distance however, it only considers the ones that share at least one border with the county. Since the county level data in this paper contains geographic units that are much closer to each other, there are problems assuming that a county very close to another yet separated by a third county should not influence the minority population and other variables. This paper therefore uses a threshold distance approach instead, and compares the results from using two different thresholds (250Km and 500Km).

will be very small and the attributes of Longxi county will not be much influential in predicting those of Zhengyuan. The Hengshan county in the city of Yulin of Shanxi province, on the other hand, is not included in predicting Zhengyuan's attributes. The distance between the two counties is 298.83Km, greater than the threshold distance. Given the relatively small average sizes of counties, the threshold distance of 250Km appears to be sufficient in considering all the relevant neighboring counties around Zhengyuan. In fact, when the threshold distance is set at 250Km, the correlation between the change in the actual minority faction of total population and the predicted is 0.475, higher than 0.415, the correlation when the distance is set at 500Km.

5 Empirical Findings

Figure 2a shows the changes in the minority fraction of county population between 1990 and 2000, and Figure 2b shows changes in lit fraction by county. Both maps show attributes in greyscales with 7 bins (classified by quantiles) to indicate positive changes with darker shades. They are also drawn without the county borders in order to show the changes more clearly. Most positive streetlight changes appear to have occurred in the eastern part and the northwestern tip of China; these regions also have experienced a decrease in the minority presence per county. There appears to be an outward migration of the minority population from the eastern and coastal parts of China, as evident in the stronger presence of the minority in the central region of the country. Furthermore, in the northwestern regions, the counties that experience an increase in minority presence appear to have a decrease in the fraction of the area with streetlights. Figures 3 and 4 show the minority population spread and lit fractions of counties for the years 1990 and 2000, respectively.

Table 1 presents the summary statistics of all the variables in consideration. It also provides the mean comparison t-statistics and p-values for the main variables of interest. These include the lit fraction of each county, total county population, as well as the minority fraction of total population. According to the t-statistics, the difference between 1990 and 2000 is significant at the 1% levels for each variable. On average China experienced a 3.6% increase in the proportion of area that is lit, while the average county population increased by roughly 20,000 people. Since the variable captures new infrastructural development rather than improvement on the existing urban areas, the overall finding suggests that during the decade, infrastructural development, if any, were not very noticeable in rural areas. Figures 3 and 4 show that while the change may be significant statistically, it may explain for only small variations; only few discernible changes in night ine lights are apparent from the maps. The changes are also diminished by the fact that the intensity changes in lighting are not reflected in the maps. In addition, the minority fraction of total population only increased 0.7% during this period, suggesting that during this period there were only very small actual changes in the overall composition of population groups. This is also reflected in the small percentage of county population categorized as immigrants; in both 1990 and 2000, less than 4% of total county population came from other places. While these figures likely changed dramatically after 2000, when the central government encouraged Hans to migrate to western provinces in the Big Development of the Northwest campaign, these changes are not reflected in the data used for this analysis. In 1990, only 2.4 % of county population was considered to live in urban cities; considering the fact that these observations include metropolitan areas such as Shanghai and Beijing, this dominance of rural population is remarkable. Again this percentage likely increased substantially after the year 2000, as China's market economy led to a massive migration of rural workers into metropolitan areas. In terms of the fraction of population with advanced education attainment (any college diploma or graduate degrees), the figure remained small but doubled from 0.2% to 0.4% over the decade. The fraction of the old group in population also increased from 5.2% to 6.6% during the same period. This increase in the fraction of retired workforce in total population shows that the population is getting old on average, and may partially explain the 3% increase in the threegeneration fraction of total households over the years, despite the country's rising social trend towards households with nuclear families.

Table 2 shows the first set of OLS regression results, where the left hand side variable is the change in the fraction of the county with streetlight. Given that many counties also have city status, each regression includes province (rather than city) fixed effects; evidence from field research suggests that in richer provinces, counties have lower remittance requirements and more is left for local allocation (Wong 1997 Pg. 209). The first specification includes only the main variables of interest, while the last column includes all the variables outlined in the basic equation above. The simple OLS regression results first allows one to look at partial correlations of these variables. They show a negative coefficient value of the minority fraction of total population, which remains statistically significant under each column at the 5% significance level. Under a causal inference story, the value of -0.156 under the first column would mean that a 10% increase in the minority fraction of total population would likely lead to a 1.56% decrease of the county area with streetlight. The magnitude appears small, although the impact is quite significant considering that the streetlight expansion over the decade was 3.6%. The streetlight provision level and urbanization measures in 1990 appear to have little influence over the change in the lit fraction of county, but their coefficient values do have the expected positive signs. Among the added control variables, the age group variable remains statistically robust and large in magnitude in Columns 5 and 6; the negative coefficient values indicate that the older the population is, the lower the provision of streetlights. In Table 2a, only the 11 provinces that have been part of the Great Development of the West were included in the analysis.¹⁴ These are the provinces that had shown slow economic development in the past, and have traditionally had dominant minority concentration. With the smaller number of counties, more variation in the dependent variable is explained by the regressors (as reflected in the higher adjusted R-squared values); however, the magnitude of the minority variable remains small.

Table 3a shows results from taking the minority population fraction in the year 2000 as a function of light spread in 1990. The results are similar to Table 2, in that the minority fraction variable remains statistically significant and negative in sign. The magnitude of the coefficient value however is again close to zero. A causal interpretation of the results suggest that under Column 2, a 10% increase in the minority fraction of total population, for example, will likely lead to a 0.19% decrease in the lit area, or less than a 2% decrease from the mean. The fraction of lit county area in 1990 on the other hand is a powerful indicator for the level of streetlight spread in 2000. Both the mean county elevation and area variable give statistically significant and negative coefficient values, suggesting that on average larger counties located in higher altitudes have less streetlights. On the other hand, larger population is positively correlated with more streetlights. The 1990 urban variable remains insignificant, since the 1990 streetlight level captures most of the same effect.

The next set of regressions uses the spatial instruments mainly to establish the causal negative effect of minority presence on the public provision level. Table 3b presents 2SLS regression results using a spatially weighted instrument for the minority fraction variable. The first threshold distance is 250 Km, and the second is 500 Km. Both the first and second stage results are presented; in the first stage, the minority fraction of total population for a given county is well predicted by the spatially weighted minority fraction of total population.

¹⁴These provinces are Gansu, Guangxi, Guizhou, Neimenggu, Nigxia, Qinghai, Sichuan, Yunnan, Xicang, Xinjiang, and Shaanxi.

The coefficient value under Column 2 is 1.157, suggesting that there is almost a one-to-one correspondence between the predicted and the actual change variable. The coefficient is also statistically significant at the 5% level under each specification.

The results show that spatially weighted neighbor county variables are significant predictors of the corresponding county's actual variables, and therefore the spatial method used to obtain the set of instruments appears valid. Another way to check the correlation between the two variables is to use spatial statistics; *Moran's I* (Moran 1950) is a standard measure of spatial autocorrelation and yields the level of clustering for each population, and is defined as

$$M = \frac{N}{\sum_{x} \sum_{y} w_{xy}} \frac{\sum_{x} \sum_{y} w_{xy} (f_x - \bar{f})(f_y - \bar{f})}{\sum_{x} (f_x - \bar{f})^2}$$
(3)

where N is the number of counties indexed by x and y; f is the fraction of the population group, \bar{f} is the mean of f, and w_{xy} is a matrix of spatial weights determined by the inversedistance weighting method. M yields the degree of spatial correlation for each population group. Negative (positive) values indicate negative (positive) spatial autocorrelation. Values range from -1 (indicating perfect dispersion) to +1 (perfect correlation), and zero value indicates a random spatial pattern. For statistical hypothesis testing, Moran's I values can be transformed to Z-scores and indicate whether the null hypothesis of zero spatial autocorrelation can be rejected. Moran's I index value for the minority fraction in 2000 is 0.722 (Z-score=139.651), suggesting that the minority population is clustered, and that given a county, the neighboring counties will have similar attributes. The positive index value and the high Z-score suggest that the minority population is spatially correlated in 2000.¹⁵ In the second stage, the predicted minority fraction variable remains statistically significant and negative in value. The coefficient value remains close to zero, suggesting that the minority factor does not explain much of the variations in the provision of streetlights. For example, the coefficient value under Column 2 is -0.023, with the threshold set at 250 km. This means that a 10% increase in the minority fraction of total population will likely lead to a 0.23% decrease in the lit area. The streetlight spread in 1990 is again statistically significant and the county area has a negative impact on the light provision, while the lagged urbanization and total county population show statistically significant positive coefficient values.

 $^{^{15}}$ Similalry, the index value for 1990 is 0.732 (Z-score=141.660).

6 Conclusion

This paper looks at the local provision of public goods in China and finds that minority group presence has a negative impact on the amount of streetlights provided. By using both demographic and geographic data at disaggregated levels, it investigates the extent to which local public good provision may be determined in a non-democratic state. The empirical results show that at the county level there is only weak evidence that Han-dominated areas enjoy more infrastructural provision than minority group-dominated areas. Under the centralized government, there appears to be little discrimination against minority groups in terms of streetlight provision. The paper suggests one plausible explanation for the empirical pattern: the disparity between the two groups, if any, may be an unintended result of the central government's policy for economic development, carried out by local officials and the wealthy Han majority.

Major discriminatory treatment against the minority leads to several consequences, one of them being higher levels of uprisings. The animosity between the Han majority and other ethnic groups for example increased in various parts of China during the period of dramatic economic development. Ethnic conflicts are certainly not recent phenomena in China.¹⁶ However, over the past decade, violent uprisings stemming from the unrest between the Han majority and the rest appear to have risen along with China's rapid market economy. For example, governmentsponsored projects such as the "Big Development of the Northwest," or "the Great Opening up of the West" starting in 2000 saw Xinjiang, China's northwest "autonomous region," drawing the Han majority investment and labor to explore the province's natural resources such as petroleum and natural gas. While these projects were supposed to promote economic prosperity by providing basic infrastructures for the Muslim minority Uighurs and hence ease the ethnic tension between the native minorities and the Han migrants, uprisings in these regions suggest that the expansion may have exacerbated ethnic tension. One may interpret these insurgencies as outcomes of the central government's misguided effort to provide for its people. At least from the results shown above, there does not seem to be much basis for claiming that the local government is implementing a discriminatory provision policy. Rather, small disparities in local public goods provision appear to have resulted from indiscriminate development policies.

Following this paper's implication on the current violence in China, an ongoing project

¹⁶The country's efforts to maintain a unified state for example has been challenged in the past by the short-lived independent East Turkestan Republic (1944-1949) in Xinjiang and continuing international support for Tibet's sovereignty.

specifically looks at potential geospatial implications of each of China's 56 minority groups. The existing work on ethnic insurgencies, civil wars, and secessions have found that larger and more concentrated minority groups are more prone to ethnic violence.¹⁷ When the minority group is clustered and geographically apart from the majority, it may be easier to target them without the danger of hurting the Han majority. China Historical Township Population Census Data 2000 allows a further disaggregation of data at the township level. The next step of studying local violence in China would therefore be to identify the individual effect of each of the country's 56 population groups listed as an ethnic minority. When certain minority groups are easily identifiable based on their geographic locations, do these groups face more violence, and are more violent than others that are more dispersed and mixed with the majority? The next research addresses this question by using the township data, and provides a perspective on the importance of groups' geographic salience. One way to differentiate ethnic groups is by looking at their geographic concentration levels at the county level. Tibetans and Uighurs for example are considered to be highly clustered, since they spread over regions, with each neighboring county having a similar population fraction of these groups. On the other hand, Drungs and Yugurs may be considered to be more randomly spread, since they only exist in few regions that are spread far apart. Given that there are more minority groups than Tibetan and Uighurs in China, it will also be useful to construct a measure of the overall geographic concentration of ethnic groups.

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 $^{^{17}}$ Walter (2006) suggests that concentrated minority groups are able to organize more effectively. Saideman & Ayres (2000) offer a similar explanation. Fearon and Laitin (1999) argue that dispersed minorities are less likely to engage in ethnic violence because they are less inclined to join in separatist wars, not having a common territory to claim as their own.

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Table	1:	Summary	Statistics
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Variable	Obs		Mean	Std. Dev.	Mean Compa	rison Test
Dependent Variable					T-stat	P-Value
Lit Fraction of County, 1990		1794	0.143	0.222		
Lit Fraction of County, 2000		1794	0.179	0.242	22.398	0.000
Change in the Lit Fraction of County		1794	0.036	0.067		
Main Variables						
Minority Fraction of Total Pop., 1990		1794	0.216	0.330		
Minority Fraction of Total Pop., 2000		1794	0.223	0.335	8.212	0.000
Change in Minority Fraction of Total Pop.		1794	0.007	0.035		
Total County Pop., in millions, 1990		1794	0.396	0.296		
Total County Pop., in millions, 2000		1794	0.417	0.319	10.034	0.000
Change in Total Pop., in millions		1794	0.021	0.089		
Urban Fraction of Total Pop., 1990		1790	0.024	0.113		
Additional Control Variables						
Immigrant Type						
Immigrants from the Same Province as Fraction of Total						
Pop., 1990		1794	0.015	0.024		
Immigrants from the Same Province as Fraction of Total						
Pop., 2000		1794	0.018	0.030		
Change in Immigrants from the Same Province as						
Fraction of Total Pop.		1794	0.003	0.020		
Immigrants from Other Provinces as Fraction of Total		1,7,1	01000	0.020		
Pon 1990		1794	0.008	0.021		
Immigrants from Other Provinces as Fraction of Total		1/21	0.000	0.021		
Pon 2000		1794	0.018	0.039		
Change in Immigrants from Other Provinces as Fraction		1//1	0.010	0.057		
of Total Pon		1794	0.010	0.035		
Education Attainment		1//1	0.010	0.055		
Pon w/ College Degree or Higher as Fraction of Total						
Pon (6 vrs & above) 1990		1794	0.002	0.002		
Pop. w/ College Degree or Higher as Fraction of Total		1//4	0.002	0.002		
Pop. (6 vrs & above) 2000		1794	0 004	0.005		
Change in Pon_w/ College Degree or Higher as		1//4	0.004	0.005		
Eraction of Total Pon (6 vrs & above)		179/	0.002	0.004		
Age Group		1//4	0.002	0.004		
Pon Aged 65 & Over as Fraction of Total Pon 1990		179/	0.052	0.012		
Pop. Aged 65 & Over as Fraction of Total Pop. 2000		170/	0.052	0.012		
Change in Pon. Aged 65 & Over as Fraction of Total		1//4	0.000	0.017		
Pon		170/	0.014	0.000		
Household Composition		1774	0.014	0.009		
# of Households w/ Three or More Generations as						
Fraction of Total # of Households 1000		1700	0 160	0.063		
# of Households w/ Three or More Generations as		1790	0.109	0.005		
π of Households w/ Three of Nore Orientations as		1704	A 100	በ በረብ		
Change in # of Households w/ Three or More		1/94	0.199	0.009		
Congrations as Fraction of Tetal # of Households		1700	0.020	0.040		
Concerning as Fraction of 10tal # of Households		1790	0.030	0.049		
Area (in 100km aguar 1)		1704	0.100	1 1 4 7		
Area (in 100km-squared)		1/94	0.100	1.16/		
Elevation (in km)		1/94	0.433	0.968		
Longitude		1/94	110.177	10.035		
Latitude		1794	33.018	6.778		

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Change in the Lit Fraction of County				nty
Lit Fraction of County, 1990	0.010	0.007	0.006	0.004	0.003
•	(0.021)	(0.023)	(0.023)	(0.026)	(0.026)
Urban Fraction of Total Population	0.024	0.022	0.022	0.025	0.027
Ĩ	(0.021)	(0.021)	(0.021)	(0.022)	(0.022)
Minority Fraction of Total Population	-0.156**	-0.144**	-0.144**	-0.141*	-0.140*
5	(0.047)	(0.049)	(0.049)	(0.052)	(0.052)
Change in Total Population, in millions	0.007	-0.009	-0.010	-0.026	-0.026
	(0.026)	(0.018)	(0.019)	(0.029)	(0.028)
Change in Immigrants from the Same	(01020)	0.112	0.110	0.086	0.090
Province as Fraction of Total Population		0.112	0.110	0.000	0.070
riovinee us ridenon or roun ropulation		(0, 090)	(0.088)	(0.094)	(0.096)
Change in Immigrants from Other Provinces		0.097	0.000)	(0.074)	0.086
as Fraction of Total Population		0.077	0.070	0.077	0.000
as i faction of fotal i optiation		(0.163)	(0.164)	(0.156)	(0.153)
Change in Population w/ Collage Degree or		(0.103)	(0.104)	(0.150)	(0.133)
Lisher as Erection of Total Depulation			0.110	0.239	0.297
Higher, as Fraction of Total Populatio			(0, 200)	(0.265)	(0.275)
Classic Develotion Acad (5. 9. Ocean of			(0.390)	(0.505)	(0.575)
Change in Population Aged 65 & Over as				-0.510	-0.520
Fraction of Total Population				(0, 7 , 0, c)	(0 770)
				(0.786)	(0.773)
Change in Number of Households w/ Three or					0.032
More Generations as Fraction of Total					
					(0.068)
Constant	0.034**	0.034**	0.034**	0.042**	0.041**
	(0.003)	(0.003)	(0.003)	(0.014)	(0.014)
	1 500	1 500	1 500	1 500	1 500
Observations	1,790	1,790	1,790	1,790	1,789
Number of provgb	30	30	30	30	30
Adjusted R-squared	0.009	0.011	0.010	0.013	0.012

Table 2: Ethnic Concentration Effect on Light Provision

Robust standard errors in parentheses ** p<0.01, * p<0.05, + p<0.1

	(1)	(2)	(3)	(4)	(5)	
VARIABLES	Change in the Lit Fraction of County					
Lit Fraction of County, 1990	0.070	0.071	0.055	0.051	0.051	
	(0.073)	(0.072)	(0.062)	(0.058)	(0.057)	
Urban Fraction of Total Population	0.020	0.015	-0.018	-0.021	-0.021	
	(0.036)	(0.033)	(0.029)	(0.029)	(0.029)	
Minority Fraction of Total Population	-0.132**	-0.114**	-0.109**	-0.110**	-0.110**	
	(0.031)	(0.031)	(0.028)	(0.020)	(0.020)	
Change in Total Population, in millions	0.053	0.047	0.030	0.082**	0.082**	
	(0.032)	(0.034)	(0.025)	(0.025)	(0.024)	
Change in Immigrants from the Same		0.081	0.134	0.166	0.166	
Province as Fraction of Total Population						
		(0.112)	(0.112)	(0.119)	(0.122)	
Change in Immigrants from Other Provinces		0.090	-0.043	-0.042	-0.042	
as Fraction of Total Population						
		(0.104)	(0.145)	(0.124)	(0.124)	
Change in Population w/ College Degree or			7.841*	7.485**	7.484**	
Higher, as Fraction of Total Populatio						
			(2.556)	(2.254)	(2.291)	
Change in Population Aged 65 & Over as				0.675	0.676	
Fraction of Total Population						
-				(0.494)	(0.464)	
Change in Number of Households w/ Three					-0.000	
or More Generations as Fraction of Total						
					(0.054)	
Constant	0.019**	0.018**	0.008	0.001	0.001	
	(0.004)	(0.004)	(0.005)	(0.009)	(0.010)	
	. ,	. ,	. ,	. ,	. ,	
Observations	816	816	816	816	816	
Number of provgb	11	11	11	11	11	
Adjusted R-squared	0.072	0.073	0.121	0.128	0.127	

Table 2a: Ethnic Concentration Effect on Light Provision (11 Provinces)

Robust standard errors in parentheses ** p<0.01, * p<0.05, + p<0.1

Tuble 54: Willofty Topulation Effect on E	agine i to via	Jon, I cui	2000	
	(1) Error	(2)	(3)	(4)
Traction of County Lit, 200				
Minority Fraction of Total Population	-0.052	-0 024**	-0.017*	-0.019*
withomy reaction of rotal ropulation	(0.032)	(0.02+	(0.001)	(0.01)
Area in 100km-squared	(0.03+)	-0.003**	-0.003**	-0.003*
rieu in rookin squared	(0.010)	(0.000)	(0.000)	(0.003)
Mean Elevation in km	-0.102**	-0.018*	-0.015+	-0.015+
	(0.035)	(0.010)	(0.008)	(0.012)
Longitude	-0.006*	-0.001	-0.001+	-0.001
Longitude	(0.003)	(0.001)	(0.001)	(0.001)
Latitude	-0.003	-0.002	-0.001	-0.001
	(0.007)	(0.002)	(0.002)	(0.002)
Lit Fraction of County, 1990	(01007)	0.997**	0.993**	0.988**
		(0.019)	(0.020)	(0.022)
Urban Fraction of Total Population, 1990		0.021	0.020	0.017
1 /		(0.017)	(0.017)	(0.019)
Total County Population, in millions, 2000			0.020	0.020
			(0.014)	(0.014)
College Graduates as Fraction of Total Population			0.286	0.253
C I			(0.379)	(0.352)
Fraction of population over 64 years old			0.230	0.253
			(0.266)	(0.248)
Fraction of Household with 3 Generations or More				0.045
				(0.066)
Immigrants from Same Province as Fraction of Total				0.074
ropulation				(0.062)
Immigrants from Other Province as Fraction of Total Population				0.018
1				(0.114)
Constant	1.099**	0.262*	0.231 +	0.215+
	(0.272)	(0.109)	(0.126)	(0.120)
Observations	1 70/	1 790	1 790	1 700
R-squared	0.084	0.910	0.910	0.911
Number of Provinces	30	30	30	30
	50	50	50	50

Table 3a: Minority Population Effect on Light Provision, Year 2000

Robust standard errors in parentheses ** p<0.01, * p<0.05, + p<0.1

Table 50: Ethnic Concentration Effect on Light Provision-IV First Stage Results						
	(1)	(2)	(3)	(4)		
VARIABLES	250km	250km	500km	500km		
	Threshold	Threshold	Threshold	Threshold		
Minority Fraction of Total Pop.	1.240**	1.157**	1.617**	1.560**		
(weighted)						
	(0.027)	(0.030)	(0.045)	(0.051)		
Area in 100km-squared		-0.001		-0.008+		
-		(0.005)		(0.004)		
Mean Elevation, in km		0.040**		0.064**		
		(0.008)		(0.009)		
Longitude		0.006**		0.014**		
-		(0.002)		(0.002)		
Latitude		-0.001		0.001		
		(0.002)		(0.002)		
Lit Fraction of County, 1990		-0.038*		-0.026		
		(0.019)		(0.021)		
Urban Fraction of Total		-0.152**		-0.152**		
Population, 1990						
		(0.031)		(0.034)		
Total County Population, in		-0.089**		-0.140**		
millions, 1990						
		(0.015)		(0.017)		
Constant	-0.048**	-0.705**	-0.124**	-1.720**		
	(0.007)	(0.176)	(0.010)	(0.202)		
Observations	1,792	1,789	1,794	1,790		
R-squared	0.546	0.576	0.421	0.494		
Number of Provinces	30	30	30	30		

Table 3b: Ethnic Concentration Effect on Light Provision-IV First Stage Results

Standard errors in parentheses ** p<0.01, * p<0.05, + p<0.1

Table 3b: Second Stage Results							
	(1)	(2)	(3)	(4)			
VARIABLES	250km	250km	500km	500km			
	Threshold	Threshold	Threshold	Threshold			
Minority Fraction of Total	-0.120**	-0.023*	-0.129**	-0.028*			
Population							
-	(0.029)	(0.011)	(0.033)	(0.013)			
Area in 100km-squared		-0.004*		-0.003+			
-		(0.002)		(0.002)			
Mean Elevation, in km		-0.015**		-0.014**			
		(0.004)		(0.004)			
Longitude		-0.001*		-0.001*			
-		(0.001)		(0.001)			
Latitude		-0.001		-0.001			
		(0.001)		(0.001)			
Lit Fraction of County, 1990		0.996**		0.996**			
-		(0.008)		(0.008)			
Urban Fraction of Total		0.023+		0.022 +			
Population, 1990							
-		(0.013)		(0.013)			
Total County Population, in		0.021**		0.020**			
millions, 1990							
		(0.007)		(0.007)			
Constant	0.206**	0.255**	0.208**	0.249**			
	(0.008)	(0.074)	(0.009)	(0.073)			
Observations	1 792	1 789	1 794	1 790			
Number of Provinces	30	30	30	30			
Trumber OF FTOVINCES	50		50	50			

Standard errors in parentheses ** p<0.01, * p<0.05, + p<0.1

Figure 1: Spatial Weight Calculation of Neighboring Counties



Figure 2a: Changes in Minority Population, 1990-2000



Changes in Minority Population (as Fraction of Total County Population)



Figure 2b: Changes in Lit County Fraction, 1990-2000



Figure 3a: Minority Population, 1990



Figure 3b: Lit Counties, 1990



Figure 4a: Minority Population, 2000



Figure 4b: Lit Counties, 2000

