The Social Ecology of Rural Violence: Land Scarcity, the Organization of Agricultural Production, and the Presence of the State[1]

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This article develops a conceptual framework to study rural violence by extending the insights of human ecology. Four hypotheses are proposed regarding the effects of land distribution, collective ownership, and the organization of agricultural production on homicide rates. These hypotheses are tested using data from a census of all agricultural production units in a sample of Mexican municipalities. An unequal distribution of land is associated with higher rates of violence. Insecure property rights and the commodification of agricultural production are also conducive to more homicides. A fifth hypothesis is derived from a consideration of the state's role in preventing violent conflict. In remote areas that historically have been far from the reach of the state, individuals are more likely to settle disputes violently. Topographical features are used to measure the accessibility of state institutions.

Sociological research on the structural origins of criminal violence has focused almost exclusively on urban settings. A large number of studies examine the effects of aggregate or ecological factors such as poverty, income inequality, and residential segregation on rates of violent crime in samples of U.S. metropolitan areas and within neighborhoods in urban centers (Blau and Blau 1982; Messner 1983; Williams 1984; Messner and

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Tardiff 1986; Bailey 1984; Land, McCall, and Cohen 1990; Peterson and Krivo 1993; Morenoff, Sampson, and Raudenbush 2001). By contrast, studies of violence in rural settings either focus on the conditions for collective violence or, when they analyze interpersonal violence, emphasize the importance of cultural factors or small group dynamics instead of aggregate structural features of rural communities (Muir 1993; Chagnon 1988; Boehm 1984; Rosaldo 1980; Koch 1974). The implication is that an investigation into the origins of rural violence requires an entirely different theoretical and methodological approach.

The lack of attention to ecological theories of crime in rural areas is unfortunate not only because rural areas continue to be the sites for an enormous amount of violence—in fact, rural homicide rates surpass those of urban centers in many parts of the world—but also because the extension of these theories to different settings holds the promise of new insights and forces researchers to refine the causal mechanisms that are often formulated in universal terms. Indeed, a true test of the scope and explanatory power of ecological theories of crime and violence is their ability to explain violence in settings other than those for which they were originally conceived but which nevertheless share analytical similarities. An examination of the origins of rural violence may also lead to a consideration of new factors that may be usefully applied in urban settings.

In this article, I examine the ecological correlates of lethal violence in rural Mexico. In contrast to the United States, where homicide rates in rural counties are considerably lower than in metropolitan areas (FBI 2000), rural municipalities in Mexico have higher rates of homicidal violence than urban municipalities. This relation appears to hold even when various standard correlates are taken into account (Villarreal 2002). The Federal District, located in the central part of Mexico City, has a homicide rate that is slightly below the national average, while predominantly rural states, such as Oaxaca and Guerrero in southern Mexico, have a homicide rate approximately twice the national average (three times that of the United States). However, not all rural areas of the country have such high rates. Indeed some rural municipalities have homicide rates that are among the lowest in the nation. Not only do rural municipalities have a higher average homicide rate, but they also have more variation in homicide rates. My purpose is to explain this variation.

In the following sections, I develop a conceptual framework to study rural violence by extending the insights of human ecology. I propose four hypotheses regarding the effects of land distribution, collective ownership, and the organization of agricultural production on homicide rates. I test these hypotheses using aggregate data from a census of all agricultural production units in a sample of Mexican municipalities. A fifth hypothesis is derived from a theoretical consideration of the role of the state in

preventing violent conflict. I argue that in remote mountainous areas that are far from the reach of the state individuals are more likely to settle their disputes violently. Moreover, the relative absence of state institutions for mediating disputes will be conducive to cultural practices that may in turn promote violent conflict. The use of topographical features to measure the relative access to the state is one of the key contributions of the study.

HUMAN ECOLOGY AND RURAL VIOLENCE: THE EFFECT OF LAND SCARCITY

One of the basic principles of human ecology as first proposed by Robert Park and Ernest Burgess was that, in direct analogy with the plant and animal world, competition among individuals determines their spatial distribution within urban areas (Park 1936; Park and Burgess 1925). The competition for resources and space that human ecologists describe as characteristic of urban settings has its direct counterpart in the competition for arable land in rural areas, with the difference that in rural areas land is seen as a resource necessary for subsistence and not simply as a place of residence. The subsistence farmer or peasant depends on the land for his or her survival, whereas the urban dweller prefers a certain part of the city based on the convenience and amenities it affords. Because the loss of land, or loss of good quality land, has a direct impact on the livelihood of the peasant and may indeed be life-threatening, conflict over land may be expected to turn more violent.

Two conditions further aggravate land conflicts in the countryside. First, there are more restrictions on the redistribution of population compared to movement between neighborhoods in urban areas. The greater dependence on kinship and friendship networks and cultural attachment to a village or to a particular ethnic and linguistic group make migration to neighboring areas more difficult and costly (unless network ties there have already been established). Second, cities are expanding or expandable systems. They grow by incorporating new land, and often entire towns, into larger metropolitan areas. Such expansion, and the possibility of increasing population density, may prevent the escalation of conflict over space. By contrast, in rural settings, the expansion of arable land is severely limited once forest lands are depleted. There are also limitations to increasing population density since capital investments are usually needed to increase crop yields or develop processing industries. Conflict over land therefore more often takes the form of a zero-sum game (Foster 1965; Black-Michaud 1975, pp. 172–78).

The scarcity of land may lead to greater rates of violence in a com-

munity, not only as a result of direct confrontation between individuals competing for a limited resource that is needed for survival, but also indirectly through a weakening of social bonds between residents. A situation where there is insufficient arable land for everyone and where individuals are living in desperate conditions will breed mistrust among residents and prevent cooperation. As social control theorists have argued in the context of urban areas, the loss of cohesion among residents may impair a community's ability to prevent crime (Bursik and Grasmick 1993; Sampson and Groves 1989; Kornhauser 1978; Janowitz 1975; Shaw and McKay 1942). With these two causal factors in mind, I propose a first hypothesis with regards to the impact of agrarian structures on rural violence.

HYPOTHESIS 1.—*When agricultural land is scarce relative to the number of individuals, there will be more conflict and therefore more homicides.*

A second hypothesis regarding the effect of land distribution on the level of violence in rural communities may be derived from strain or anomie theories of crime. According to anomie theorists, crime and violence may result not only from an absolute lack of resources, but also from a sense of relative deprivation, or from the inability of individuals to obtain the resources that are generally available to a particular reference group (Merton 1938; Patterson 1991; Passas and Agnew 1997). Following this line of reasoning, researchers have examined the effect of income inequality on homicide rates in U.S. urban areas and specifically have compared it to the effect of poverty or absolute deprivation (Blau and Blau 1982; Messner 1982, 1983; Williams 1984; Bailey 1984). Since many rural residents derive their income from the land, we may suspect that an unequal distribution of land, and not just its overall scarcity, may lead to increased violence in a similar way as income inequality is thought to affect crime in urban areas.

Relative deprivation is not a mechanical consequence of a discrepancy in wealth or land, but is rather a subjective reaction to the level of inequality, and, as such, it depends on the cultural framework within which individuals operate (Stack 1984; Gurr 1970; Runciman 1966). Stack (1984) argues that the effect of inequality on crime depends on the presence of an egalitarian national culture that holds that inequality is illegitimate. He tests this proposition by using measures of the presence of an egalitarian ideology such as a strong organized labor movement and the existence of socialist political parties. Because of the long-standing presence of an egalitarian ethos with respect to land ownership in rural Mexico, the country is a particularly promising site to test the criminogenic effects of inequality. This egalitarian ethos is embodied, for instance, in the Mexican Constitution of 1917. Article 27 of the constitution is often considered to be one of the most important legacies of the Mexican revolution, and

especially the agrarian elements within it. Among other things, this article allowed the state to expropriate private property "to ensure a more equitable distribution of wealth" (quoted in Avalos 1992, p. 6). A second hypothesis with regards to land distribution derived from relative deprivation theory may therefore be stated as follows.

HYPOTHESIS 2.—*An unequal distribution of land will lead to more violent conflict.*

COLLECTIVE OWNERSHIP OF LAND: *EJIDOS* AND COMMUNAL LANDS

Conflict over land may result not only from scarcity, but also when property rights over plots are not clear, are not well enforced, or are contingent. Mexican law supports two different types of collective land tenure in addition to private and public ownership. Written during the Mexican Revolution, the Agrarian Law of 1915 and Article 27 of the 1917 constitution captured the demands of a large segment of the peasantry for the restitution of lands taken from them during the course of the 19th century. The Agrarian Law of 1915 made explicit the rights of villages or agrarian communities over communal lands first recognized by colonial authorities and later rescinded by Liberal reformers in the mid-19th century. Article 27 of the constitution made provisions for the breakup of large landholdings and the creation of agrarian collectives known as *ejidos*. In the decades following the revolution, large tracts of land were distributed in the form of ejidos. By 1999, there were a total of 27,285 ejidos nationwide, employing 3.1 million members and their dependents. There were also 2,197 agrarian communities employing over half a million members. Approximately 51.4% of the country's rural land is either *ejidal* or communal, while 37.6% is private, and the remaining portion is made up of public lands and agricultural colonies (Robles 1999; Cornelius and Myhre 1998).

Ejidos and agrarian communities may exercise a large amount of discretion in the apportionment of land among their members. Communal lands within agrarian communities are distributed according to village traditions, usually based on individual family needs. And while every *ejidatario* or *ejidataria* (ejido member) has a right to a portion of land, which can be bequeathed to family members, he or she cannot sell or mortgage it.[2] Decisions concerning the distribution of land among ejido

[2] In addition to ending the government's constitutional obligation to distribute land, the reform of the Agrarian Law in 1992 also allowed ejidatarios to obtain individual titles for their lands and to privatize or disband the ejido if so agreed by the ejido assembly (see Cornelius and Myhre 1998, pp. 1–4). During the period considered in this study (1990–91), this law was not yet in effect.

members, as well as other matters, are made by ejido assemblies headed by elected officials. In addition to the land that is allotted to individual ejidatarios and ejidatarias, a portion of the ejido's land may be worked by the collectivity, and all members may benefit from it.

Because apportionment of land within ejidos and agrarian communities is often carried out by an internal political process, it frequently leads to disputes. Conflicts within ejidos and agrarian communities arise with regards to the limits of individual plots (since there are no titles specifying the precise boundaries), the inheritance of ejidal lands, and the use of lands belonging to the entire community, among other issues. Disputes between entire ejidos and agrarian communities and their neighbors over lands are also common and often turn violent (see the appendix, below, for a breakdown of disputes among members of ejidos and agrarian communities based on data from the Agrarian Prosecutor's Office, a government agency in charge of resolving conflicts in rural areas).

Case studies of ejidos and agrarian communities repeatedly find insecure property rights to be a source of conflict and violence. In their systematic review of available ethnographic studies of rural Mexico, DeWalt and Rees (1994) find that "the historic ambiguity in determining exact boundaries are the source of most conflicts between communities" (p. 23). Boundaries between village lands are often marked using large stones, maguey plants, or trees. "With various transfers over the years lands between communities are often claimed by each, and may in fact have been historically used by both. If this land becomes valuable, as is the case with good agricultural land or land with forest resources, the conflicts can result in violence and even death" (p. 24). The authors find that boundary conflicts are especially common in the South Pacific region of the country, which includes the states of Guerrero, Oaxaca, and Chiapas. In this region, conflicts between ejidos are reported in 30% of the communities studied. Dennis (1987) provides a rich description of how a dispute between two agrarian communities is Oaxaca over communal lands led to violent confrontations spanning several generations. Similarly, Greenberg (1981) traces the origin of blood feuds between Chatino villages in southern Oaxaca to disputes over lands used for coffee production. However, violent conflicts between agrarian communities are by no means unique to the South Pacific region. In his classic study of the village of Tepoztlán in central Mexico, Oscar Lewis ([1951] 1963, pp. 221–52) also documents violent confrontations with a neighboring village over forest lands.

The tendency for insecure property rights to cause violent conflicts within and between ejidos and agrarian communities may be stated in the form of a third hypothesis.

HYPOTHESIS 3.—*When property rights are not well enforced or are*

contingent, there will be more conflict over lands. For this reason, ejido and communal units will experience more violence.

THE ORGANIZATION OF AGRICULTURAL PRODUCTION IN THE MEXICAN COUNTRYSIDE

An influential theoretical tradition whose origins may be traced to the Chicago School of sociology argues that greater social cohesion among community members leads to lower rates of violent crime. More cohesive communities are expected to have lower crime rates because they are better able to enforce social norms and exercise guardianship over property and persons (Shaw et al. 1929; Shaw and McKay 1942; Janowitz 1975; Kornhauser 1978; Sampson and Groves 1989; Bursik and Grasmick 1993). Advocates of this view, known as social disorganization theory, developed their arguments based on the experience of urban areas, yet their insights may also extend to rural settings. However, because residents of rural towns and villages are not only neighbors, but are also intricately tied to each other for the purposes of agricultural production, the degree of social cohesion in such communities will depend to a large extent on the relations of production and exchange associated with the prevailing agricultural system. In particular, I hypothesize that agricultural systems that require a greater degree of dependence among residents in the production process, such as those involving small-scale production for subsistence, will be associated with greater social cohesion and, therefore, with less crime. Conversely, agricultural systems that require less cooperation and those that involve more commodified relations of production and exchange will be associated with less cohesion and, therefore, with more crime.

The concept of social capital is often used to refer to the collective gains associated with increased cohesion among community members and specifically to its effect on lowering crime rates (Coleman 1990, pp. 300–321; see also Sampson, Morenoff, and Earls 1999). As James Coleman points out, the exchange of favors not only may benefit individuals involved but also may create a web of obligations that constitutes a public good. All else being equal (e.g., income), communities in which peasants depend on the aid of others for their livelihood will have more social control than communities of isolated producers or agricultural workers for hire. The latter will depend more on their relation with their employer for their livelihood than on other community members. The introduction of wage labor into large agricultural enterprises will weaken traditions of reciprocity and individuals' dependence on others for subsistence, and there-

fore they may also weaken the power that communities exercise over individual behavior. This hypothesis may be stated as follows.

HYPOTHESIS 4*a*.—*Agricultural production systems that involve more commodified relations of production and exchange will be associated with a breakdown of community social cohesion and therefore with more violence.*

Participation in agricultural markets will also lead to greater conflict over property and control over trade. This is particularly evident in agricultural areas dedicated to the production of cash crops. In his study of violence among the Chatino in the southern Mexican state of Oaxaca, James Greenberg (1989) finds that the introduction of coffee production disrupted the organization of communities and led to violent conflicts over land. Although the lands were technically still communal, the investment in coffee plants turned individual parcels into de facto private property. As the traditional system of land distribution based on usufruct rights and inheritance was replaced by private ownership, land became concentrated in fewer hands, and violent conflicts errupted:

> As privatization engendered conflicts between claims to land based on "sale" and those based on traditional rights of inheritance or usufruct, the fuel of envy and witchcraft accusations was added to the fires that produced homicides. As privatization proceeded apace, many villagers were reduced to landless rural proletarians. Witchcraft accusations soon gave way to killings and vendettas, until blood feuds tore the Indian communities apart. (Greenberg 1989, p. 194)

Similarly, in his study of the Huasteca region in northeastern Mexico, Frans Schryer (1990) documents how the introduction of modern cattle production fostered class distinctions and conflict between subsistence farmers and the new cattle-raising elite. This relation between the commodification of agricultural and livestock production and conflict over land may be stated as an extension of the previous hypothesis.

HYPOTHESIS 4*b*.—*The introduction of cash crops will lead to greater conflict over resources and control over trade, and consequently to more violence.*

REGIONAL TOPOGRAPHY AND THE PRESENCE OF THE STATE

A long-standing tradition in social thought dating back to Thomas Hobbes argues that modern states are conducive to a reduction in interpersonal violence. In his classic statement in the *Leviathan*, Hobbes argued that without a sovereign state that could keep men in awe, society would be reduced to a constant state of war of all against all. Life under such

conditions, according to his oft-quoted passage, would be "solitary, poor, nasty, brutish and short" (Hobbes [1651] 1962, p. 100). Although researchers have identified examples of peaceful stateless societies, case studies and cross-national comparisons generally support the proposition that the presence of the state reduces interpersonal violence (see Cooney [1997; 1998, pp. 45–66] for a review of the anthropological evidence).[3]

One important way that a well-functioning state helps reduce violence is by providing an alternative, peaceful mechanism for resolving disputes (Black 1983; Cooney 1997; Gould 1999, p. 375). Lacking this state mechanism, individuals are often forced to take matters into their own hands, using violence as a form of self-help (Middleton and Tait 1958; Bohannan 1977; Black 1983; Boehm 1984, pp. 65–89). Moreover, in order to protect their property and guarantee their safety, individuals in societies without effective state law enforcement institutions may choose to band together, forming systems of mutual defense based on kinship and tribal membership. While such collective arrangements can serve to regulate or inhibit violence, they frequently lead to its perpetuation through blood feuds or vendettas (Gould 2000). The condition of statelessness is not unique to rural areas or premodern societies. There are marginalized groups within societies with modern states that are far from the reach of state authorities and situations where the state cannot be appealed to in order to resolve disputes, such as in illegal markets. It is precisely in these settings where violent conflict is frequent in modern societies (Black 1983; Cooney 1997; Shakur 1993; Canada 1995).

One explanation for the variation in homicide rates across Mexican rural areas is precisely their differential access to the state. In remote rural areas where individuals have little recourse to the courts to settle their disputes, and where residents cannot rely on the police for protection, disputes are more likely to be settled by the use of force. Physical obstacles such as mountains and rivers often constitute natural barriers to state institutions for residents of rural villages. In her study of legal practices among indigenous groups in the southern Mexican state of Oaxaca, Laura Nader describes the difficulty of gaining access to district courts in remote mountainous areas:

[3] The strengthening and centralization of a national state may of course increase the overall rate of violence by waging war against other states or by persecuting its own citizens. Thus, Cooney (1997) has described the relation between state power and lethal violence as U-shaped. However, state-sponsored killings constitute a relatively small fraction of the violent deaths in Mexican rural areas. In effect, I am dealing with the downward part of the U-shaped curve. The reduction in interpersonal violence attributed to the state in previously stateless societies must also be distinguished from the other effects of colonialism through which many of these societies first come into contact with state authorities (Cooney 1998, pp. 54–59).

> The district court is located in San Idelfonso de Villa Alta, a mestizo village between six and eight hours' walking distance from Talea. In traveling to Villa Alta, one has to cross a mountain called Matahombres (killer of men). The name is apt, and I realized how motivated one would have to be to take a case to the district court after I had traveled the route myself. It is approximately an hour's downhill walk from Talea to the little hamlet of Santa Gertrudis, which is all that is left of a once active mining community. Then one has a steep climb up the mountain, followed by a descent to the only water between Santa Gertrudis and Villa Alta. From the river it is upward again for about an hour and a half to reach the small town of Villa Alta. In the 1960's the population of Villa Alta was 600 people. Twenty years later its size remains the same, and it is still necessary to walk the long mountain road to the district seat. (Nader 1990, p. 162)

Such a long trek constitutes a clear disincentive to using the state as a mediator in disputes, and perhaps not surprisingly, individuals in the communities studied by Nader preferred to resolve their conflicts through other means. In the analysis below, I systematically test a fifth hypothesis based on this insight regarding the natural barriers to state institutions.

HYPOTHESIS 5.—*Remote mountainous areas will have higher rates of violence due to the absence of state institutions.*

The degree of remoteness of Mexican rural areas, and therefore the relative accessibility of state institutions, is measured using the variation in altitude. As the passage from Nader's (1990) book suggests, mountains constitute natural barriers against state penetration. The variation in altitude accurately captures the mountainous nature of the terrain. Figure 1 shows the homicide rate in Mexican municipalities, and figure 2 shows the population-weighted standard deviation in elevation of all cities and towns located within them.[4] The standard deviation in elevation clearly delineates the two mountain ranges that extend from north to south on the eastern and western part of the country—known as the Sierra Madre Oriental and the Sierra Madre Occidental, respectively—as well as the central volcanic region. Between these two mountain systems in the north is the central plateau (Hanratty 1997; West and Augelli 1989, chap. 2). More important, a visual comparison of the two maps reveals a remarkable coincidence between the mountainous areas and those with high homicide rates.

In the regression analysis below, I test the association between the

[4] The population estimates used to construct the indicator of variation in altitude are from the 1995 Population Count (*Conteo de Población y Vivienda*), a shorter version of the census conducted halfway between the decennial censuses, because data from the Population Count are disaggregated for more towns (104,142) than the 1990 census used to construct other municipal variables. However, the results presented below hold even when the standard deviation of the altitude is not weighed by the population in each town.

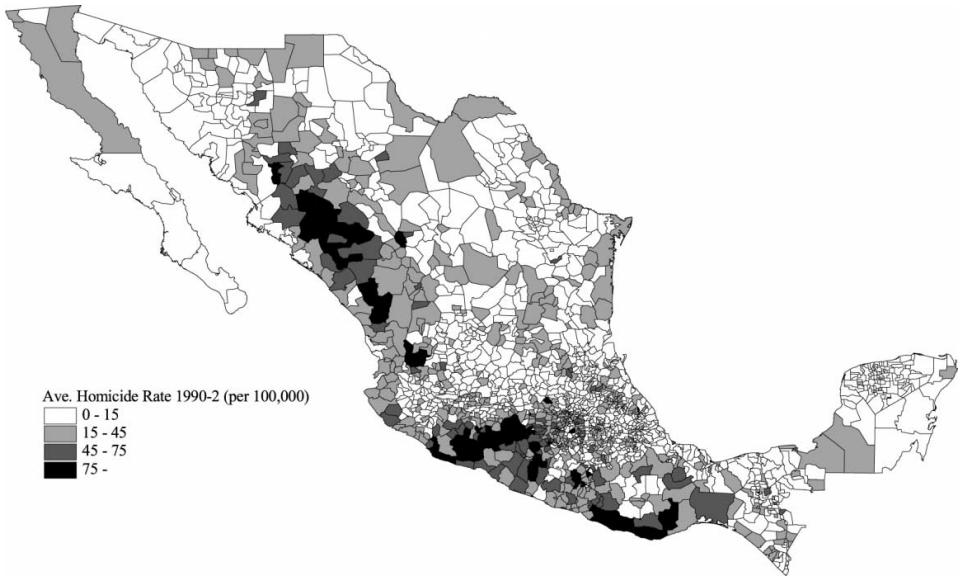

FIG. 1.—Average homicide rate in Mexican municipalities, 1990–92.

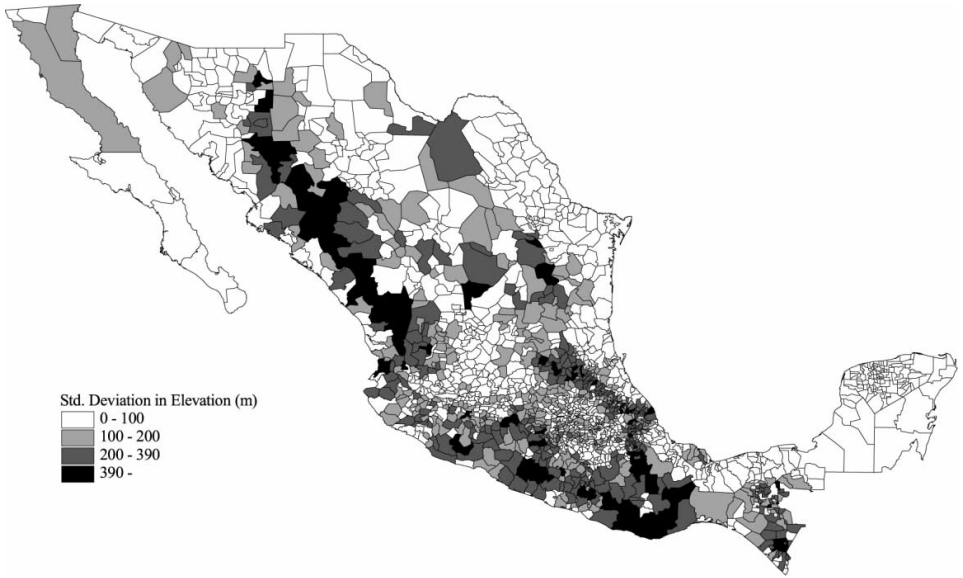

FIG. 2.—Variation in altitude of Mexican municipalities.

variation in elevation and the homicide rate, along with predictors that control for other differences among rural areas, including land scarcity and the organization of agricultural production. Testing the effect of the state presence in this way is preferable to approaches taken by researchers in the past. Until now, evidence for the reduction in violence due to the presence of the state has been based on: (1) meta-analyses of anthropological studies of violence in stateless and state societies (Koch and Sodergren 1976; Rosenfeld and Messner 1991); (2) comparisons of the incidence of violence in particular countries before and after the consolidation of a state (see Cooney [1997] for a review); (3) studies of "stateless locations" within industrial societies such as the United States, including illegal markets and disadvantaged communities where individuals have little or no access to legal institutions (Black 1983). As Cooney (1998, pp. 50–54) observes, cross-cultural studies of the effect of the state on the prevalence of violent conflict are problematic because the anthropological evidence is often incomplete and it is difficult to control for other differences across societies that might also affect the rate of violence. Similar problems plague case studies of violence in particular societies before and after the advent of the state, as well as studies of illegal markets. By contrast, in the analysis below, I am able to control for a large set of structural differences across rural areas of Mexico.

DATA AND MEASURES

The hypotheses described above are tested using a sample of rural municipalities in Mexico. Municipalities are the smallest administrative units for which homicide statistics are available nationwide. They are roughly equivalent to counties in the United States. The number of homicides are obtained from vital statistics compiled by the Mexican government in accordance with the World Health Organization guidelines, which identify "homicide and injury purposely inflicted by other persons" as a cause of death (INEGI 1992; WHO 1977, 1992). In order to smooth out yearly fluctuations, the total number of homicides over a three-year period (1990–92) is used, and the population at risk is assumed to be three times the municipal population.[5] Population estimates and all socioeconomic variables used as controls are drawn from the 1990 population census, so as

[5] The aggregation of crimes over a three-year period is customary in order to smooth out yearly fluctuations (Messner 1983; Sampson 1987; Morenoff et al. 2001). Since both the homicide counts and the exposure group are aggregated for the three-year period, the coefficients in the regressions below may be interpreted as the effects of each variable per person-year.

to coincide as closely as possible to the year for which the agricultural variables are available.

The sample of rural municipalities is constructed by selecting all municipalities in which more than 75% of the population lives in towns of less than 2,500 residents. The criterion for inclusion in the sample is based on the size of towns, because the Mexican census provides no guidelines for defining a rural municipality based on its total population.[6] A total of 697 municipalities (37% of all municipalities in the country) satisfy this criterion and are therefore included in the sample (minus some eliminated due to missing values).[7]

The variables for land scarcity, collective ownership, and the organization of agricultural production are all drawn from the 1991 Agricultural and Livestock Census (INEGI 1993). This census collects information on all agricultural and livestock production units in the country, including the size of plots, the type of ownership, the form of agricultural production, the amount and type of agricultural product harvested, and the number of individuals employed. I measure the scarcity of land for the sample of rural municipalities (hypothesis 1) in three different ways: the percentage of rural production units of five hectares of land or less, the log of the average plot size, and the log of persons per hectare of agricultural land. The percentage of rural production units of five hectares of land or less is meant to capture the proportion of residents who suffer an absolute scarcity of land in a similar way as the percentage of families below a poverty line is often used as a measure of absolute resource deprivation. The log of the average plot size (analogous to the logged mean income) is a measure of the central tendency and tells us whether residents of the municipality on average experience a scarcity of land. Finally, the log of persons per hectare of agricultural land should capture the scarcity of land in that it is a measure of the amount of people living from agricultural plots of the same size. Because the extent to which small plots of land satisfy the needs of residents will depend on the quality of the land, I introduce the log of maize yields (expressed as tons per hectare) along with each indicator of land scarcity in the regression models. Based on the review of ethnographic studies by DeWalt and Rees (1994, p. 24) quoted above, more valuable lands are expected to result in more violence by raising the stakes of disputes over ownership.

The degree of land inequality (hypothesis 2) is measured by adapting

[6] Although the exact cutoff points may seem somewhat arbitrary, the results presented hold for a considerable range of criteria, including limiting the sample to municipalities with 75% and 100% of residents living in towns of less than 5,000 residents.

[7] Municipalities belonging to the state of Oaxaca were grouped into 30 districts commonly used for statistical purposes (INEGI 2002).

an indicator commonly used for income inequality known as Theil's index (Theil 1967). As noted by Allison (1978), Theil's index of inequality is scale invariant and satisfies the principle of transfers whereby inequality increases when income (or in this case land) is transferred from a poorer person to a wealthier one. An additional advantage of Theil's index compared to other measures of inequality such as the Gini coefficient is its greater sensitivity to transfers among low income earners (small landowners) (Allison 1978, p. 869). The index is computed using grouped data, with the unusual advantage that the exact mean of each category of plot size is known (since both the total surface area and the number of units in each of the eight plot size categories are known). The index of land inequality is given by:

$$T = \frac{1}{u_{tot}} \sum_{i=1}^{G} (u_i) z_i \ln (z_i),$$

where $z_i = (s_i/u_i)/(s_{tot}/u_{tot})$ is the ratio of the average plot size for agricultural units in plot size category i (their entire surface area s_i over the number of units u_i) to the average plot size of all agricultural units in the municipality (total surface area s_{tot} over the total number of units u_{tot}), and G is the number of plot size categories.[8]

In order to test the third hypothesis regarding the effect of contingent or not well-enforced property rights (hypothesis 3), I enter the percentage of the rural surface area in each municipality constituted by ejidos and communal units according to the Agricultural and Livestock Census into the regression models. In accordance with the third hypothesis, those municipalities with a larger percentage of communal and ejido lands are expected to have higher homicide rates. An inspection of these two variables reveals that the highest concentrations of collectively held lands are found precisely in those regions with highest homicide rates.

I measure the impact of the relations of agricultural production (hypothesis 4) using two different indicators. First, I enter the percentage of subsistence agricultural units, defined as those producing only for internal consumption within the household and not for sale in the market. Nationally, close to half of all agricultural units produce only for internal consumption. Because subsistence farmers will depend to a greater extent on the aid of nearby residents for harvesting and other activities, communities characterized by subsistence farming may be expected to exert more control over individual behavior and should therefore have less interpersonal violence. However, agricultural units that produce only for

[8] The eight plot size categories are less than 2 hectares; 2–5 hectares; 5–20 hectares; 20–50 hectares; 50–100 hectares; 100–1,000 hectares; 1,000–2,500 hectares; and more than 2,500 hectares of land.

internal consumption include those that cannot satisfy the needs of their members by cultivating their own land, and whose members must therefore seek supplementary income through outside employment. Households engaged in agricultural production for internal consumption may paradoxically be more involved in labor markets and depend less on help from others. The percentage of agricultural units that produce for internal consumption may therefore not be an adequate measure of the extent to which residents depend on one another for the purposes of production. The second measure I use to test the impact of the relations of production is the percentage of agricultural units with individual (as opposed to group) organization of production. Agricultural units with individual organization are those where a single individual is responsible for all decisions regarding its use and administration (INEGI 1993). Finally, I test the effect of cash crop production on homicidal violence using the percentage of units dedicated to harvesting coffee and raising cattle.

CONTROL VARIABLES

Six control variables are introduced in the regression models based on prior research on homicide in Mexico (Villarreal 2002), as well as a review of existing work on the structural correlates of homicide in the United States (Land et al. 1990; Parker, McCall, and Land 1999). First, I introduce the log of the population density as a measure of the degree of public social interaction. All else being equal, a greater number of residents per surface area may be expected to raise the number of homicides by increasing the opportunities for conflict and providing a greater sense of anonymity and less willingness to enforce social norms (Sampson 1983, 1985). The percentage of the population constituted by young males ages 15–29 is included as a measure of the age structure of the population. Since young men tend to account for a disproportionate number of homicide offenders and victims (Hirschi and Gottfredson 1983), municipalities in which young men constitute a larger proportion of the population are expected to have higher overall homicide rates. The ethnic composition of a municipality is accounted for by using the percentage of residents five years of age or older who speak an indigenous language. Because of the economic disadvantage of indigenous groups in Mexico and their relative isolation, they may be expected to exhibit concentration effects similar to those described for African-American communities in U.S. inner cities and consequently may produce higher rates of violence (Sampson and Wilson 1995; Massey 1995; Wilson 1987). However, many indigenous communities maintain strong social and political institutions that may serve to enforce norms and preserve order, and they may therefore exhibit

lower homicide rates. The illiteracy rate is used as an indicator of resource deprivation. As I have argued elsewhere, the percentage of illiterate adults is a better measure of poverty than one based on income because nonmonetary forms of wealth generation, including production for subsistence, are particularly important in rural settings. Economic distress is generally thought to weaken social ties among community residents and decrease social control. In fact, the illiteracy rate was found to be one of the strongest predictors of higher homicide rates in a national study of all municipalities (Villarreal 2002). The percentage of female-headed households was also found to be an important predictor of homicide rates in previous work and is therefore included in the regressions below. A high prevalence of single-parent households and marital dissolution may increase rates of violent crime by reducing the level of supervision and guardianship of activities in the community (Sampson 1987; Sampson and Groves 1989). A dummy variable is also introduced in the regression models to control for the municipalities located in the state of Mexico. Although some of these municipalities are technically rural, they are located in the Valley of Mexico in close proximity to Mexico City and tend to have higher homicide rates compared to the rest of the country, even when accounting for basic structural factors.

Finally, as described above, a measure of the local topography is used to test the effect of access to state institutions on the rate of homicidal violence. However, remote rural areas are not only farther from the reach of state institutions, they are also farther from medical services. Since quick access to medical facilities may enhance the survival rate of victims of physical attacks, they can decrease the homicide rate for reasons that have nothing to do with the existing level of violent conflict. Put another way, proximity to hospitals may make the difference between what may otherwise be legally categorized as assault or intended homicide and an actual homicide. I therefore introduce the number of medical doctors in the municipality per 10,000 residents according to the 1990 census as a predictor of homicide rates in all the regression models.

METHODS

The distribution of homicide rates in Mexican municipalities is heavily skewed toward lower values. It has the shape of a rapidly decaying function where most municipalities have low homicide rates. Homicides are, after all, relatively rare events. Under these conditions, ordinary least squares regressions lead to unreliable estimations (King 1988). The number of homicides in each municipality more closely resembles a positive count variable of the sort commonly encountered

in epidemiological studies. I therefore use negative binomial regressions to test the hypotheses described above (Beck and Tolnay 1995; Long 1997; Cameron and Trivedi 1998). Negative binomial regressions are similar to the more commonly known Poisson regressions in that the underlying distribution of the dependent variable is assumed to be close to a Poisson distribution, and maximum likelihood estimation is used. However, whereas Poisson regressions assume that the variance of the dependent variable is equal to its mean, negative binomial regressions allow for greater dispersion.[9]

RESULTS

Table 1 shows the results of the negative binomial regression models of homicide on the three separate measures of land scarcity in Mexican rural municipalities (hypothesis 1). The results of each of the three models contradict my original hypothesis: a smaller average plot size, a greater number of persons per hectare of land, and a higher percentage of agricultural units with a small plot size are all associated with *lower* rates of homicide (although the significance level for the coefficient of one of these indicators is quite low). One way of interpreting these findings is that municipalities with smaller plots are less dedicated to agricultural production and therefore less likely to exhibit conflicts over land. Second, it may be the case that complete landlessness and not the size of individual plots is associated with more conflict and violence. Those municipalities with larger landholdings may have a greater number of unemployed and displaced peasants struggling for land. Another possible explanation for the negative association between land scarcity and homicide is that the various indicators of land scarcity are so closely related to the overall population density that it is impossible to distinguish the effects of these two predictors in the regression models. A larger number of persons per hectare of agricultural land almost necessarily implies a large number of residents per total surface area of the municipality.[10]

[9] Negative binomial regressions assume that the dependent variable follows an overdispersed Poisson distribution with mean μ_i^*. The mean is an exponential function of the predictors, an offset term and a variable u_i:

$$\mu_i^* = \exp(\mathbf{x}_i\boldsymbol{\beta} + offset_i + u_i),$$

where e^{u_i} follows a gamma distribution with parameters $1/\alpha_i$ and $1/\alpha_i$. The extent of overdispersion is captured by the parameter α_i (see Stata Corp 2001).

[10] A separate model was tested in which a composite index of land scarcity/population density was used as a single predictor. The composite index was constructed using factor analysis with all three measures of land scarcity and the population density. The results of that model are consistent with those shown in table 1, in that a greater

TABLE 1

COEFFICIENTS FROM THE NEGATIVE BINOMIAL REGRESSION MODELS OF HOMICIDE ON LAND SCARCITY AND INEQUALITY (Hypotheses 1 and 2)

Variables	Model 1	Model 2	Model 3
Plot size and crop yields:			
% units ≤ 5 hectares	−.007**		
	(.002)		
Log average plot size		.124*	
		(.057)	
Log persons per hectare			−.078
			(.054)
Theil's land inequality	.189**	.093	.103
	(.059)	(.055)	(.055)
Log maize yields	.251**	.241**	.252**
	(.080)	(.081)	(.080)
Demographic variables:			
Log population density	−.241**	−.216**	−.244**
	(.045)	(.057)	(.057)
% young males	−.004	−.011	−.011
	(.038)	(.038)	(.038)
% indigenous	−.010**	−.011**	−.011**
	(.002)	(.002)	(.002)
Resource deprivation:			
Illiteracy rate	.045**	.043**	.043**
	(.004)	(.004)	(.004)
Family structure:			
% female-headed households	.051**	.048**	.047**
	(.013)	(.013)	(.013)
Access to medical attention:			
Medical doctors per 10,000	−.030*	−.030*	−.029*
	(.013)	(.013)	(.013)
Geographical region:			
Valley of Mexico	1.413**	1.351**	1.339**
	(.196)	(.195)	(.195)
Constant	−9.350**	−9.825**	−9.526**
	(.640)	(.707)	(.685)
Overdispersion parameter alpha	.799**	.806**	.809**
	(.061)	(.062)	(.062)
N	686	686	686
χ^2	212.37	205.95	203.31
Log likelihood	−1,751.78	−1,754.99	−1,756.31

NOTE.—SEs in parentheses.

* $P < .05$.

** $P < .01$, two-tailed tests.

By contrast, a greater inequality in the distribution of land (hypothesis 2) is associated with higher rates of homicidal violence. The effect is indeed quite strong. An increase of one standard deviation in Theil's index corresponds to a 20.1% increase in the homicide rate, according to the results of the most complete model below. In other words, it appears that relative scarcity of land, and not absolute scarcity, is conducive to greater conflict and more homicidal violence. This finding supports strain theory as it relates to the distribution of land in rural areas, and it parallels the results of studies showing a positive effect of income inequality on homicide in U.S. metropolitan areas.[11] Finally, we also note that better-quality land, measured in terms of maize yields, is associated with higher homicide rates, although the magnitude of the coefficient is small.[12]

The results presented in table 2 corroborate the third hypothesis regarding the effects of property rights on rural homicide rates. Those municipalities with a large percentage of ejido and especially communal lands have much higher homicide rates when all other relevant variables are controlled, including land scarcity and the quality of land. All else remaining equal, increases in the percentage of surface area constituted by ejido and communal lands of one standard deviation are associated with increases of 20.1% and 34.5% in the homicide rate, respectively. These findings strongly support the notion that ill-enforced or contingent prop-

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scarcity of land/population density is associated with more homicides per population. The large factor loadings also suggest that the measures of land scarcity and population density are closely related.

[11] The result is also consistent with an alternative explanation based on the relative status of disputants in a specific conflict and that of legal officials. Cooney (1998) suggests that a large difference in status between disputants and legal authorities leads to a distrust of the latter by the former and an unwillingness to settle their disputes through legal channels. Since inequality increases the status difference between rural disputants and authorities, it may lead to an increase in violence. In general, the results of the statistical analysis based on aggregate measures are compatible with other incident-level explanations.

[12] Mortality statistics, from which the homicide counts used as a dependent variable are drawn, constitute the most accurate source of information on homicidal violence since they are based on death certificates and are not affected by the efficacy of local law enforcement institutions. Nevertheless, in order to verify that the findings presented here are not the result of biases in the way that mortality statistics are compiled and reported, I tested the same models using an alternative source for the dependent variable. I obtained homicide counts from the number of individuals charged with a homicide offense in federal and state courts in each municipality. The results of the regressions using the number of alleged homicide offenders were largely consistent with those reported in this article. Only the coefficients for the percentage of agricultural units with individual organization and the percentage of units dedicated to cattle production failed to reach statistical significance at the .05 level.

erty rights over land are conducive to greater conflicts and higher rates of violence.[13]

The results of the second and third models in table 2 provide contradictory evidence regarding the hypothesis that rural municipalities characterized by more isolated and commodified forms of agricultural production have higher homicide rates (hypothesis 4*a*). Municipalities with a larger percentage of agricultural units with individual (as opposed to group) organization have significantly higher homicide rates, suggesting that greater cooperation in the agricultural production process may lead to increased social cohesion and lower rates of criminal violence. On the other hand, a greater percentage of units producing for internal consumption within the household, instead of for sale in the market, is associated with *more* homicides per population, although the magnitude of the coefficient is relatively small. As discussed above, the percentage of agricultural units producing only for internal consumption may not be an accurate indicator of the extent of commodification of relations of production since individuals in these households may find it necessary to supplement their income by seeking outside employment.

The results are much more conclusive with regards to the effects of cash crop production on rates of lethal violence. Increases of one standard deviation in the percentage of units dedicated to coffee and cattle production are associated with increases of 22.9% and 28.4% in homicide rates, respectively. These large effects are consistent with the proposition that the introduction of capitalist forms of agricultural production create social dislocations and weaken the web of social relations that help enforce norms and prevent violence in rural communities.

Table 3 shows the results of the model testing the importance of regional topography, used here as a measure of state presence. The results strongly support the fifth hypothesis. Municipalities characterized by mountainous terrain, as measured by the population-weighted standard deviation in elevation, have much higher homicide rates, even when controlling for all other structural factors, including land scarcity, collective ownership,

[13] The Mexican government's recent efforts to regularize land titles for individual parcels within ejidos through the Program for the Certification of Ejido Land Rights and the Titling of Urban House Plots (PROCEDE) may provide a natural experiment to dissociate the effects of contingent property rights from other time-invariant factors. If a reduction in homicide is observed over time in those municipalities where individual land titles have been given out, then there will be additional evidence to support the proposition regarding property rights. Since the PROCEDE program was initiated after the time period considered in the present analysis, it should have no effect on the results presented.

TABLE 2

COEFFICIENTS FROM THE NEGATIVE BINOMIAL REGRESSION MODELS OF HOMICIDE ON COLLECTIVE OWNERSHIP, AGRICULTURAL ORGANIZATION AND PRODUCTION OF CASH CROPS (Hypotheses 3 and 4)

Variables	Model 1	Model 2	Model 3
Collective ownership:			
% ejido surface area	.006**	.007**	.007**
	(.002)	(.002)	(.002)
% communal surface area	.014**	.014**	.014**
	(.002)	(.002)	(.002)
Organization of agricultural production:			
% individual production		.090**	
		(.034)	
% subsistence agricultural units			.006*
			(.002)
% coffee production		.006**	.008**
		(.002)	(.002)
% cattle production		.014**	.012**
		(.003)	(.003)
Plot size and crop yields:			
% units $\leq$ 5 hectares	−.011**	−.009**	−.010**
	(.002)	(.002)	(.002)
Theil's land inequality	.277**	.308**	.298**
	(.063)	(.063)	(.063)
Log maize yields	.265**	.248**	.251**
	(.078)	(.078)	(.077)
Demographic variables:			
Log population density	−.179**	−.081	−.077
	(.048)	(.057)	(.057)
% young males	−.004	.008	.006
	(.037)	(.036)	(.036)
% indigenous	−.013**	−.011**	−.012**
	(.002)	(.002)	(.002)
Resource deprivation:			
Illiteracy rate	.043**	.041**	.038**
	(.004)	(.004)	(.004)
Family structure:			
% female-headed households	.051**	.049**	.047**
	(.013)	(.012)	(.012)
Access to medical attention:			
Medical doctors per 10,000	−.021	−.017	−.014
	(.013)	(.013)	(.013)
Geographical region:			
Valley of Mexico	1.333**	1.231**	1.155**
	(.185)	(.189)	(.189)
Constant	−9.677**	−19.751**	−10.919**
	(.615)	(3.412)	(.660)

TABLE 2 (*Continued*)

Variables	Model 1	Model 2	Model 3
Overdispersion parameter alpha	.702**	.661**	.666**
	(.056)	(.053)	(.053)
N	686	685	685
χ^2	267.9	303.33	302.64
Log likelihood	−1,724.01	−1,703.47	−1,703.82

NOTE.—SEs in parentheses.
* $P < .05$.
** $P < .01$, two-tailed tests.

and the organization of agricultural production.[14] One standard deviation of the variation in altitude is associated with a 29.8% increase in the homicide rate. Since the variation in altitude may be considered an indicator of the accessibility of state institutions for dispute resolution and law enforcement, this result suggests that the lack of state penetration in rural areas is conducive to more violent conflict.[15]

The coefficients of the control variables are largely consistent with expectations based on prior research. A higher illiteracy rate is associated

[14] Previous work on homicide in Mexico has found the extent of political competition in Mexican municipalities to be a significant predictor of rural homicide rates (Villarreal 2002). The effect of political competition was tested along with the other predictors in separate regressions not presented. While the extent of political competition, measured as the percentage of votes for parties other than the Institutional Revolutionary Party (PRI), was found to be a significant predictor, the inclusion of this variable did not alter any of the findings discussed.

[15] Spatial autocorrelation models are often used to control for the spatial dependence of homicides across geographical units of analysis. The reasoning is that the boundaries of geographical units are permeable, in that residents of one municipality may commit or be victims of a homicide in nearby municipalities. Typically, a contiguity matrix is used to construct the spatial weights matrix (e.g., Villarreal 2002). However, because the sample of rural municipalities used in the analysis are not entirely contiguous (all nonrural municipalities are eliminated from the sample), the resulting contiguity matrix is too sparse to be meaningful. For this same reason, there is less risk of spatial autocorrelation. Nevertheless, in order to ensure that the results of the regressions presented here are not affected by the spatial dependence of homicide rates across municipalities, I used the Huber/White/sandwich estimation technique with clustering to compute standard errors for the coefficients in separate regressions. This technique has the advantage that it produces correct standard error estimates, even when cases included within groups or clusters are not independent, so long as they are independent across clusters (Stata Corp, pp. 256–60). I grouped into separate clusters all rural municipalities that were contiguous. The 686 municipalities formed a total of 99 clusters. The results of the full model with clustering and robust standard errors were almost identical to those presented in table 3. Only the significance level for the percentage of agricultural units with individual organization dropped below .05 compared to the regression without clustering. This technique produces overly conservative estimates since it allows for dependence between municipalities that are far removed from each other.

TABLE 3
COEFFICIENTS FROM THE NEGATIVE BINOMIAL REGRESSION MODEL OF HOMICIDE ON VARIATION IN ALTITUDE
(Hypothesis 5)

Variables	Model 1
Local topography:	
SD of altitude	1.728**
	(.327)
Collective ownership:	
% ejido surface area	.006**
	(.002)
% communal surface area	.011**
	(.002)
Organization of agricultural production:	
% individual production	.073*
	(.034)
% coffee production	.003
	(.002)
% cattle production	.012**
	(.003)
Plot size and crop yields:	
% units ≤ 5 hectares	−.010**
	(.002)
Theil's land inequality	.224**
	(.063)
Log maize yields	.195**
	(.076)
Demographic variables:	
Log population density	−.036
	(.058)
% young males	.001
	(.036)
% indigenous	−.009**
	(.002)
Resource deprivation:	
Illiteracy rate	.033**
	(.004)
Family structure:	
% female-headed households	.041**
	(.012)
Access to medical attention:	
Medical doctors per 10,000	−.010
	(.013)
Geographical region:	
Valley of Mexico	1.190**
	(.185)
Constant	−17.948**
	(3.465)

TABLE 3 (*Continued*)

Variables	Model 1
Overdispersion parameter alpha	.609**
	(.051)
N	674
χ^2	331.19
Log likelihood	−1,651.45

NOTE.—SEs in parentheses.
* $P < .05$.
** $P < .01$, two-tailed tests.

with higher homicide rates, indicating that more disadvantaged areas continue to have higher rates of violence, even after the inequality in the distribution of land and other characteristics of the agricultural system are taken into account. Similarly, a higher prevalence of female-headed households is associated with higher homicide rates. The negative coefficient for the percentage of residents who speak an indigenous language suggests that the greater strength of indigenous social institutions may be conducive to less violence once structural factors are taken into account. It is surprising that neither the age structure nor the density of population appear to have a significant effect on the level of homicide. Municipalities in the Valley of Mexico have homicide rates well above the rest of the country, even when all other variables are controlled. Although the higher rates of homicide in the rural municipalities surrounding Mexico City may be due to a spillover of crime from the nation's capital, a separate variable controlling for contiguity to urban areas failed to reach statistical significance in models not presented.[16] Finally, the coefficient for the number of doctors per population is only marginally significant in the regression models, suggesting that the lack of access to health care does not substantially affect the incidence of deaths due to homicide.[17]

THE ROLE OF THE STATE

I have argued that mountainous areas are prone to violent conflict due to the inaccessibility of state institutions for the mediation of disputes and crime prevention. The positive association between the variation in altitude and higher homicide rates was interpreted as corroborating this

[16] The exclusion of the dummy variable for the Valley of Mexico from the models does not alter the main findings discussed in the article.

[17] Despite the relatively large number of predictors in the regression models, there is no evidence of multicollinearity. The maximum variance inflation factor (VIF) never exceeds 5.0 in any of the models presented.

relationship. However, it is possible that the remoteness of rural areas leads to higher homicide rates for some other reason. In order to further test the causal relation suggested, I introduce four more direct measures of state presence in separate regression models. First, I introduce the number of individuals employed in security forces in the municipality per 10,000 residents, according to the 1990 census. Although this occupational category includes individuals employed as private security guards and military personnel, it may nevertheless be considered a rough measure of the coercive capacity of the state. Second, I introduce separate measures of the total amount of spending on public administration and police by municipal governments per population (logged). The municipal budget allocation for police has the disadvantage that it only includes expenses for police forces administered by municipal governments. Since police personnel are also paid by the state and federal governments, and there is no information available on how state and federal police personnel are assigned to municipalities, municipal spending is only an approximate measure of local police presence. Third, some municipalities have several public prosecutor offices (*agencias del ministerio público*), while others have none. The lack of public prosecutor offices where citizens can file complaints may constitute a disincentive for residents to settle disputes by legal means, since they will have to travel far to file their claims. I therefore introduce the number of public prosecutor offices per 10,000 residents as another indicator of state presence. Finally, because the effectiveness of the state in pursuing offenders may be more important than the number of personnel or the municipal budget, I introduce the ratio of individuals actually charged with homicide by state and federal authorities to the number of homicides reported in mortality statistics as a measure of the efficacy of local law enforcement institutions. To summarize: if the causal relation between the variation in altitude and higher homicide rates is due to the inaccessibility of state institutions, we should observe a significant relation between these more direct measures and the homicide rate, as well as an attenuation of the effect of the topographical measure when the former are introduced into the regression models.

The results of the regression models testing the association between these more direct measures of the presence of the state on homicidal violence are shown in table 4. With the exception of the efficacy of law enforcement, given by the ratio of individuals charged with a homicide to homicides committed, none of the measures of state presence in the municipality are significant predictors of the homicide rate. With regards to the significant predictor, a higher proportion of homicides resulting in charges against individuals is associated with lower homicide rates in a municipality, suggesting that a greater efficacy in local law enforcement may indeed deter potential offenders. However, the variation in altitude

TABLE 4
COEFFICIENTS FROM THE NEGATIVE BINOMIAL REGRESSION MODELS OF HOMICIDE ON MEASURES OF STATE PRESENCE

Variables	Model 1	Model 2	Model 3	Model 4
Topographical factors:				
SD of altitude	1.370**	1.774**	1.727**	1.713**
	(.298)	(.377)	(.327)	(.334)
State presence:				
Law enforcement efficacy	−.461**			
	(.047)			
Log total public spending per population		.039		
		(.063)		
Log spending on police per population		.006		
		(.010)		
Public prosecutor's offices per population			.074	
			(.065)	
Employed in public security per population				.000
				(.002)
Collective ownership:				
% *ejido* surface area	.006**	.007**	.006**	.006**
	(.001)	(.002)	(.002)	(.002)
% communal surface area	.010**	.009**	.011**	.009**
	(.002)	(.002)	(.002)	(.002)
Organization of agricultural production:				
% individual production	.062	.067	.074*	.082*
	(.033)	(.037)	(.035)	(.035)
% coffee production	.004*	.005*	.003	.003
	(.002)	(.002)	(.002)	(.002)
% cattle production	.009**	.011**	.012**	.012**
	(.003)	(.003)	(.003)	(.003)
Plot size and crop yields:				
% units ≤ 5 hectares	−.010**	−.010**	−.010**	−.010**
	(.002)	(.002)	(.002)	(.002)
Theil's land inequality	.246**	.173**	.218**	.206**
	(.058)	(.065)	(.063)	(.063)
Log maize yields	.163*	.199*	.192*	.169*
	(.070)	(.081)	(.076)	(.078)
Demographic variables:				
Log population density	−.050	−.072	−.029	−.056
	(.054)	(.067)	(.059)	(.06)
% young males	.015	−.015	−.001	.000
	(.033)	(.039)	(.036)	(.040)

TABLE 4 (*Continued*)

Variables	Model 1	Model 2	Model 3	Model 4
% indigenous	−.010**	−.009**	−.009**	−.008**
	(.002)	(.002)	(.002)	(.002)
Resource deprivation:				
Illiteracy rate	.032**	.033**	.033**	.034**
	(.004)	(.005)	(.004)	(.005)
Family structure:				
% female-headed households	.035**	.035**	.042**	.045**
	(.011)	(.013)	(.012)	(.013)
Access to medical attention:				
Medical doctors per 10,000	−.008	.005	−.010	−.013
	(.012)	(.014)	(.013)	(.013)
Geographical region:				
Valley of Mexico	.982**	1.158**	1.193**	1.206**
	(.168)	(.195)	(.185)	(.187)
Constant	−16.345**	−17.032**	−18.031**	−18.771**
	(3.302)	(3.770)	(3.474)	(3.559)
Overdispersion parameter alpha	.463**	.525**	.607**	.607**
	(.043)	(.050)	(.051)	(.052)
N	667	523	674	625
χ^2	418.94	283.57	332.51	315.87
Log likelihood	−1,603.53	−1,331.14	−1,650.79	−1,586.09

NOTE.—SEs in parentheses.
* $P < .05$.
** $P < .01$, two-tailed tests.

continued to be a significant predictor of the homicide rate even when these more direct measures of the state presence were included in the regression models.

The failure of the more direct measures of state presence to account for the effect of the local topography may be due to the inadequacy of these measures, as discussed earlier. A more intriguing explanation for why the variation in altitude continues to have a significant effect after controlling for more immediate measures of state presence, and one that is partly supported by the historical record, is that the measure of remoteness is capturing not the contemporaneous lack of state presence, but rather its absence in those regions during an earlier historical period. The remoteness of these regions could have made them inaccessible to state institutions at an earlier time and set in motion practices that are embedded in local culture and that remain despite a greater state presence today. Researchers of violence and feuding in other contexts have argued that stateless societies promote a culture of honor characterized by a greater sensitivity to insult and a willingness by individuals to use force in defense of their reputation (Nisbett and Cohen 1996, chap. 1). A tough reputation becomes especially important when there is no protection from

the state. Such a culture of honor may persist even after the power of the state is well established, and it may in fact entail a disdain for the law. So, for instance, Nisbett and Cohen (1996) trace the origins of contemporary violence in the southern United States to the persistent effects of statelessness in the regions from which the first Scotch-Irish settlers of the South came from over two centuries ago.

CONCLUSIONS

One important test of the scope of a sociological theory is its ability to explain social phenomena beyond the specific setting for which it was originally formulated. In the process of extending the theory, we are forced to extract from it what are its core principles and refine the causal mechanisms it suggests. The inability of the theory to fully explain the social phenomena in the new setting may also lead us to consider new explanatory factors. In the preceding analysis of homicide in rural Mexico, I have extended theories of human ecology that were formulated with the context of U.S. urban areas in mind. Drawing on insights from Chicago School theorists, I suggested that land scarcity would result in higher rates of violent conflict. While the statistical results appear to contradict this hypothesis, there are some questions about the adequacy of the indicators used. The evidence presented was much more consistent with strain theory, another (related) theoretical tradition first derived based on the U.S. urban context. In direct analogy with results of studies of the effect of income inequality on crime in the United States, an unequal distribution of land, and not its absolute scarcity, was found to be conducive to violent conflict.

Not only the relative distribution of land, but also the contingency of land property rights was found to be associated with higher homicide rates. Areas of rural Mexico with a high percentage of communal and ejido lands, where claims to specific plots are less secure, have much higher homicide rates. This finding does not necessarily indicate that the collectivization of agricultural production leads to violent conflicts. In fact, areas where agricultural units with group organization are more common were found to have fewer homicides per population. The results of the statistical analysis also strongly support the notion that the production of cash crops, such as coffee and cattle raising, is conducive to greater violence. I argued that the introduction of more commodified relations of production and exchange may lead to a breakdown of social cohesion and greater conflict over resources.

Perhaps the most important finding of this study has to do with the influence of the state. Remote mountainous areas where the presence of

the state is more tenuous had higher rates of violence. I argued that the absence of state legal institutions will encourage individuals to take matters into their own hands, settling disputes by violent means. Because mountain ranges constitute natural barriers to state penetration, I used the variation in altitude in a municipality as an indicator of the state presence. The results of the statistical analysis strongly support the notion that state institutions reduce violence. Testing the relation between rates of violence and state presence in this way constitutes an improvement from previous studies based on comparisons of anthropological evidence from different state and stateless societies. It is interesting, however, that when more direct measures of the state presence were introduced into the analysis they failed to account for the effect of mountainous regions. This result was interpreted as suggesting that the effect of the absence of the state may not be contemporaneous, but may be due to a patterning of behavior based on cultural practices established by the lack of state penetration at an earlier historical period. While this interpretation is consistent with the historical experience in other settings, more detailed research is clearly needed to further test the historical argument.

The finding that a greater presence of the state may reduce violent conflict is an example of the benefits that may be derived from examining theories of violence in a new context. The sharp variation in the degree of state penetration in Mexican rural areas highlighted the need to take into account the degree to which state institutions are present. However, the causal mechanism proposed here is general enough to be applicable in urban settings. As in small rural towns in Mexico, marginalized communities within U.S. inner cities may lack access to state institutions that help mediate disputes in nonviolent ways and guarantee the personal safety and the protection of property of residents. Moreover, as in Mexican rural areas, it may be the case that the relative absence of effective state institutions may set in motion culturally inscribed practices that have long-term consequences.

APPENDIX

Causes of Disputes in Ejidos and Agrarian Communities in Mexico

Evidence of the frequency and nature of conflicts within and between ejidos and agrarian communities may be obtained from data compiled by the Agrarian Prosecutor's Office (Procuraduría Agraria). Established in 1992 as part of the Mexican government's reform of the agrarian laws, the Agrarian Prosecutor's Office is the agency in charge of resolving disputes among members of ejidos and agrarian communities, as well as providing other legal assistance and aid in the titling of plots (De Janvry,

Gordillo, and Sadoulet 1997, p. 20). Between 1992 and 1999 the Agrarian Prosecutor's Office received a total of 343,021 disputes or controversies (*controversias*), defined as "confrontations between two or more actors" (Robles 1999, p. 37). Table A1 provides a breakdown of the most common causes of disputes according to the prosecutor's office's own classification system. By far the largest number of disputes filed involved the rights of individual ejido or agrarian community members. Among these, the most common were disputes over the rights to specific plots (27.0% of all disputes), succession rights to membership in an ejido or agrarian community (19.1%), rights to housing or *solares* (9.7%), boundaries of a plot (6.6%), and the alienation of rights to a plot or common land (3.5%). All these categories of disputes are a result of ill-defined or contingent property rights in accordance with hypothesis 3.

The second most common group of disputes reported by the Agrarian Prosecutor's Office involves those between ejido or agrarian community members and members of their governing bodies (11.5% of all cases). Individuals typically complained that they were unjustly denied membership in the ejido or agrarian community (4.5%) and that they were denied access to communal lands (1.6%) by the governing body. Although conflicts with authorities are less frequent than those involving individual property rights, they nevertheless indicate how the political process by which decisions within ejidos and agrarian communities are made lead to disputes. The abuse of power by officeholders within ejidos is also a recurrent theme in ethnographic studies. These powerful local officials often use their positions to obtain land for themselves and those close to them and to embezzle funds from government assistance programs (see DeWalt and Rees [1994, pp. 13–33] for a comprehensive review).

Finally, the third largest category of disputes involves the rights of entire ejidos or agrarian communities (36,470 cases, or 10.6%). Since these disputes are filed on behalf of the entire group and not an individual, the baseline group or population at risk is much smaller (slightly less than 30,000 ejidos and agrarian communities), making these disputes more common than would otherwise appear from the total percentages reported in table A1. The most common disputes in this category are also due to ill-defined property rights, including disputes over boundaries with other ejidos (14,185 cases), private landholders (8,325 cases), and agrarian communities (3,105 cases).[18]

[18] While the presence of the Agrarian Prosecutor's Office as a mediator in disputes between agrarian actors may serve to reduce the use of violence to resolve them, any suppression effect will be absent from the analysis presented in this article since the period analyzed (1989–91) predates the creation of the Agrarian Prosecutor's Office in 1992.

TABLE A1
DISPUTES REGISTERED BY THE AGRARIAN PROSECUTOR'S OFFICE, 1992–99

Type of Dispute	*N* Cases	%
1. Disputes involving the rights of individual ejido or agrarian community members:		
Over rights to a plot	92,531	27.0
Over succession rights to ejido or agrarian community	65,555	19.1
Over rights to housing within the ejido or agrarian community	33,180	9.7
Over boundaries of a plot	22,579	6.6
Over alienation of rights to a plot or common land	12,112	3.5
Other	21,370	6.2
Total	247,327	72.1
2. Disputes between ejido or agrarian community members and their governing bodies:		
Over denial of membership in ejido or agrarian community	15,391	4.5
Over use or access to communal land	5,354	1.6
Over denial of recognition as a possessor of land without rights (*posesionario*)	5,114	1.5
Over separation of a member of the ejido or agrarian community	4,090	1.2
Over the allocation of rights over land	3,631	1.1
Other	5,807	1.7
Total	39,387	11.5
3. Disputes involving rights of the entire ejido or agrarian community:		
Over boundaries with another ejido	14,185	4.1
Over boundaries with private landholders	8,325	2.4
Over boundaries with agrarian communities	3,105	0.9
Demand of restitution of land, water, or forest	2,727	0.8
Other	8,128	2.4
Total	36,470	10.6
4. Other	19,837	5.8
Total	343,021	100.0

SOURCE.—Robles (1999) and Procuraduría Agraria.
NOTE.—Categories are based on the Procuraduría Agraria's own classification system (my translation).

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