



TARGETING VIOLENCE REDUCTION IN BRAZIL: Policy Implications from a Spatial Analysis of Homicide

MATTHEW C. INGRAM AND MARCELO MARCHESINI DA COSTA¹

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Violence in Latin America generates heavy economic, social and political costs for individuals, communities and societies. A particularly pernicious effect of violence is that it undermines citizen confidence in democracy and in their own government. Responding to public fear, politicians across the region have hastily adopted a wide range of policy responses to violence, ranging from militarizing public security, to ‘mano dura’ crack downs, to negotiating truces with organized crime, to decriminalizing illicit economic activity. Although many of these policies are politically expedient, few are based on evidence of how public policy actually affects rates of violence.

By contrast, this paper examines how violence clusters within a country—Brazil—to study how public policies affect homicide rates and how these policies might be further tailored geographically to have greater impact. Brazil provides a particularly useful case for examining the effectiveness of violence-reduction strategies because of the availability of comparable data collected systematically across 5562 municipal units. This allows for an explicitly spatial approach to examining geographic patterns of violence—how violence in one municipality is related to violence in neighboring municipalities, and how predictors of violence are

also conditioned by geography.² The key added value of the spatial perspective is that it addresses the dependent structure of the data, accounting for the fact that units of analysis (here, municipalities) are connected to each other geographically. In this way, the spatial perspective accounts for the fact that what happens in nearby units may have a meaningful impact on the outcome of interest in a home, focal unit. Thus, the spatial approach is better able to examine compelling phenomena like the spread of violence across units.

We visualize data on six types of homicide—aggregate homicides, homicides of men, homicides of women (i.e., “femicides”), firearm-related homicides, youth homicides (ages 15-29) and homicides of victims identified by race as either black or brown (*mulatto*), i.e., non-white victims—all for 2011, presenting these data in maps. We adopt a municipal level of analysis, and include homicide data from 2011 for the entire country, i.e., on all 5562 municipalities across 27 states (including the Federal District). This allows us to develop maps that identify specific municipalities that constitute cores of statistically significant clusters of violence for each type of homicide. These clusters offer a useful tool for targeting policies aimed at reducing violence. We then develop an analysis based on a

¹ Matthew C. Ingram is an Assistant Professor of Political Science in the Rockefeller College of Public Affairs and Policy, and a Research Associate at the Center for Social and Demographic Analysis (CSDA), University at Albany, State University of New York (SUNY). Marcelo Marchesini da Costa is a doctoral student in the Department of Public Administration, University at Albany. Please direct all correspondence to: mingram@albany.edu. Any errors and omissions are the responsibilities of the authors alone.

² To our knowledge, only two studies examine violence across all Brazilian municipalities, and of these, only Carvalho et al. (2005) do so from a spatial perspective. Thus, our findings update and build on Carvalho et al. and also provide a spatial complement to the non-spatial findings in Lance (2014). Alexandre Carvalho, Daniel Ricardo De Castro Cerqueira, and Waldir Lobão, “Socioeconomic Structure, Self-Fulfillment, Homicides and Spatial Dependence in Brazil,” *Texto Para Discussão* n.1105, no. IPEA (2005); Justin Earl Lance, “Conditional Cash Transfers and the Effect on Recent Murder Rates in Brazil and Mexico,” *Latin American Politics and Society* 56, no. 1 (2014): 55–72.

spatial regression model, using predictors from the 2010 census and other official sources in Brazil.

This paper finds that areas with higher rates of marginalization and of households headed by women who also work and have young children experience higher rates of homicide, which suggests increased support for policies aimed at reducing both marginalization and family disruption. More specifically, the paper finds that policies that expand local coverage of the Bolsa Família poverty reduction program and reduce the environmental footprint of large, industrial development projects tend to reduce homicide rates, but primarily for certain types of homicide. Thus, violence-reduction policies need to be targeted by type of violence. In addition, the spatial analysis presented in the paper suggests that violence-reduction policies should be targeted regionally rather than at individual communities – informed by the cluster analysis and the spatial regression. Finally, this paper argues that policies aimed at femicides, gun-related homicides, youth homicides and homicides of non-whites should be especially sensitive to geographic patterns, and be built around territorially-targeted policies over and above national policies aimed at homicide more generally.

IMPACT OF VIOLENCE IN LATIN AMERICA AND IN BRAZIL

Violence in Latin America directly affects the quality of life of individuals and communities, and is also increasingly understood to undercut political and

economic development. For public health scholars, violence presents a direct harm to health and wellbeing, causing injury and, in the worst cases, death. Violence also generates serious costs to democracy. Fear and insecurity erode public trust and interpersonal confidence, hindering civic engagement and participation in public life. Further, low public trust undermines the legitimacy of democratic institutions, and persistent insecurity can generate support for heavy-handed or authoritarian policies.³ Indeed, in some new democracies in the region, frustration with criminal violence has led majorities to support a return to authoritarian government.⁴ Further, a 2011 poll in Mexico found more than a quarter of respondents willing to support a candidate tied to organized crime for the sake of peace and security.⁵ Across the region, polls identify crime and citizen security as top policy priorities.⁶ Thus, the prevention and reduction of violence is crucial to democratic stability and institutions.

Violence also generates heavy economic costs, dampening development. In the U.S., estimates of the annual financial costs of gun shots alone stand at \$126 billion.⁷ Similarly, a 1999 report from the Inter-American Development Bank (IDB) found that the health care costs of violence constituted 1.9 percent of GDP in Brazil, 5.0 percent in Colombia, 4.3 percent in El Salvador, 1.3 percent in Mexico, 1.5 percent in Peru and 0.3 percent in Venezuela.⁸ Along with law enforcement costs, costs to the court system, economic losses due to violence, and the cost of private security, violent crime has

³ Margaret Sarles, “USAID’s Support of Justice Reform in Latin America,” in *Rule of Law in Latin America: The International Promotion of Judicial Reform*, eds. Pilar Domingo and Rachel Sieder (London: Institute of Latin American Studies, University of London, 2001); José Miguel Cruz, “The Impact of Violent Crime on the Political Culture of Latin America: The Special Case of Central America,” in *Challenges to Democracy in Latin America and the Caribbean: Evidence from the AmericasBarometer 2006-2007*, ed. Mitchell Seligson (Vanderbilt University, 2008).

⁴ Ibid., 241.

⁵ Raúl Benítez Manaut, *Encuesta Ciudadanía, Democracia y Narcoviolencia* (CIDENA) (México, DF: CEGI, SIMO, and CASEDE) 2012, p.57, cited in Andreas Schedler, “The Criminal Subversion of Mexican Democracy” *Journal of Democracy* 25 (2014).

⁶ Marta Lagos and Lucía Dammert, “La seguridad ciudadana: El problema principal de América Latina.” (May 9, 2012) *Latinobarómetro*. Available at: http://www.latinobarometro.org/documentos/LATBD_La_seguridad_ciudadana.pdf.

⁷ Ted R. Miller and Mark A Cohen, “Costs of gunshot and cut/stab wounds in the United States, with some Canadian comparisons,” *Accident Analysis & Prevention* 29, no. 3 (1997): 329-341.

⁸ Juan Luis Londoño and Rodrigo Guerrero, *Violencia en América Latina: Epidemiología y costos* (Banco Interamericano de Desarrollo, Red de Centros de Investigación de la Oficina del Economista Jefe. Documento de Trabajo R-375, Washington, D.C., 1999); Mayra Buvinic and Andrew Morrison, *Violence as an obstacle to development* (Inter-American Development Bank, 1999) (cited in Londoño and Guerrero); see also WHO, *World Report on Violence and Health* (World Health Organization, 2002).

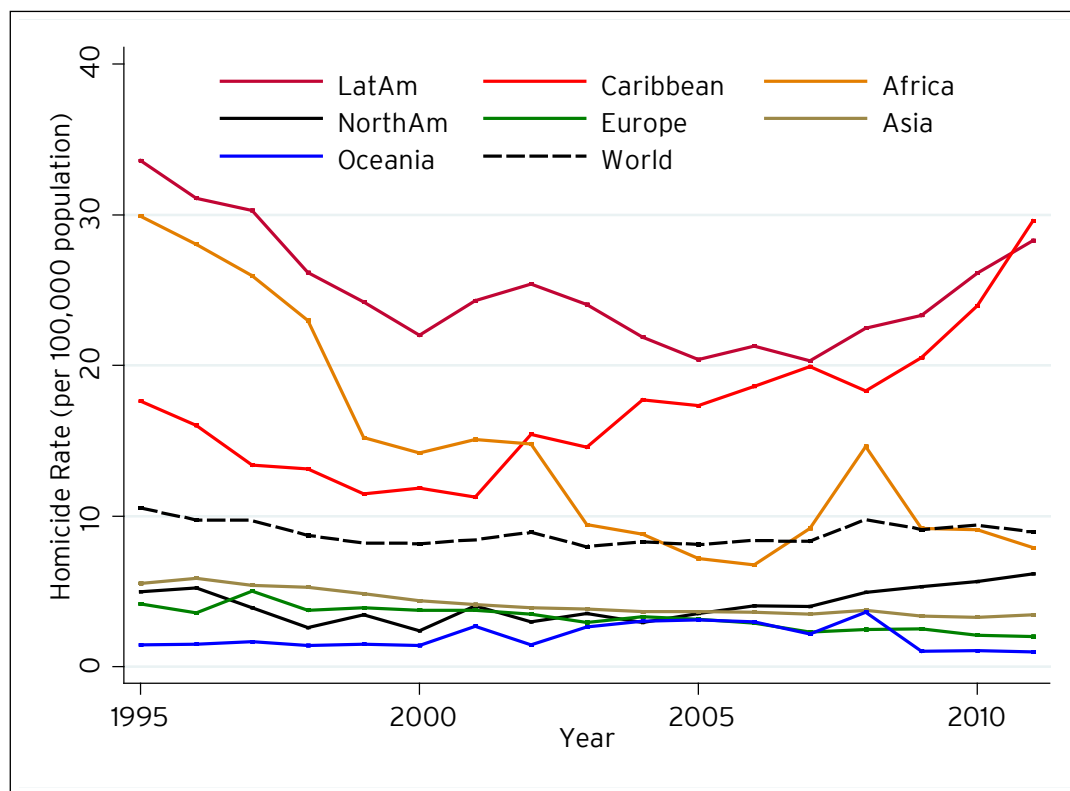
been estimated to cost Brazil 10.5 percent of GDP, Venezuela 11.3 percent, Mexico 12.3 percent and El Salvador and Colombia more than 24 percent of GDP.⁹

In 2004, violence in Brazil was estimated to cost the public sector US\$9.6 billion, with a total cost for society—including some of the indirect costs outlined above—of almost US\$30 billion.¹⁰ Given Brazil's total GDP that year of US\$663,760,341,880,¹¹ violence cost 4.5 percent of GDP. Restating, violence routinely costs several countries, including Brazil, 4-10 percent of GDP. Given that GDP growth rates of 3-4 percent would be considered healthy, a substantial reduction of violence in these

countries would have dramatic benefits for development. In sum, concerns about public health, democracy and development motivate the need for a better understanding of the patterns and causes of violence, and of the need to translate this understanding into improved policies for violence reduction and prevention.

The intensity of violence in Latin America motivates this study. According to some estimates, Latin America holds 8 percent of the world's population but accounts for 42 percent of all homicides.¹² The United Nations Office on Drugs and Crime (UNODC) reports homicide rates for the major regions of the world from 1995 to 2011.¹³ UNODC data

FIGURE 1. HOMICIDE RATES ACROSS WORLD REGIONS, 1995-2011



⁹ Londoño and Guerrero, *Violencia en América Latina*, 26; Robert L. Ayres, *Crime and violence as development issues in Latin America and the Caribbean* World Bank Publications, 1998, cited in Paulo Mesquita Neto, "Public-Private Partnerships for Police Reform in Brazil," in *Public Security and Police Reform in the Americas*, eds. John Bailey and Lucia Dammert (Pittsburgh: University of Pittsburgh Press, 2006), 49.

¹⁰ Michael Eduardo Reichenheim et al., "Violence and Injuries in Brazil: The Effect, Progress Made, and Challenges Ahead," *The Lancet* 377, no. 9781 (2011): 1962-75.

¹¹ World Bank Open Data, available at: <http://data.worldbank.org/> (last accessed July 12, 2014).

¹² Moisés Naím, "La gente más asesina del mundo," *El País* (December 15, 2012).

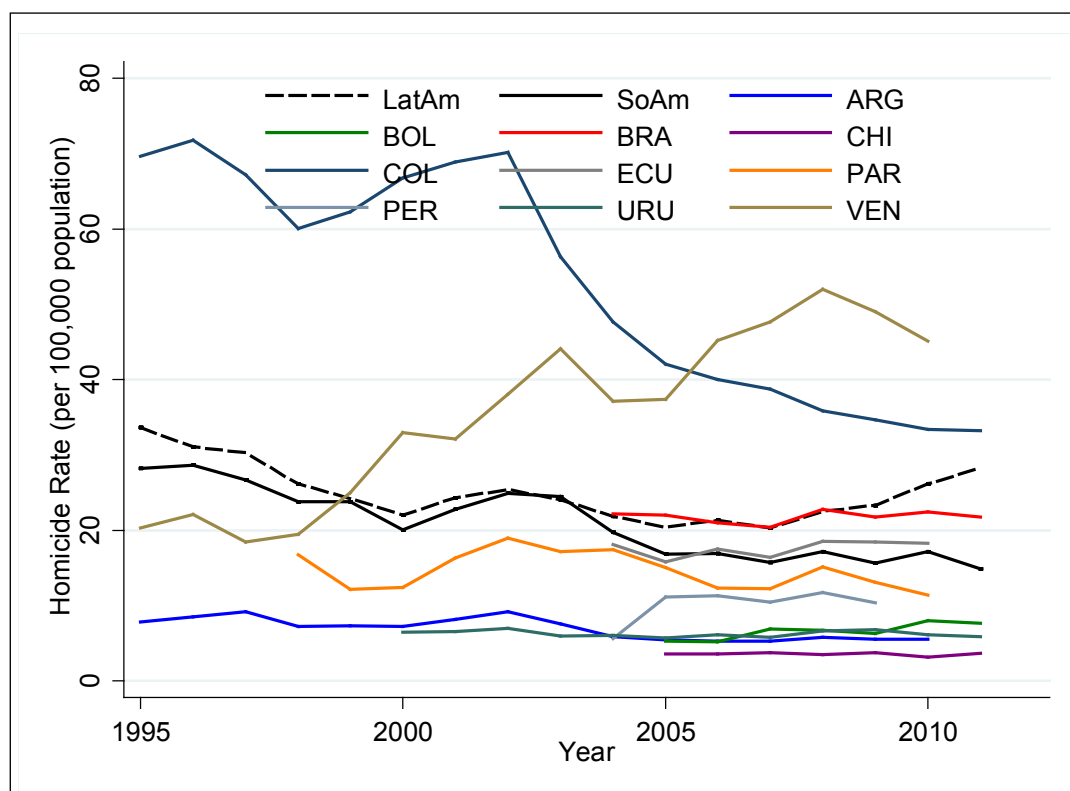
¹³ United Nations Office on Drugs and Crime (UNODC), *Global Study on Homicide*, available at: <http://www.unodc.org/gsh/> (last accessed September 9, 2014).

reveal two patterns that set Latin America apart. First, homicide rates in this region are much higher than in other regions, and much higher than the global average. Specifically, homicide rates in Latin America have been 4-6 times higher than those in North America. For instance, while the U.S. homicide rate was 5 per 100,000 in 2010, the rate for Latin America was approaching 30. Figure 1 graphs these regional trends, showing the high and increasing homicide rates in Latin America and the Caribbean.

Focusing on Brazil and its neighbors, Figure 2 graphs national homicide rates for South America from 2000-2011 in reference to the already high and increasing rate for Latin America (dotted line) and the sub-regional rate only for South America (solid black line). Notably, Brazil's homicide rate

(red) closely tracks the broader Latin America regional rate, while several countries fall below that, including Argentina, Chile, and Uruguay. However, Brazil is consistently higher than the average rate for South America. Updating the data beyond the time frame in Figure 2, UNODC data show the national homicide rate in Brazil increased from 2011 to 2012, from 23.4 to 25.2 per 100,000. Only two countries in South America have homicide rates higher than Brazil: Colombia and Venezuela. Brazil had homicide rates similar to the ones from the United States in the beginning of the 1980s, but by the end of that decade had already doubled the American rates.¹⁴ In the beginning of the 2000s, Brazil was already known as one of the countries with the highest homicide rates in the world.¹⁵ Homicides are the main cause of death by external causes among men between 15 and 34 years of age

FIGURE 2. HOMICIDE RATES ACROSS SOUTH AMERICAN COUNTRIES, 2000-2011



¹⁴ Teresa P.R. Caldeira and James Holston, "Democracy and Violence in Brazil," *Comparative Studies in Society and History* 41, no. 4 (1999): 691-729.

¹⁵ Maria de Fátima Marinho de Souza, James Macinko, Airlane Pereira Alencar, Deborah Carvalho Malta and Otaliba Libânio de Moraes Neto, "Reductions in Firearm-Related Mortality and Hospitalizations in Brazil after Gun Control," *Health Affairs* 26, no. 2 (2007): 575-84.

in some Brazilian cities, and overall, homicide is only surpassed by cardiovascular disease.¹⁶ Also, in 2004 more than 70 percent of the homicides were committed using firearms.¹⁷ State capitals concentrated nearly 40 percent of deaths by firearms, despite having only 24 percent of the Brazilian population.¹⁸

In sum, reviewing the global patterns from Figure 1 reveals that Latin America has an exceptionally high homicide rate compared with the rest of the world, and the regional patterns from Figure 2 show that Brazil's national homicide rate closely tracks the regional rate. As such, Brazil could be considered typical of this phenomenon in the region. Further, Brazil is the region's largest country and largest economy, and existing research within Brazil notes a marked unevenness in the distribution of homicide—especially different types of homicides—in the country's urban areas.

HOMICIDE IN BRAZIL: A MUNICIPAL VIEW

Figure 3 maps 2011 homicide rates (deciles) at the municipal level in Brazil. Lighter colors indicate low homicide rates, with white identifying those municipalities with no homicides, and darker colors identify communities with high homicide rates. Even a cursory examination of this kind of map shows that violence is unevenly distributed across Brazil. Further, about 10 percent of Brazilian cities (541) have homicide rates above 40 per 100,000, and more than 5 percent of cities (312) have homicide rates above 50. Thus, at least in

comparison with global and regional homicide rates, a very large number of Brazilian cities experience levels of violence far above any regional average,¹⁹ and above most national averages. In comparison with the U.S., where the highest municipal homicide rate hovers around 50, and only a handful of cities ever cross 40, Brazil has hundreds of cities that experience higher levels of violence than the worst U.S. cities.

Our subsequent analysis proceeds in two phases: (1) exploratory analysis of spatial clusters of violence, and (2) explanatory analysis in the form of spatial regressions. The exploratory analysis includes Figures 4-9, which report the results of cluster analyses for different types of homicide.²⁰

Starting with Figure 4, every municipality that is colored represents the core of a statistically significant cluster of homicide. That is, each colored unit is the heart of a larger area (that includes the colored area and all surrounding units) with levels of violence that are either similarly high or similarly low. Red units are those where the homicide rate is unusually high and the rate is also unusually high in surrounding units (i.e., “hot spots”). Blue units are those where the homicide rate is low and is also unusually low in surrounding units (i.e., “cold spots”). Stated differently, red units identify the center of an area where there is a strong association between high violence in unit A and similarly high violence in unit A's neighbors, and this is a distribution of violence that we would not expect to see by chance. Conversely, blue units identify the

¹⁶ Simone M. Santos, Christovam Barcellos, and Marília Sá Carvalho, “Ecological Analysis of the Distribution and Socio-Spatial Context of Homicides in Porto Alegre, Brazil,” *Health & Place* 12, no. 1 (2006): 38–47.

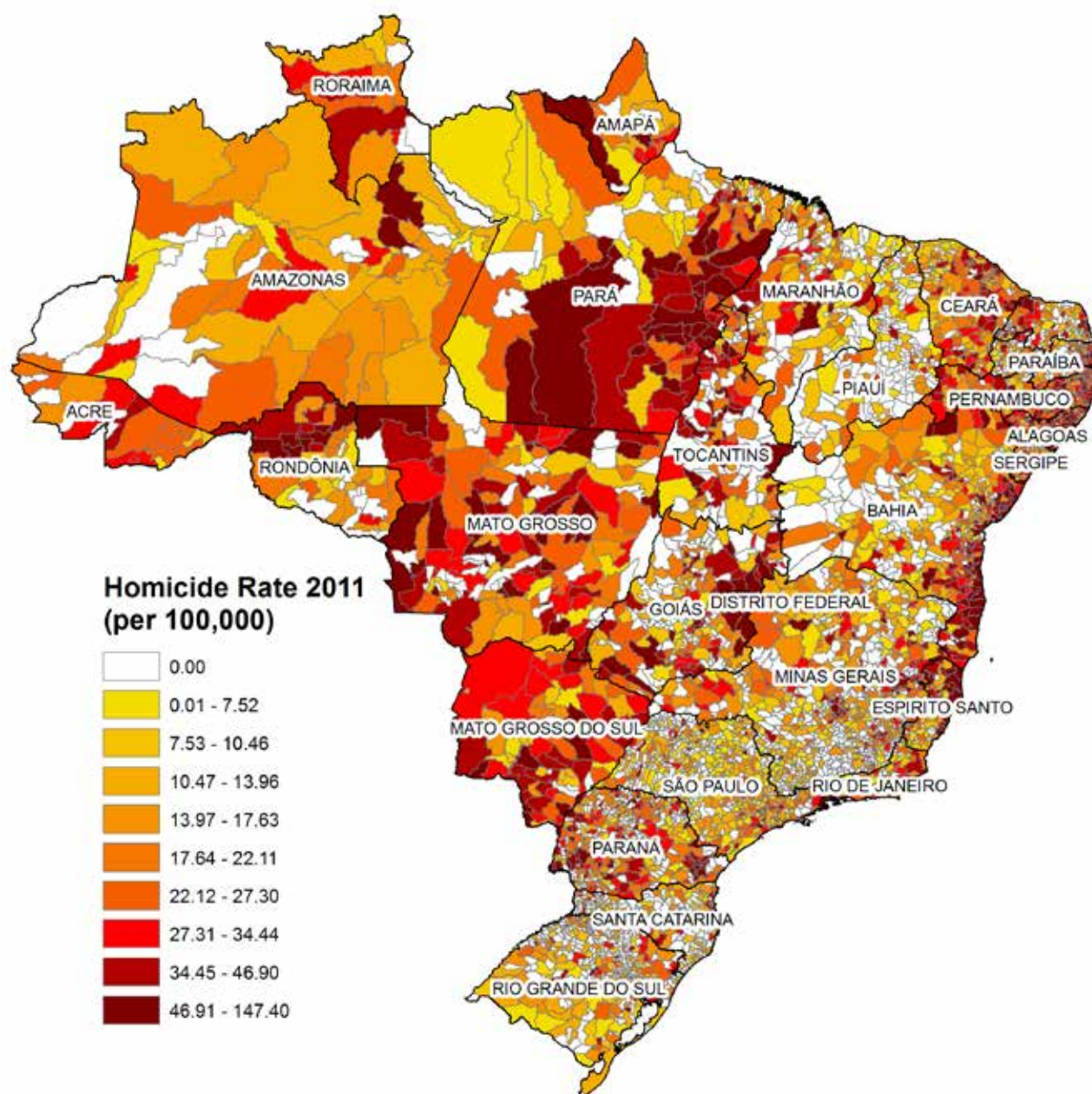
¹⁷ Maria de Fátima Marinho de Souza et al., “Reductions in Firearm-Related Mortality” 575–84.

¹⁸ Ibid.

¹⁹ In 2011, the average for Latin America was 28.3; the average for South America was 14.9 (UNODC, see note 13).

²⁰ All cluster analyses are based on smoothed rates. Due to the large variation in the base population across Brazil's municipalities, the raw homicide rate can be deceptively high with a small number of homicides in units where the base population is low (denominator is low, inflating the risk calculation). Conversely, the rate can be deflated even with a large number of homicides where the base population is very large. Rate smoothing address this variance instability, adjusting the rate in units with small populations downward and the rate in units with large population upward based on the distribution of population across all units (see Assunção and Reis 1999; Anselin 2005). All LISA maps presented here include this smoothing. It should also be noted that cluster analysis is sensitive to the manner in which spatial weights are specified. All of the reported findings use a first-order queen contiguity matrix to capture connectedness among units.

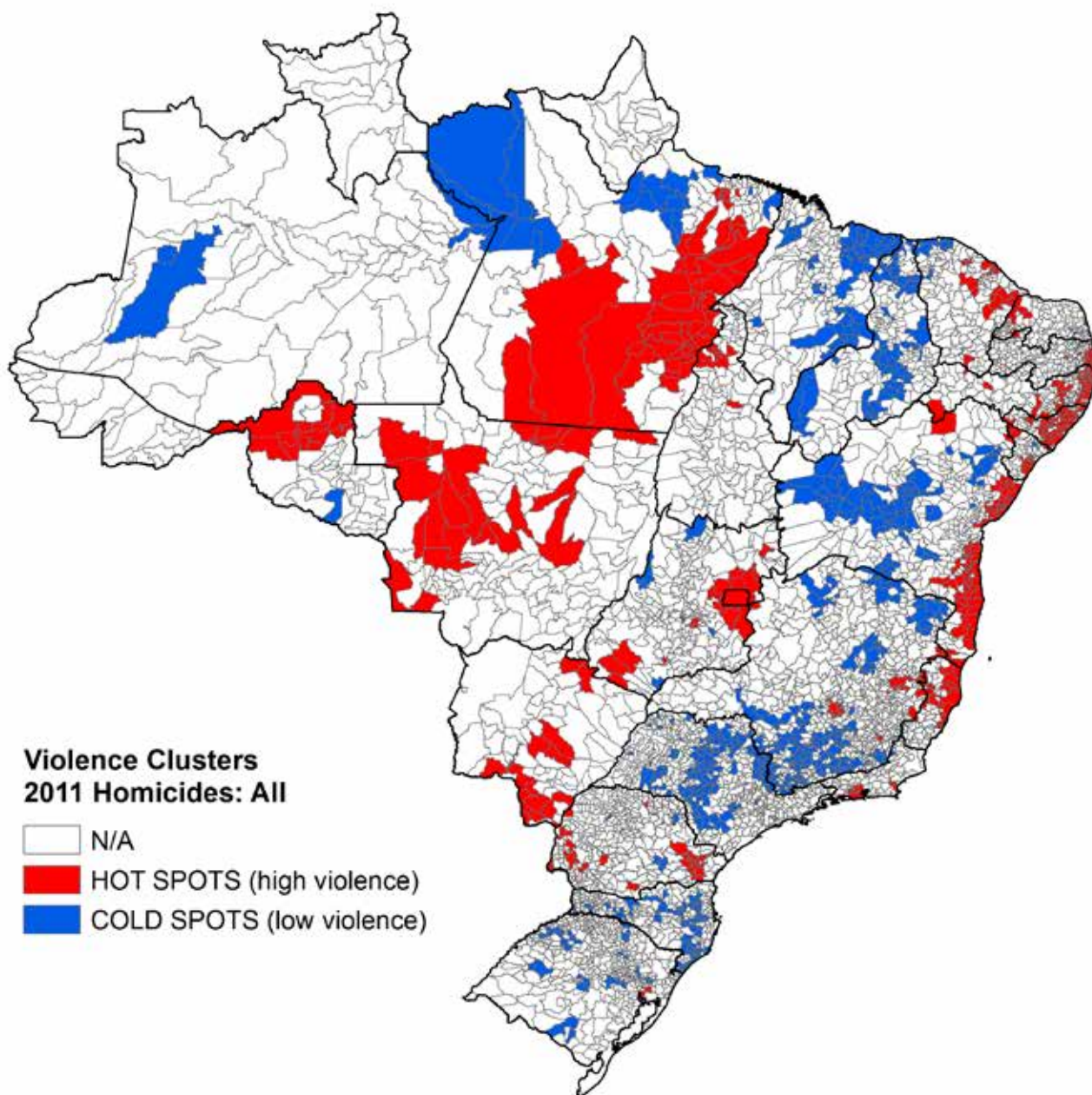
FIGURE 3. HOMICIDE RATES FOR 2011 IN BRAZIL'S MUNICIPALITIES



center of an area where there is a strong association between low violence in unit A and similarly low violence in unit A's neighbors, and this is a distribution of violence that we would also not expect to see simply by chance. Again, it bears emphasizing that the colored units represent cores of violence clusters, so the full cluster that exhibits this statistically significant relationship extends beyond the

colored units to include all neighboring units. The municipalities that are not colored (i.e., white) have homicide rates that are not as strongly associated with the homicide rates of their neighbors, thus they are not the core of a statistically significant cluster of homicide. This is why the legend indicates that the notion of clustering is not applicable ("N/A") to these municipalities.

FIGURE 4. HOMICIDE CLUSTERS: ALL HOMICIDES

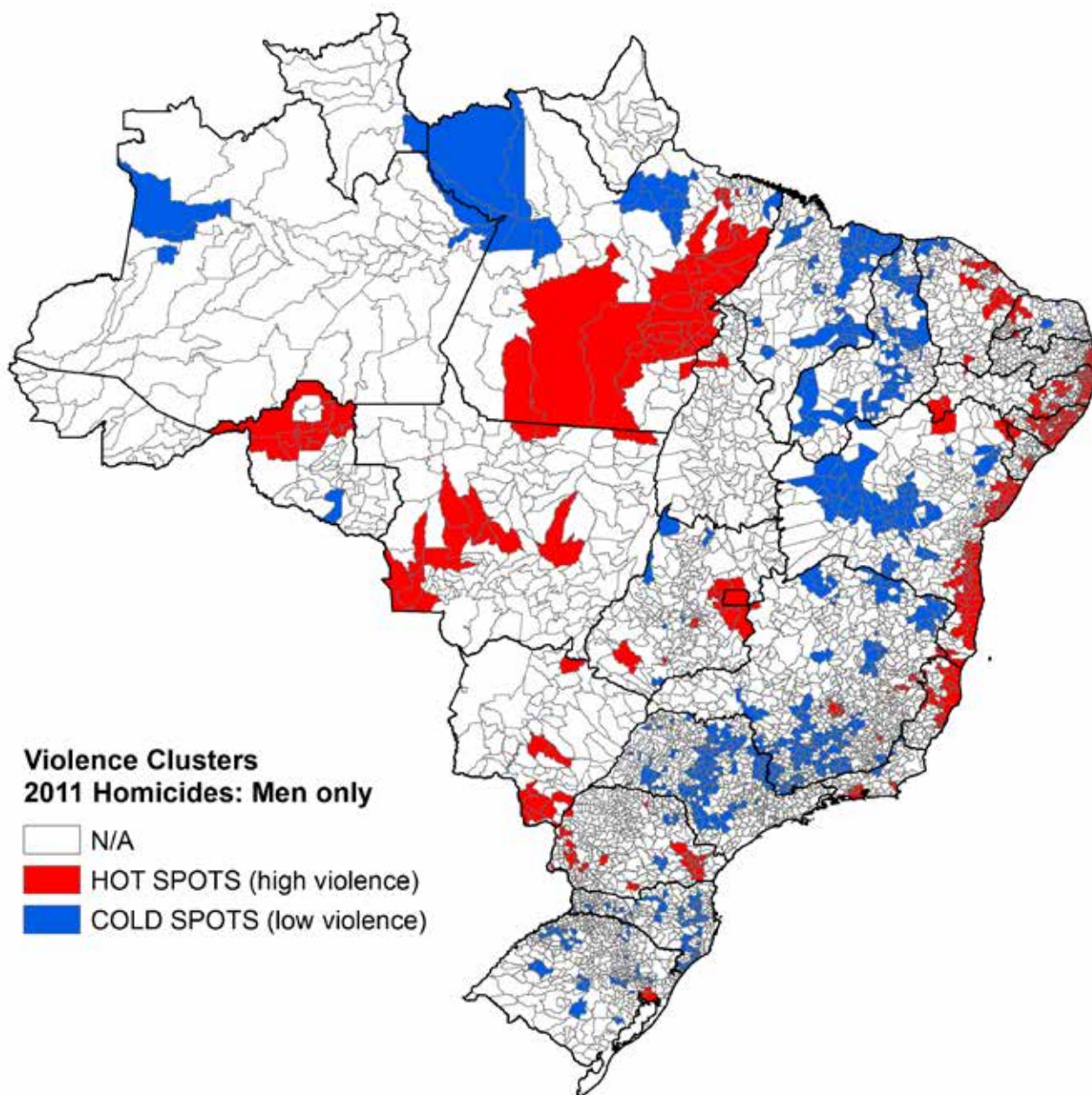


Several large “hot spots” are distributed throughout Brazil, including the area in and around the country’s capital, Brasília, virtually all coastal municipalities from Espírito Santo to the northeastern part of the country, a large swath of municipalities in Pará and Maranhão, another large section of the states of Rondônia and Mato Grosso, and a large set of municipalities along the border with Paraguay

and Argentina. Thus at this early stage of analysis, it appears the geographic association of high levels of violence is especially acute in the northeast of the country.

Disaggregating this overall homicide rate, Figure 5 turns to homicides of men only. In general, the same pattern appears to hold for Figure 5 as

FIGURE 5. HOMICIDE CLUSTERS: MEN ONLY

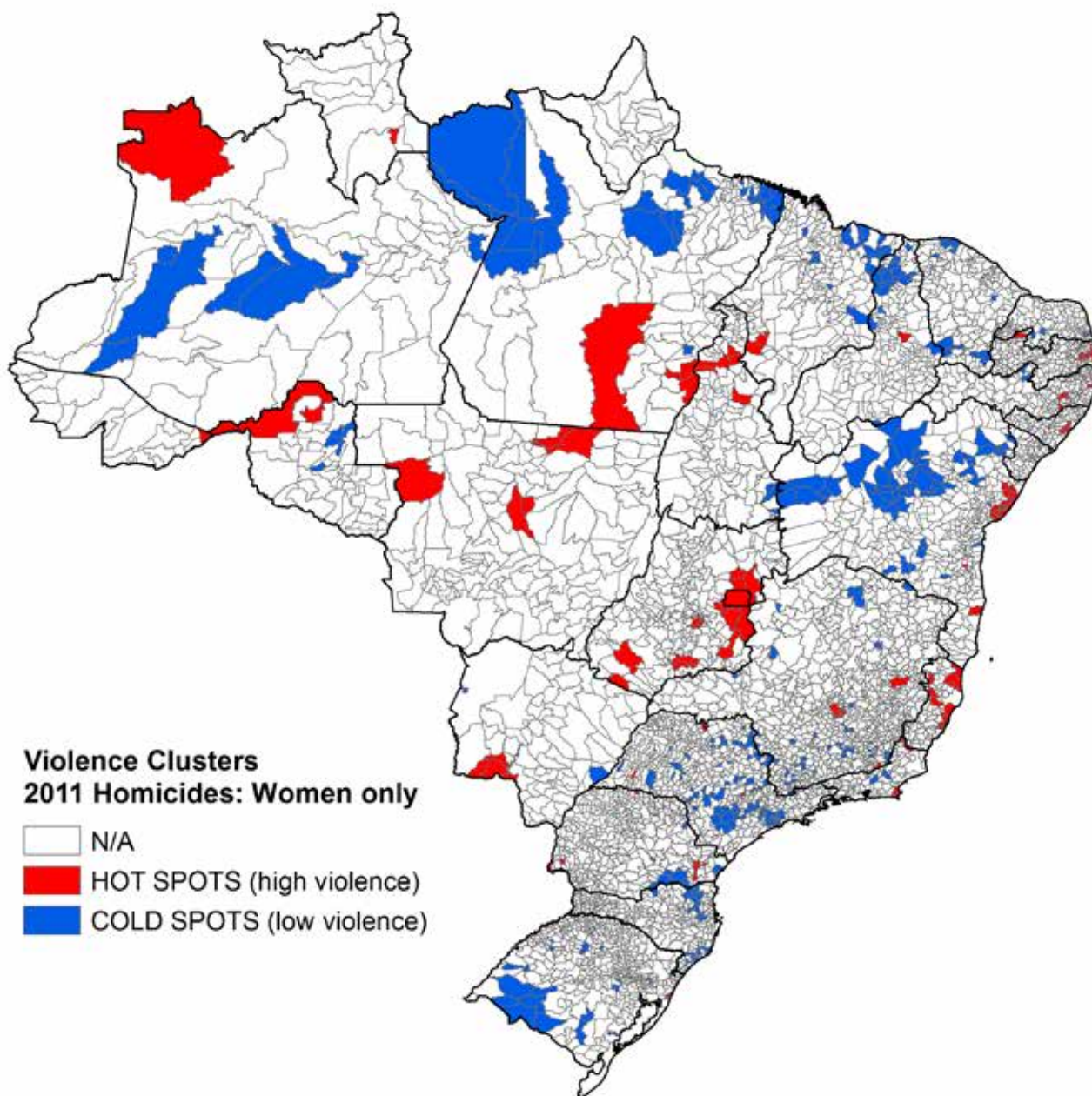


appeared in Figure 4. This is not surprising since most homicide victims are men.

Figure 6 reports the results for femicides. Even a quick glance at the cluster map shows that the pattern of geographic distribution of femicides departs from the ones seen thus far, showing fewer and smaller clusters. However at a more localized

level, some areas of concern remain—like the large cluster around the nation’s capital, or the smaller clusters near the international crossing into Paraguay at Foz de Iguaçu and Ciudad del Este. Also, new areas of concern emerge, like the northwestern part of the state of Amazonas bordering Colombia (*cabeça do cachorro*, or “head of the dog”). This area near the international border is heavily

FIGURE 6. HOMICIDE CLUSTERS: WOMEN ONLY (I.E., FEMICIDES)



militarized and there is a persistent concern about human and sex trafficking, which would tend to be associated with violence against women. Indeed, in 2013 the federal police arrested nine people in a ring accused of sexual abuse of indigenous girls.²¹

Further, a large portion of the state of Espírito Santo constitutes a cluster of high femicide rates, along with a large region north of Salvador, the capital of the state of Bahia.

²¹ Fernando Gabeira, “O pulo do gato na cabeça do cachorro,” *Estadão* (December 3, 2011), available at: <http://www.estadao.com.br/noticias/geral,pulo-do-gato-na-cabeca-do-cachorro,806282> (last accessed September 4, 2014); Katia Brasil, “PF prende 9 suspeitos de exploração sexual de indígenas no AM,” *Folha de São Paulo* (May 23, 2013), available at: <http://www1.folha.uol.com.br/fsp/cotidiano/110380-pf-prende-9-suspeitos-de-exploracao-sexual-de-indigenas-no-am.shtml> (last accessed September 4, 2014).

FIGURE 7. HOMICIDE CLUSTERS: FIREARMS

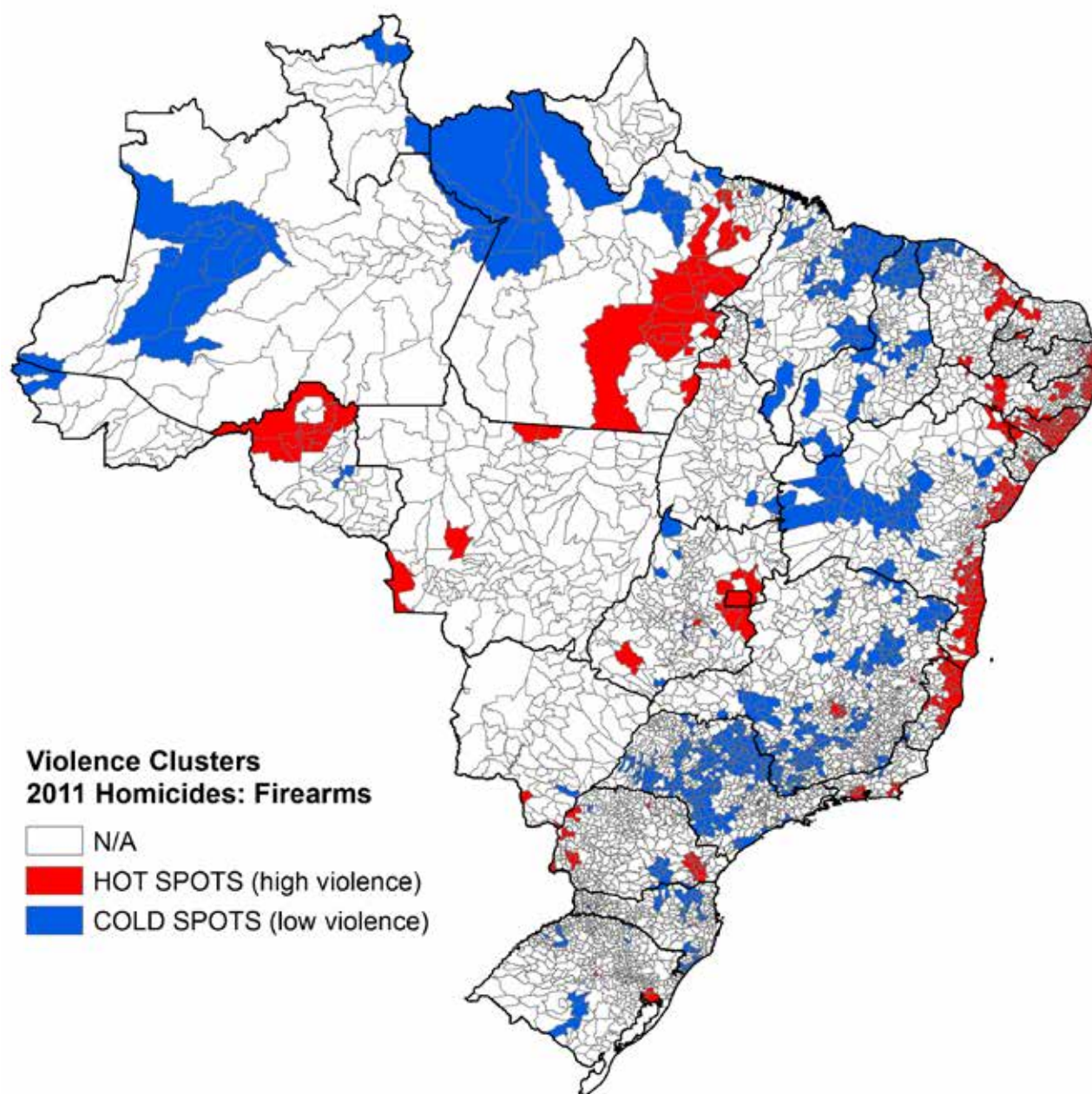


Figure 7 reports the results for firearm-related homicides. Overall, there is more clustering than with femicides, returning to the larger and more numerous clusters observed with aggregate homicides and homicides of men. Large regions of high levels of violence include the western part of the state of Pará and northern part of Tocantins, the northern half of the state of Rondônia (and including adjoining

areas in Amazonas), the region in and around the nation's capital and almost the entire eastern coastline from Paraíba to Espírito Santo. Several smaller areas are also compelling, including the area around Foz do Iguaçu in the state of Paraná, and the fact that a cluster of high violence surrounds the city of Rio de Janeiro but not São Paulo.

FIGURE 8. HOMICIDE CLUSTERS: YOUTH ONLY

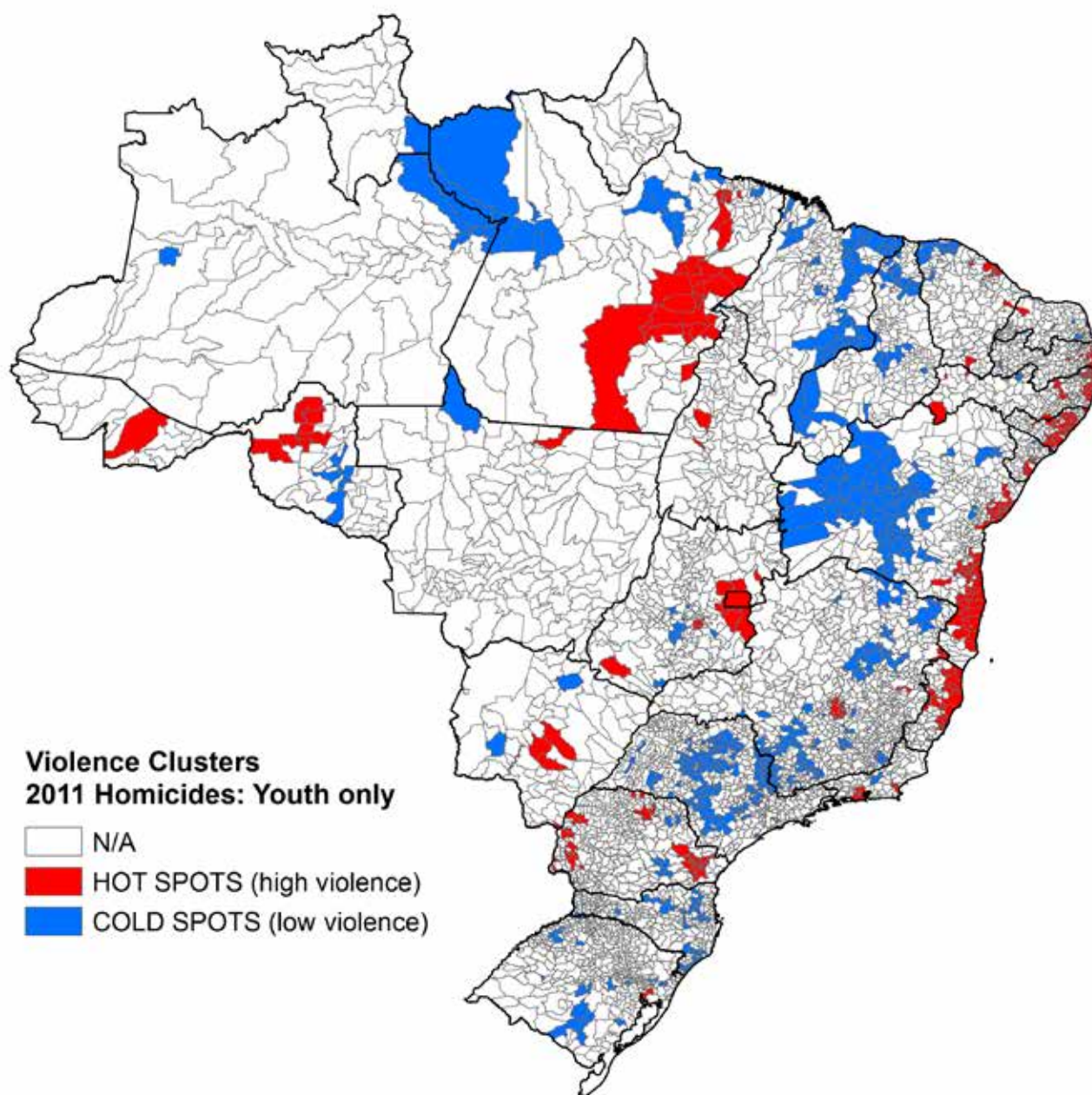
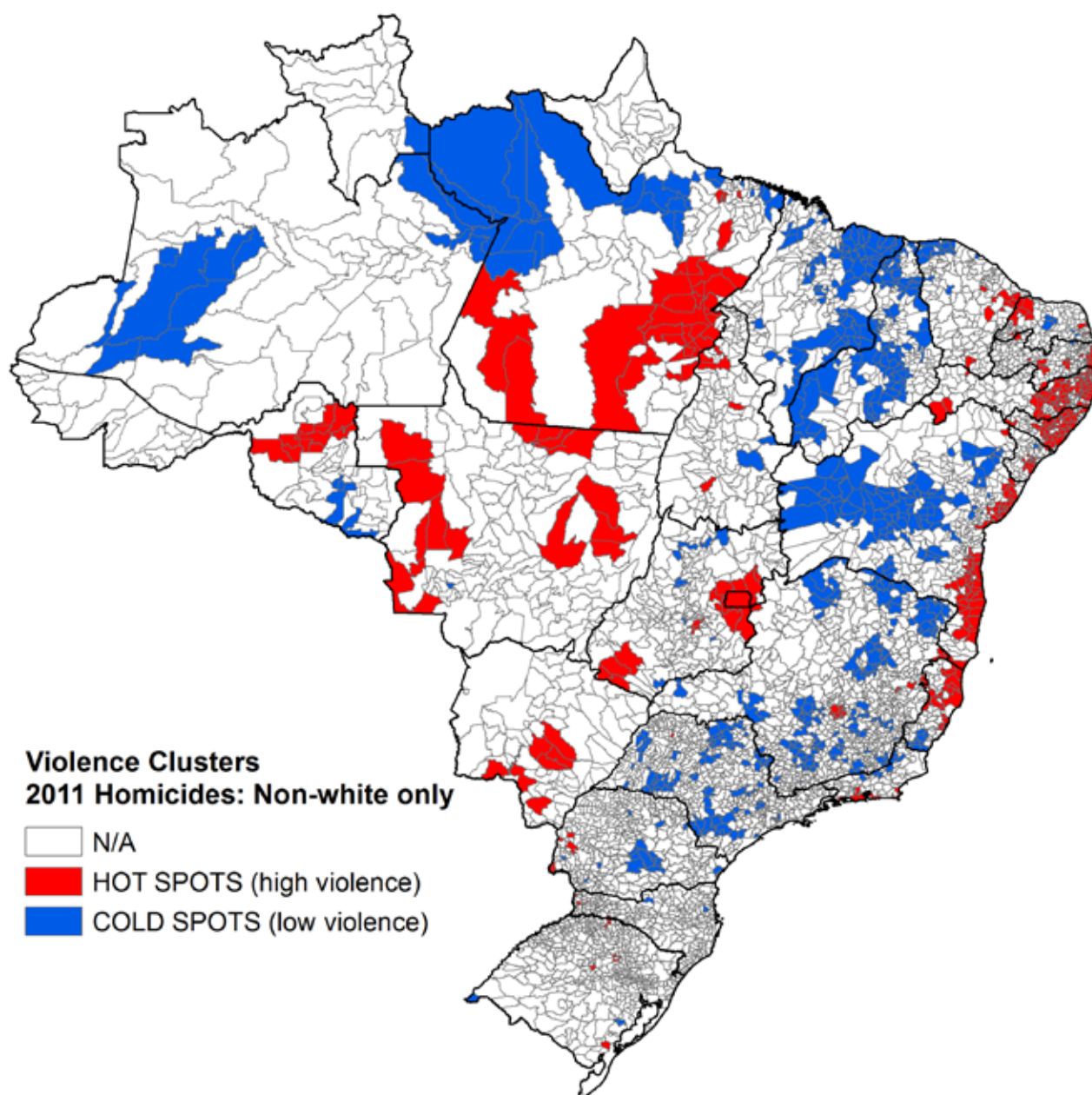


Figure 8 reports the results for homicides of youth. Overall, there is substantial clustering. Local patterns mirror those seen with aggregate homicides and firearm-related homicides.

Turning to homicides of victims classified by race, we report the results for black and brown victims together, i.e., for victims that could be generally

classified as non-white. These data depend on figures for the base population, which are generated by self-reported racial characteristics in the census, and figures for homicides, which hinge on racial characteristics reported by authorities. Given racial politics in Brazil, people might be less likely to self-identify as black than as brown, while authorities may be more likely to classify victims into

FIGURE 9. HOMICIDE CLUSTERS: NON-WHITE ONLY



darker categories.²² These reporting tendencies may cause distortions in the data if we were to analyze only black victims apart from victims identified as brown. Since our substantive interest is in the patterns of victimization among non-whites, a fuller, more accurate accounting of non-white vic-

tims is likely to appear if we collapse the categories of black and brown together.

Figure 9 reports the cluster map for the collapsed category of victims classified as black or brown. Locally, several of the same clustering patterns as pre-

²² See Jan Hoffman French, "Rethinking Police Violence in Brazil: Unmasking the Public Secret of Race," *Latin American Politics and Society* 55 (2013): 161-181.

viously observed with all homicides, gun-related homicides or youth homicides appear, including a large region of high violence covering parts of and straddling the borders of Pará, Tocantins and Mato Grosso, clusters of high violence spanning most of the eastern coastline, straddling borders of several states, a cluster in and around the city of Rio de Janeiro and a substantial cluster around the nation's capital.

The data that generated the previous maps also helps identify the municipalities around which some of the strongest clustering of high levels of violence occurs. We can sort all of the red “hot spots” in order to identify those communities we might label as the “hottest” spots of violence around the country.²³ Further, we can do this for the different categories of homicide we have identified.

For all homicides, clusters of high violence are strongest in three northeastern states: (1) Paraíba, (2) Alagoas and (3) Bahia. Examining the top 10 clusters of high violence, one of the strongest clusters forms around João Pessoa, which is the state capital of Paraíba. Turning to homicides of men only, the top 10 clusters of high violence also come from the same three northeastern states: Paraíba, Alagoas and Bahia. Two municipalities on this top 10 list—João Pessoa and Maceió—are state capitals. Further, Marechal Deodoro and Rio Largo neighbor Maceió in Alagoas, Pilar neighbors Marechal Deodoro and Messias neighbors Rio Largo. Thus, the area around Maceió, the capital of Alagoas, is a remarkable cluster of high levels of violence.

As was the case with the cluster maps, the top 10 clusters of femicides identify some of the same communities, but also identify new areas of

concern. Five states contribute the municipalities with the top 10 clusters for femicides: (1) Paraíba, (2) Bahia, (3) Espírito Santo, (4) Rio de Janeiro and (5) Goiás. The first two are familiar from the earlier discussion, but the other three states are new. Goiás is the state that surrounds most of the national capital of Brasília, and Rio de Janeiro is home to one of the country's most famous cities. Vitória (ES) and João Pessoa (PB) are both state capitals, and both appear in the top 10 of the list of strongest clusters of femicide rates.

As was the case with all homicides and homicides of men only, the top 10 clusters of firearm-related homicides, youth homicides and homicides of non-white victims are generated by cities in three states: (1) Paraíba, (2) Alagoas and (3) Bahia. The re-appearance of these three northeastern states across different measures of homicide suggests this geographic region is an area of concern and should be a priority target of violence-reduction policies. Moreover, regarding youth violence, the greater area around Maceió, the capital of Alagoas, continues to be represented heavily among the top 10 clusters of violence, including the municipalities of Maceió, Marechal Deodoro, Pilar, Rio Largo and Messias. Regarding non-white homicides, two state capitals are again on the top 10 list: João Pessoa and Maceió. Table 1 summarizes the geographic distribution of the strongest clusters just mentioned, identifying the states that contribute the cities that constitute the 10 strongest cluster cores (i.e., “top 10” cities), as well as the state capitals that are among those top 10 cities.

Complementing the cluster analysis above, we conducted several more sophisticated regressions to test a variety of explanations of violence. The

²³ Local indicators of spatial autocorrelation (LISA values) are a measure of the association between the homicide rate in one unit and the homicide rate in neighboring units (Luc Anselin, “Local indicators of spatial association—LISA,” *Geographical Analysis* 27 (1995): 93-115). Each municipality has a different LISA value. A LISA value is positive if the local homicide rate is high and the neighborhood rate is also high, or if the local rate is low and the neighborhood rate is also low. In either case, a positive LISA value captures the clustering of similar values (high or low) of homicide rates. In contrast, a LISA value is negative if the local rate is high and the neighborhood rate is low, or if the local rate is low and the neighborhood rate is high; in either case, a negative LISA value captures the clustering of dissimilar values. Thus, LISA values convey meaningful information about the clustering of similar or dissimilar values. Further, the average of all LISA values conveys the overall, country-wide spatial association of homicide rate; this global measure of association is known as Moran's *I*. Units can be sorted by LISA value and the local level of violence, identifying those units that exhibit the strongest clustering of high violence.

TABLE 1. SUMMARY OF GEOGRAPHIC DISTRIBUTION OF STRONGEST CLUSTERS (CORES)

	All	Male	Femicides	Firearms	Youth	Black & Brown
States contributing top 10 cities	Paraíba	Paraíba	Paraíba	Paraíba	Paraíba	Paraíba
	Alagoas	Alagoas	Bahía	Alagoas	Alagoas	Alagoas
	Bahía	Bahía	Espírito Santo	Bahía	Bahía	Bahía
			Rio de Janeiro			
			Goiás			
State capitals among top 10 cities	João Pessoa	João Pessoa	João Pessoa	João Pessoa	João Pessoa	João Pessoa
		Maceió	Vitória		Maceió	Maceió

outcomes of interest in these models captured several different types of homicide, including aggregate homicide rates, homicides of male victims only, femicides, gun-related homicides, homicides of youth only and homicides of victims classified by race as black or brown. These models also tested a wide range of dominant explanations from sociological and criminological studies of violence, including population pressures, unemployment, poverty, single-parent and female-headed households. We were particularly interested in measures of socioeconomic marginalization (a composite measure of poverty, illiteracy and rurality), cash transfer programs and development projects with an environmental impact. While a full discussion of these models is beyond the scope of this brief, we extract several key findings below, setting aside those with reduced or longer-term policy relevance (e.g., large-scale demographic pressures) and emphasizing those that are most policy relevant, especially in the short and medium terms.

Table 2 summarizes the main findings. The main predictors of interest are listed in the first column on the left, followed by the results for each type of homicide. Within each column the first sign (+ or -) indicates the theoretically expected relationship between the predictor and violence, and the second sign after the forward slash reports the actual

relationship found during the course of analysis. If the relationship was not statistically significant, this is indicated by “ns,” and if the relationship was not consistent, this is indicated by the number of models (out of a total of six) that showed the reported result. If there is no note regarding the number of models, the result held across all models, as was the case with marginalization and state capacity.

The findings fall into two primary categories. First, the most robust findings, i.e., those that have consistent statistical significance and direction of effect across all models, include: (1) marginalization has the anticipated positive effect on violence; (2) state capacity has a consistently significant and unexpectedly positive relationship with homicide rates; and (3) the spatial lag term (ρ), which captures the neighborhood average of homicide, is statistically significant and exerts a positive effect, indicating that homicides in one municipality can be explained in part by homicides in nearby municipalities.

Second, findings that are statistically significant in most but not all models, or for some but not all type of homicide, include the following: (a) the proportion of households that are headed by a women with no education and with kids under age 15 (FHHWK) has the expected positive relationship with all types of homicide except

femicides; (b) the adult-male employment rate has a consistently significant and unexpectedly positive relationship with all types of homicide, though the effect is less consistent with homicides of black and brown victims; (c) the proportion of poor, eligible families covered by Bolsa Família (BF coverage) has a protective, negative effect for most types of homicides, but the findings are most consistent for gun-related, youth, and non-white homicides; and (d) industrial development projects with an environmental impact (EI) have a harmful, positive effect on homicide rates; this effect is uniformly consistent for femicides, but is also fairly consistent for gun-related, youth and non-white homicides.

Findings regarding state capacity and employment rates, though counterintuitive, align with recent research in U.S. Regarding state capacity, existing research suggests the finding here may be endogenous; that is, the positive association is a result of state resources being directed at areas of high violence, rather than state capacity causing an increase in violence. Additional research would be needed to examine this endogeneity. Regarding employment rates, higher employment rates create more targets and opportunities for crime and violence, thus we should expect to see homicide and other crime rates increase as economic activity increases. Given the consistent and policy-relevant effect of marginalization, environmental impact and BF

coverage, additional analyses examined the extent to which the effects of these variables are local or regional. That is, we examined whether these features of municipalities have a harmful or beneficial effect only within units of analysis, or whether their effect extends to neighboring municipalities. The results show that these effects extend beyond individual municipalities. For instance, marginalization in one municipality increases the likelihood of elevated homicide rates in neighboring municipalities. Also, development projects with an environmental impact in one municipality lead to increased homicide rates in neighboring municipalities. Again, alongside the other results showing clusters of violence and the spread of violence from nearby units, these results strongly endorse a regional approach to violence prevention. Specifically, violence-reduction policies need to be targeted at groups or sets of relevantly connected municipalities rather than at individual, isolated communities.

CONCLUSIONS AND POLICY IMPLICATIONS

Overall, the findings suggest that violence clusters geographically in non-random ways and that violence in one municipality spills over into homicide in neighboring municipalities. The following points sum up our conclusions.

TABLE 2. SUMMARY OF REGRESSION RESULTS ACROSS TYPES OF HOMICIDE

	All	Male	Femicides	Firearms	Youth	Black & Brown
Marginalization	+/+	+/+	+/+	+/+	+/+	+/+
Female HH	+/+	+/+	+/ns	+/+	+/+ (5/6)	+/+ (5/6)
Adult male employment rate	-/+	-/+	-/+	-/+	-/+	-/+ (5/6)
State capacity	-/+	-/+	-/+	-/+	-/+	-/+
BF coverage	-/- (3/6)	-/- (3/6)	-/ns	-/- (5/6)*	-/- *	-/-
Env. Impact	+/+ (3/6)	+/+ (3/6)	+/+	+/+ (4/6)*	+/+ (4/6)	+/+ (4/6)

* one or more models show significance at .10 level

1. Socioeconomic marginalization has a harmful effect across all measures of homicide and across all models; put briefly, as marginalization increases, homicide rates increase
2. Family disruption and social disorganization, captured by the percentage of women with no education who are heads of households and have kids under age 15 (FHHWK), also has a harmful effect across all types of homicide except femicides
3. Environmental impact (EI) has a harmful effect on women; that is, there is a strong, positive association between EI and the femicide rate
4. Bolsa Família (BF) coverage has a protective effect against gun-related homicides, homicides of youth, and non-white homicides
5. All types of homicide cluster geographically, though in slightly different patterns
6. Homicide in nearby communities increases the likelihood of homicide in one's home, focal community

One of the main findings relates to the utility of conditional cash transfer programs like Bolsa Família in reducing gun-related homicides, youth homicides and homicides of non-white victims, but its lack of any effect with regards to other types of homicides. These cash transfer programs, then, have a valuable violence-prevention power for certain types of violence. To be clear, the mechanism by which this happens is not elucidated here. It may be that these programs reduce marginalization (which we find contributes to all types of homicides across the board), and therefore indirectly reduce violence. The causal pathway remains an open question, but the results here regarding BF coverage and several types of homicide have clear policy

implications. Specifically, conditional cash transfer programs are a promising policy option in the struggle to prevent and reduce violence, especially in the struggle to prevent or reduce firearm-related violence and violence directed at youth and non-white individuals.

Also, industrial projects that have an environmental impact increase the risk of several types of homicides, but the result is especially consistent for femicides. This suggests that certain development strategies may have unintended harmful social consequences, especially for women. One illustrative case is the municipality of Altamira, in the state of Pará. Altamira is the main construction site for the large hydro-electric dam of Belo Monte on the Xingu River. The women in this city are mostly against the construction of the dam,²⁴ despite the large number of jobs being created, and the main reason given for their opposition is the increase in violence. One of the possible explanations why women are particularly vulnerable to violence is the massive influx to the region of temporary workers—generating a large pool of people who may feel relatively anonymous or un-rooted to local communities—and perhaps also the increase in prostitution that follows large movements of transient workers like this. Thus, policies could be both proactive and reactive, aiming to educate local populations about the predictable effects of a large development project in the area, screen workers during hiring and tailor policing efforts. However, policymakers should also be attuned to coordinating these policies with the geographic areas affected by the development project, ensuring that policies are not tailored too locally so that negative consequences spill over into adjoining areas. For instance, an increased policing effort targeted narrowly at the immediate area around a development project may simply cause harmful behaviors to move a short distance away.

²⁴ “Para moradores de Altamira, Belo Monte trouxe renda e problemas,” Datafolha Institute (December 16, 2013), available at: <http://datafolha.folha.uol.com.br/opiniaopublica/2013/12/1386247-para-moradores-de-altamira-belo-monte-trouxe-renda-e-problemas.shtml>.

Policy implications that derive from these conclusions fall into four main areas: (1) substantive content of policy-reduction and violence-prevention policies; (2) how to prioritize these policies; (3) targeting of violence-reduction or violence-prevention policies according to both type of homicide and geographic area; and (4) the relevance of these policy implications in the current political context in Brazil.

First, the findings strongly support policies that (a) reduce marginalization, (b) reduce family disruption by reducing the incidence of households headed by women with no education and young children, (c) reduce environmental impact of industrial development projects and (d) increase coverage of conditional cash transfer programs like Bolsa Família.

Second, regarding prioritization of these policies, marginalization is perhaps the first priority given the consistency of results. However, future research could also clarify the marginal reduction in violence according to investment in reducing marginalization and compare these results with marginal gains from reducing FHHWK, increasing BF coverage, or reducing EI.

Third, regarding policy targeting, the results help inform how policymakers should distribute resources more efficiently by identifying which policies are more effective depending on type of violence and geographic area. Regarding type of violence, if aggregate homicide rates or the homicide of males only is the primary concern, marginalization and FHHWK are key policy content areas. In contrast, if femicides are the main concern, then policies should focus on marginalization and reducing EI. Alternately, if gun-related, youth or non-white homicides are key concerns, then policies oriented at increasing BF coverage deserve greater attention.

In all cases, the results suggest strategies for geographic targeting, namely, that policies should not be aimed at individual, isolated communities.

Rather, violence-prevention and violence-reduction policies – with the content outlined above – should be targeted at groups or sets of relevantly connected communities. The cluster maps (presenting the “hot spots” and “cold spots” of violence) can help guide this geographic targeting. In this regard, sets of communities that straddle state boundaries or other relevant administrative or jurisdictional boundaries (e.g., judicial districts, electoral districts) raise a possible barrier of cross-jurisdictional collaboration. Failure to address this kind of collaboration while developing and targeting violence-reduction policies could pose a substantial obstacle for enacting and implementing these policies, especially where key actors on different sides of jurisdictional boundaries (e.g., mayors, governors) are from different political parties.

LOOKING AHEAD

Lastly, these policy implications resonate deeply with the domestic political context in Brazil, including several recent developments and upcoming events in Brazil. Until the morning of August 13, 2014, the incumbent candidate, Dilma Rousseff, running for reelection under the banner of the center-left Workers’ Party (PT), was leading the polls against Aécio Neves, a senator from the state of Minas Gerais, running under the center-right Brazilian Social-Democratic Party (PSDB). Eduardo Campos, the former governor of Pernambuco, from the center-left Brazilian Socialist Party (PSB), was consistently appearing in third place in the polls as he sought to unseat Rousseff and interrupt 20 years of control of the national executive by Ms. Rousseff’s Workers’ Party (2003-present) and Mr. Neves’ Brazilian Social Democratic Party (1995-2002).

On August 13, however, Eduardo Campos died in a plane accident while on the campaign trail. The death of Mr. Campos dramatically altered the trajectory of the Brazilian presidential election, which has two rounds of voting scheduled for October 2014. Marina Silva replaced Campos as the PSB’s presidential candidate; up to that point, Ms. Silva

had been Campos's vice-presidential running mate. However, on August 26, less than two weeks after Mr. Campos's death, the polls predicted Ms. Silva would win second place in the first round of voting, forcing a second round and then winning that second round against Ms. Rousseff.

The tragedy of the plane crash has the potential to highlight the conflict between two women with similar, center-left profiles, but yet with distinct policy priorities. If the more right-wing candidate, Mr. Neves, falls to third place in the first round of voting, the contest in the second round in Brazil, for the first time in history, will be between two traditionally center-left parties. Ms. Rousseff and Ms. Silva were both ministers during the PT's first administration, under Luiz Inacio "Lula" da Silva. However, while the former Minister of Energy, Ms. Rousseff, gained prestige with Lula, rose to Chief of Staff and ended up chosen to be his successor in the 2010 presidential election, Ms. Silva suffered several defeats in Lula's government as Minister of the Environment.

Ms. Silva ultimately resigned from Lula's administration in 2008. After a first attempt to run for president in 2010, she tried to create a new political party, but the Brazilian electoral courts did not approve the registration of this party in time for Ms. Silva to run for president in 2014. This led to the first dramatic move in this election, which was her last-minute affiliation to the PSB when Mr. Campos agreed to allow her to continue with the efforts to register the new political party after the election. Now after the death of Mr. Campos and Marina's ascent to the top of the PSB ticket, and with real chances of winning, nobody knows if the attempt to create a new political party will continue. It seems clear, however, that debates about a development model based on large industry and infrastructure, like the construction of dams, hydroelectric plants and the transposition of rivers, or a more environmentally sustainable option, should become more prominent as the Brazilian election approaches.

Given the results presented here, the upcoming election could have a major impact on shaping development policies as Brazil moves forward, policies that have consequences for violence. Regardless of the election results, then, these results should help inform policy proposals. Despite some ambiguities and uncertainties, we can reasonably expect differences in policies depending on the outcome of the election. If Ms. Rousseff wins, Bolsa Família (BF) will probably retain its current support, and may in the long term help reduce marginalization, therefore reducing violence; however the current development model is also likely to remain the same, prolonging the harmful environmental impact (EI) of existing and new development projects. If Ms. Silva wins, there is also an expectation that policies regarding BF will likely stay in place or be expanded,²⁵ but a Silva administration would, all else being equal, be more likely to introduce changes in the development model, at least where EI is concerned. In spite of some increasingly conservative proposals in her economic and social agenda, it is reasonable to anticipate that a Silva administration would be most likely to reduce the environmental footprint of large development projects or transform these development projects, thereby reducing the likelihood of violence in and around these projects, especially against women. If Neves wins, it is unclear what kind of support BF could expect. Further, it is likely that a Neves administration would maintain the same development model with its attendant harmful effects due to environmental degradation. To be sure, there are other candidates in Brazil's presidential election beyond these three. Some of the other candidates present very different projects for the country, like the leftist policies presented by the Socialism and Freedom Party. What remains to be seen is how much traction any of the substantive differences in the programs can gain in order to influence the debate and the vote, in 2014 or in the future.

²⁵ "The Silva surger: Brazil's presidential election has a new favourite. What is she like?" *The Economist* (September 4, 2014).