FIGHTING THE WAR OF THE FLEA: THE GEOGRAPHY OF INSURGENT TACTICS AND ROAD INFRASTRUCTURE

ABSTRACT. Rebel groups draw on a wide range of tactics to pursue military objectives, and which tactics rebels deploy can vary dramatically across a country's territory. While extant literature has explored how rebel groups wield violence generally, insurgents' use of tactics often follow distinct logics. We present an account of the strategic considerations underlying where insurgents choose to carry out costly, disruptive attacks against the state. Such disruptive tactics are fundamental to asymmetric, irregular conflicts common across many contexts, yet are understudied. Using detailed event data on a broad array of rebel behavior, an instrumental variable strategy, and a survey of inter-city trade from the Colombian civil war, we show that rebels tend to leverage disruptive tactics in locales densely connected to the country's road system, but not tactics bearing on territorial conquest. We further provide evidence that the trade-boosting effect of road infrastructure is a plausible mechanism linking these variables. The findings have implications for understanding rebel strategy and speak to growing scholarship on the nexus between roads and civil war violence.

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Accounting for subnational variation in insurgent violence is a central research program in the study of conflict. Extant literature has investigated numerous factors that shape the geography of violent conflict, including the nature of terrain composition (Fearon and Laitin, 2003), demographic concentration (Nedal, Stewart and Weintraub, 2015; Dolan, Besaw and Butler, 2018), distance to national capitals (Minhas and Radford, 2017), and the spatial distribution of natural resources (Ross, 2004). Even as research on subnational variation in violence has grown large, however, the bulk of scholarship in this area tends to collapse all rebel behavior into a binary choice between violence and nonviolence. These accounts fail to distinguish among the diversity of tactics that rebels employ or provide accounts of specific forms of violence, and we thus know relatively little about why rebels tend to use certain tactics in some places but not others.

This lacunae in the literature is particularly striking given that armed rebels have demonstrated an impressive ability to wield a wide variety of tactics and strategies in pursuit of military objectives. For example, the mix of tactics deployed by Hezbollah – ambushes and rocket attacks, an elaborate system of underground concrete bunkers, complex weapons systems including air defense units – were likely pivotal in forcing a withdrawal of IDF forces from southern Lebanon (Saad-Ghorayeb, 2002; McGregor, 2006). More recently, Boko Haram has pursued a similarly mixed strategy, targeting civilian centers with brutal terrorist attacks while also conducting motorized infantry attacks against military targets, in some cases managing to route Nigerian military forces (Walker, 2012). Moreover, tactical variation is not random: as we aim to show, different types of tactics follow distinct logics. How armed actors fight can also have decisive consequences for the broad trajectory of civil wars, including how successful groups are at extracting concessions from the state (Fortna, 2015), the transition to a post-conflict scenario (Weintraub, Vargas and Flores, 2015; Balcells and Kalyvas, 2014; Chu and Braithwaite, 2017), and the treatment and abuse of civilians in civil wars (Kalyvas, 2006; Wood, 2014). Understanding how rebels fight and where violent tactics are employed is thus critical for explaining micro-level conflict dynamics.

In this article, we provide a theoretical account and empirical test of variation in the deployment of insurgent tactics commonly used in asymmetric, 'slow-burn' irregular wars. We conceptually distinguish between disruptive tactics – low-intensity attacks whose purpose is to impose costs on the state by undermining its normal functioning – and territorial tactics bearing on capturing and holding territory from the state. While the logic of territorial tactics are well-studied in political science (Kalyvas, 2006; Steele, 2011; Balcells, 2016), insurgents also frequently use disruptive attacks, particularly in locations where rebels are unlikely to contest or consolidate territorial control. We argue that the distribution of road infrastructure across a country's territory plays a key role in determining where rebels leverage disruptive tactics. Cities that are densely connected to the country's road network are more likely to be targeted with disruptive attacks, as causing havoc in these transportation hubs can impose heavy political and economic costs on the state. In contrast, these locations are not more likely to be challenged territorially given the difficulty rebels face in executing and securing their capture.

To test these arguments, we leverage fine-grained data on a rich variety of modalities of insurgent behavior in the Colombian conflict, during a period of time in which rebel forces aggressively contested the state (1988-2005). We show that rebels tend to deploy disruptive tactics in cities with higher levels of road infrastructure, but that the same pattern is not present for tactics bearing on territorial conquest. Using a survey of inter-city commercial trade, we find support for commercial activity serving as a mechanism linking road infrastructure and the use of disruptive tactics. In serving as conduits for inter-city commercial traffic, cities with high road density become more valuable targets for disruptive attacks. The findings are robust to a variety of model specifications as well as an instrumental variable approach that draws on a map of Colombian roads from 1938, decades before the accepted start of the conflict.

In considering how subnational road infrastructure shapes rebel tactics, we contribute to extant literatures bearing on conflict dynamics, rebel tactics, and state-building. This research highlights the importance of disaggregating rebel tactics and generating theory on

the strategic deployment of violence in civil wars. We also underscore the importance of considering geographic, structural factors in how wars are fought – in this case, roads – for a literature that has paid much more attention to patterns of support among civilians (Kalyvas, 2006; Balcells, 2016). The results also add to a growing body of research on the role of roads in shaping conflict dynamics (Zhukov, 2012; Hammond, 2018). While extant work argues roads motivate diffusion or incentivize capture, we contend that irregular conflicts lead locales with dense road connections to be targeted with disruption. Finally, the results suggest academics and development practitioners should consider more seriously how violent actors respond and adapt to transportation infrastructure in ways that promote instability (Schouten and Bachmann, 2017). It may not be a question of *whether* such infrastructure promotes or inhibits conflict but rather *how* to assess and minimize trade-offs between the potential conflict-enhancing and conflict-reducing aspects of transportation infrastructure.

Rebel Tactics in War

Our argument takes as its starting point that insurgent tactics vary across both space and time, and that understanding why tactics vary is key to accounts of how wars are fought. Rebel groups of varying stripes have been observed engaging military forces in direct combat (Ortiz, 2002), using bombs and other explosive devices (Condra et al., 2017), setting up ambushes and road blocks (Schouten and Bachmann, 2017), engaging in political assassinations and kidnappings (Knickmeyer, 2014), and massacring or displacing large swaths of civilians (Valentino, Huth and Balch-Lindsay, 2004; Steele, 2011), among a host of other violent attacks. While the broader questions of why rebels fight, and what accounts for spatial and temporal variation in their use of violence is long-studied in political science (Lichbach, 1998), scholarship that disaggregates subnational variation in rebel tactics into distinct categories has been less common, particularly in the literature on subnational variation in civil war violence.

By focusing on tactics, we build on extant scholarship arguing insurgent strategy is both critical for understanding the trajectory of violence in civil wars and determined by structural and dynamic factors (Kalyvas, 2006; Balcells, 2016). Much of this work has leveraged variation in tactics *across* groups, providing accounts of why armed actors use certain forms of violence in some conflicts but not others (Bueno de Mesquita, 2013; De la Calle and Sánchez-Cuenca, 2015). Examples include why massacres are more common in some types of conflicts than others (Valentino, Huth and Balch-Lindsay, 2004) or why some types of groups are more likely to use wartime sexual violence than others (Cohen, 2013). Research on intra-group variation in tactics is more limited, even as the empirical record suggests rebel groups often pursue different strategies across a country's territory. What work exists in this vein often consider a narrow range of tactics, such as intra-group variation in how discriminately civilians are targeted (Kalyvas, 2006; Balcells, 2016; Weinstein, 2006).[1]

Here, we distinguish between two broad sets of insurgent tactics discussed in the literature, which we characterize as *disruptive* and *territorial*. We argue territorial tactics encompass rebel behavior aimed at the expansion or consolidation of territorial control. Broadly, territorial tactics often involve serious military engagement with the state, such as campaigns to expel or rout state forces from certain locales. The expulsion of the Iraqi Army from Mosul by ISIL in 2014 is one spectacular example of such an attack (Michael Weiss, 2015). In the context of insurgencies, where rebel and state forces critically depend on popular support to hold territory, territorial tactics can also aim to shape spatial patterns of popular support. Insurgents may carry out attacks against the civilian population, such as targeted assassinations, massacres, or mass displacements, in opposition-held territory to expand territorial control (Kalyvas, 2006; Zhukov, 2015), or within their own territory to consolidate popular support (Balcells, 2016). Such attacks may seek to raise the costs of defection for the civilian population, or in some cases to physically expel civilians sympathetic to enemy forces (Steele, 2011).

[1]Although forthcoming work and work-in-progress such as Condra et al. (2017), Trebbi et al. (2017), and Wright (2018) are important exceptions.

Given the consequences of territorial expansion for the trajectory of war and treatment of civilians, it is unsurprising that much of the conflict literature focuses on the dynamics of territorial tactics. However, rebels also frequently engage in low-intensity attacks whose objective is to impose small, but cumulative, costs on the state, which we characterize as *disruptive tactics*. These types of attacks are not intended to outright defeat state forces or expand a group's area of territories; instead, they follow a 'war of attrition' logic, which involves carrying out small, difficult-to-defend attacks against state and civilian targets. Disruptive tactics can take many forms, such as swift hit-and-run ambushes of security forces (Cheney, 2005), setting up of road-blocks and the destruction of civilian infrastructure (Rebosio and Wam, 2011), and low-level attacks against civilian targets outside areas of control (Condra et al., 2017). In carrying out such attacks, rebels often pursue varied military objectives. The inability of state forces to defend both themselves and civilian targets serve to undermine its legitimacy in the eyes of the population while also boosting the rebel's reputation (Rebosio and Wam, 2011), outcomes with implications for counterinsurgency success (Taber, 1965). Disruptive tactics might also serve, in particular contexts, to extract policy concessions or better settlement terms from the state (Sánchez-Cuenca, 2004).

Insurgent forces often employ a mix of these strategies, though the extent to which they rely on one set of tactics or the other is likely a function of the type of war in which armed groups find themselves. As Kalyvas and Balcells (2010) argue, the extent to which rebels are able to contest territory from the state will depend on the distribution of power among combatants and the technology of rebellion available to insurgents. We expect the use of disruptive tactics will be most common in the highly asymmetric, 'slow-burn' wars that characterize classic insurgencies, where rebel groups have little chance of directly challenging the state territorially (Taber, 1965)[2]. In the next section, we provide an account that links subnational variation in insurgent tactics to a country's road infrastructure, and derives separate expectations for disruptive and territorial tactics.

[2]Kalyvas and Balcells (2010) categorize 54% of civil wars between 1944 and 2004 as 'irregular', characterized as wars where the state enjoys high military capacity and rebels hold low military capacity.

Disruption and Road Infrastructure

States and militaries have long recognized the critical value of transportation infrastructure in the waging of war; roads and railway dictate important aspects of army logistics, including troop movement and the establishment of supply lines (Van Creveld, 2004). In modern irregular wars, state forces expend considerable effort to build and secure roads to project military force, constrain insurgent movement, and pursue 'hearts and minds' counterinsurgency strategies (Kilcullen, 2008; Kalin, 2017). Even in times of relative peace, the Israeli Defense Force has sought to maintain a high level of troop presence on roads thought to be critical for army logistics (Moore, 2014, p.654). In addition to state forces, transportation infrastructure has also influenced how insurgents behave in civil wars. Roads determine how insurgents deploy explosives to maximize impact against state forces (McFate, 2005; Townsley, Johnson and Ratcliffe, 2008; Trebbi et al., 2017), carry out ambushes (Outcomes, 2014), advance their territorial campaign from town to town (Zhukov, 2012), and pursue other strategies. While indicating a link between road infrastructure and rebel violence writ large, however, existing work does not provide an account that distinguishes how roads motivate distinct rebel tactics.

We argue that the nature of a country's road infrastructure should shape not just whether insurgents use violence, but also the kinds of tactics they deploy. As previously noted, disruptive tactics are not meant to significantly weaken the state or generate immediate territorial gains for rebel forces; instead, they leverage the speed and ease of movement of rebel forces to carry out low-intensity attacks that are nonetheless costly to the state. In selecting locations for *disruptive tactics*, we expect insurgents will choose places where attacks have the potential to impose heavy costs on the state. As a key structuring characteristic of a country's geography, roads should help shape *where* the opportunities to impose such costs are situated. In particular, cities and towns that are densely connected to a country's road network constitute important transportation hubs that hold high strategic value for the state. Striking these locations with disruptive attacks is likely to generate heavy economic costs, as the state must work to secure the location following an attack and repair damages.

Successfully attacking these locations also generates political costs for incumbents, who risk appearing weak in the eyes of the public.

Inter-city commerce serves as the mechanism linking roads and economic costs. In shaping the flow of human traffic and inter-city trade, roads present insurgents with numerous opportunities to carry out costly attacks against civilian targets. Commercial activity that is dependent on road infrastructure, for example, is particularly vulnerable to disruption by insurgent violence. Upswings in insurgent violence in a town often means that transport has to be delayed, canceled, or rerouted. Indeed, the economic effects of violence on everyday commercial activity can be staggering (Frey, Luechinger and Stutzer, 2007). Rebels can thus target towns with dense road infrastructure to impose heavy economic costs on the state.

In addition, commerce that relies on road infrastructure also presents insurgents with opportunities for disruptive tactics that involve looting: insurgents can engage in road-side piracy and the use of 'toll' road-blocks – where insurgents engage in armed robbery of commercial transport – as well as ransom kidnappings (Formisano, Sanchez and Solimano, 2005). Roads are an especially appealing settings to kidnap civilians in that they allow for quick capture and escape (Moor, Remijnse and Gómez, 2008).[3] Independent of the inter-city commerce mechanism, cities that are densely connected by road also present insurgents with opportunities to impose political costs on the state by striking military targets. In particular, towns with substantial road infrastructure present avenues for insurgents to carry out varied and difficult-to-detect ambushes on state forces and representatives (Outcomes, 2014). Such attacks can involve not just ambushes, but also the use of road-side explosive devices (Trebbi et al., 2017).

Evidence across a wide variety of cases is suggestive of the link between disruptive tactics and roads. In terms of using roads as a mechanism for disruption, *Hunde* rebels in the Congo have sought to block repair of a bridge by an international NGO in order to complicate navigation by state forces across territory (UN GoE, 2011). Similarly, using cross-national data Zhukov (2016) argues that weaker road infrastructure should lead to less violent rebel

[3]In Colombia, ransoms from kidnappings brought in hundreds of millions of dollars for the FARC between 1991 and 1999 (Netherlands, 2001).

actors, as their capabilities are severely limited in the process. In terms of the nexus between roads and looting, rebels belonging to Boko Haram have also been known to engage in roadside kidnappings, taking a number of Chinese subcontractors hostage in 2014 (Schouten and Bachmann, 2017). The Taliban have also historically taken to setting up protection rackets based on the strategic deployment of road blocks (on Oversight et al., 2010).

In sum, we expect that the interest of insurgents in carrying out disruptive attacks should be increasing in a town's level of road infrastructure. Attacking cities with higher levels of road infrastructure should be, all else equal, more disruptive to commercial activity given that road density implies a greater level of inter-municipal trade (Duranton, 2015). Similarly, towns dense in roads have more vantage points from which to attack and ambush state forces.

By contrast, the effects of the road system on rebel use of *territorial* tactics is less clear. While rebel groups might want to capture transportation hubs and other cities densely connected by road in order to challenge the state, insurgents hold little chance of capturing and defending these locations in most civil wars. Instead, the ability of rebels to expand their territorial control depends crucially on the distribution of popular support among rebel and state forces (Kalyvas, 2006; Balcells, 2016; Steele, 2011; Zhukov, 2015). Similarly, roads may help the state project power (Kilcullen, 2008), but they may also ease rebel movement and promote other sources of conflict (Schouten and Bachmann, 2017). As a result, we do not expect to observe a clear relationship between road infrastructure and territorial tactics.

- **Hypothesis**: *Insurgent disruptive tactics will increase in a city's level of road infrastructure.*

Insurgent Tactics in Colombia's Civil War

The Colombian conflict is one of the oldest in the world, beginning in the early 1960s as an asymmetric war between the Colombian government and various non-state armed groups (Karl, 2017). The largest and most active rebel groups throughout the majority of the conflict are the Revolutionary Armed Forces of Colombia (FARC) and the National Liberation Army (ELN), who led left-wing agrarian and urban insurgencies (respectively) against the state (Albertus and Kaplan, 2013). Throughout their tenure, guerrilla forces

have pursued a wide variety of military tactics against state, civilian, and competing non-state forces. These tactics include both conventional attacks and ambushes as well as acts of terrorism and destruction of civilian infrastructure.

The period under study is a particularly violent one in Colombian history (Echandía, 2006). Motivated by a variety of forces – including the growth of the coca trade and the formation of paramilitary armed groups – guerrilla groups pursued an aggressive military campaign in the 1990s and early 2000s. The guerrillas had numerous engagements with state forces, while also striking against key national infrastructure and ramping up their involvement in the drug trade and ransom kidnapping (Ortiz, 2002). Analysts have described this period of guerrilla warfare as an attempt to bring the government to the negotiating table via costly and disruptive attacks (Rabasa and Chalk, 2001, Chapter 4).

The FARC have pursued a wide variety of strategies throughout the armed conflict, and have employed both territorial and disruptive tactics. On the territorial front, FARC have often engaged the state in significant and sustained military confrontations to wrest control of territory during the period of study (Rabasa and Chalk, 2001). Moreover, the FARC have carried out selective targeting and mass displacement of civilians in certain parts of the country (Karl, 2017), as well as massacres (Angel, 2016). In terms of disruptive tactics, guerrilla forces have pursued a mix of attacks that include car bombings, forced strikes, and hit-and-run ambushes of armed forces (Rabasa and Chalk, 2001).

There is also evidence that roads have played a prominent role in guerrilla strategy. Even as late as 2013 the FARC carried out roadside ambushes against military targets (*FARC rebels kill 13 Colombian troops in ambush*, 2013). Many reports further document insurgents engaging in road-side kidnappings and armed extortions of civilian and commercial targets (*Risk Map for FARC Attacks on Oil Companies in South Colombia*, 2017; Jacobs, 1999). We also observe cases of insurgents directly attacking roads and bridges in order to create costly disruptions to economic activity (Welle, 2018).

Empirical Strategy and Data

We compile data for the project from a variety of sources. Data on disruptive tactics, including rebel-initiated attacks, rebel-initiated clashes with state forces, and ambushes come from CERAC's database of the Colombian armed conflict, one of the more widely used data sources to study the conflict (e.g.: Dube and Vargas (2013), Dube and Naidu (2015)). CERAC compiles data on over 20,000 war-related events across 950 municipalities between 1988 and 2005. The data is collected from news reports in 25 major newspapers, and supplemented by reports from a network of Catholic priests who have worked with NGOs to follow and document the war. Data are cross-checked against official sources, including that collected by the National Police and human rights organizations. Details on the data collection process are available in Restrepo, Spagat and Vargas (2006). We further leverage data on road-specific disruptive tactics, including road piracy, use of road blocks, and kidnappings from CEDE.[4] The Center for the Study of Economic Development (CEDE) at the University of the Andes hosts data on the armed conflict, collected from the Observatory of Human Rights of the Vice-Presidency of Colombia and is based on reports from the country's national security agency.[5] Finally, to measure *territorial tactics* we leverage data on FARC campaign offensives[6], collective homicides of civilians, and forced displacement of civilians (all from CEDE). These types of attacks are representative of insurgent territorial tactics discussed in the literature.[7]

Our key independent variable is the level of road infrastructure in a municipality, which we measure using data from Duranton (2015). Duranton (2015) provides data on three key

[4] Figure A.1 in the Appendix shows a few representative examples of the geographic variation of insurgent tactics.

[5] As with all event data, there are concerns about reporting bias (Davenport and Ball, 2002). While impossible to assuage these concerns fully, in using multiple data sources we follow others who have sought to minimize these concerns (Flores, 2014).

[6] Defined by CEDE as attacks whose objective is boosting or generating an advance on the group's offensive front.

[7] We characterize rebel-initiated attacks, clashes, and ambushes as disruptive tactics because they are not ostensibly about capturing and securing territory. Similarly, with the exception of kidnapping, road-based disruptive tactics impose costs on the state but do little to extend territorial control. We contrast these tactics with campaign offensives, collective homicides, and forced displacements which are explicitly about controlling civilian populations.

qualities of road infrastructure in a municipality in the year 1995: the number of major roads passing through the town; the number of road connections to neighboring towns; and the length (in kilometers) of road within the town. These qualities are all crucial to measuring the level of transportation infrastructure within a municipality, and importantly, as Table A.2 in the Appendix shows, these factors are all highly correlated. As a result, we leverage Principal Component Analysis to construct a latent road density variable.[8] In the appendix, we also present results for the baseline models following Duranton's strategy of combining these qualities into a composite index. The results are substantively similar.

A town's level of road infrastructure is, of course, not randomly assigned. As a result, we are limited in making strictly causal claims but employ a rich set of controls in order to better isolate the effects of road infrastructure levels on the varied insurgent behavior tactics we consider. To control for differences in municipal characteristics we include measures of municipal population, municipal GDP, a multi-dimensional poverty index, and altitude. In addition, to control for conflict-specific dynamics we include controls for coca cultivation, distance to the departmental capital, and a measure of paramilitary activity. Data on municipal characteristics comes from the National Statistical Agency (DANE), while the measure of paramilitary activity comes from CERAC. Finally, in our models that look at 'road looting' behaviors, we include an indicator of heightened police presence taken from Cortés et al. (2012).

In addition to our baseline models we also leverage two other sources of data from Duranton (2015) to further isolate the relationship between road infrastructure and rebel tactics in additional analysis. The first is an instrumental variables approach that leverages data on the length of roads (km) within Colombian municipalities in 1938 to instrument for contemporary road density. One concern with our baseline models is that the level of road density in a municipality could be endogenous to the armed conflict; the state might be unable to successfully build roads in places with high insurgent presence or, conversely,

[8]The results of the PCA provide good evidence of a latent road density construct in the first principal component. The standard deviation of the first principal component is 1.6, well over the commonly used threshold of 1 for retaining components. Further, the first component accounts for 85% of the common variance.

disproportionately focus road-building projects on towns with insurgent activity as part of a broader counterinsurgency strategy (Kilcullen, 2008).

The placement of roads in 1938, decades before the widely accepted start of the armed conflict, presents a plausible instrument for the contemporary road system. Road placement in 1938 was rudimentary and largely regional, meant to connect cities that were no more than 100 kilometers away (Duranton, 2015). The road system and broader country has changed significantly since 1938, with dramatic population growth and commerce in the latter half of the 20th century fueling inter-municipal road connectivity. It is plausible that the 1938 road system, developed under very different circumstances from the contemporary period, will have little to do with how insurgents in our time period behave strategically other than through its impact on the current road system. While the road system in 1938 may well have some effect on where the insurgency eventually *formed* (i.e., if lack of access to road infrastructure produces conflict-enhancing grievances), it is less likely to influence where and how insurgents choose to *attack* in our time period.

The second analysis uses a survey of transport shipments across Colombia that allows us to test a key mechanism in our theory bearing on inter-city commerce. To probe the plausibility of this argument, we employ causal mediation analysis using Data from the 2011 Commodity Flow Survey collected by the Colombian Ministry of Transportation (CMIT). To collect data for the survey, commercial trucks traveling on major Colombian roads are stopped at weight check stations, where they are asked about their origin, destination, and size of cargo. This survey allows us to measure the amount of inter-municipal trade originating from a municipality and test whether the amount of inter-municipal trade mediates the relationship between road density and insurgent behavior.

We fit a quasi-poisson count model to our outcomes unless otherwise specified, and we also consider zero-inflated negative binomial (ZINB) models. In all models, standard errors are clustered at the municipal level.

Primary Results

Here we present our baseline models for road density and insurgent activity. As expected, we find that road density has a positive and significant effect on the incidence of three different insurgent actions, including one-sided attacks, clashes, and ambushes (Table 1), even after controlling for a number of relevant covariates. These results are consistent with our claim that, in general, insurgents focus their disruptive efforts on towns that are more densely connected to the country's road network.

[Table 1 about here.]

Figure 1 plots the marginal effect of road density on each of the three outcomes. The pattern is similar and substantively large for guerrilla attacks and clashes. Ambushes are relatively rare events in the conflict event data, and the effects are more muted but still in the expected direction.

[Figure 1 about here.]

These baseline results are robust to a number of different specifications and empirical strategies. These include using road density data calculated from a more recent map of Colombia in 2010 (Table A.3), re-estimating the models using a zero-inflated negative binomial model (Table A.4), estimating a multilevel model with random intercepts at the municipal level (Table A.5), and estimating the effect of road density from the 1995 data on only the post-1995 sub-sample (Table A.6). They are also robust to including a spatial lag (Table A.7) (Beck, Gleditsch and Beardsley, 2006).

Next, we consider the effects of road density on modalities of road-specific disruptive attacks. These include road piracy, the use of road blocks, and ransom kidnappings. Across outcomes, Table 2 shows that the coefficient on road density is positive and significant. On average, insurgents are more likely to carry out these types of attacks in towns that are more densely connected to the road network. These results are also robust to using a spatial lag specification which accounts for a potential conflict diffusion effect (Table A.8).

[Table 2 about here.]

Figure 2 plots the marginal effect of road density on the three different road-based attacks. These types of attacks are, in the general context of the war, relatively rare types of actions. Even so, the effects of road density on road piracy and kidnappings appear substantial. The marginal effects of road density on the rarest event type (road blocks) is weaker and less certain.

[Figure 2 about here.]

The main results presented thus far are also robust to an instrumental variable approach using similar measures on the road system from 1938. We use the length of roads in a municipality from 1938 as an instrument for road density in the period of the conflict we are exploring. We find that the association between road density and guerrilla attacks is robust to the instrumental variable analysis(Table A.9).[9] We find further support for the instrumental variables approach in the context of road-based attacks (Table A.10). Results are substantively the same across the outcomes, significant at conventional levels for road piracy, at $p < .1$ for kidnappings, but no longer significant for road blocks.

As expected, we conversely do not find that road density significantly predicts insurgent territorial tactics (Table A.11 in the Appendix). This likely reflects the idea that rebels face high costs in attempting to capture these locations. Collectively the results suggest that road density produces a sharp division in the types of tactics insurgents use, promoting the use of disruptive tactics in particular.[10]

Commerce Mechanism.

Finally, we test whether inter-municipal trade plausibly mediates the relationship between municipal road density and insurgent tactics. Central to our argument is that insurgents

[9]We use two-stage least squares to estimate the instrumental variable model. Given the challenges associated with incorporating an instrumental variables approach to a count model, we instead estimate a linear probability model on the incidence/absence of guerrilla and road-based attacks (Dube and Vargas, 2013).

[10]The null on territorial tactics also assuages concerns that the disruptive/territorial distinction actually reflects an urban/rural divide in rebel behavior. If we expect that insurgents are more prone to use territorial tactics in rural areas than urban areas, and roads are positively correlated with urbanization, then we should see a negative association between territorial tactics and road density.

target towns that are more densely connected by road because roads imply a greater level of inter-municipal commerce. If true, the effect of road density on conflict should be mediated by the level of commerce passing through the town in question. We follow the approach described in Imai et al. (2011) for estimating average causal mediation effects (ACME) and average direct effects (ADE). Of course, neither road density nor commercial trade can be randomly assigned and as a result we cannot be certain that sequential ignorability is satisfied; we thus present this evidence as suggestive of the mechanism in our argument.

For the mediating variable, we use the survey of transport shipments and calculate average shipment weight (in thousands of tons, logged) originating from a municipality. Here, 'treatment' is municipal road density, where the 'control' condition is the level of road density in the first quartile of the road density distribution and 'treatment' condition is the level of road density in the third quartile. As the analysis is meant to be suggestive, we focus on the most general outcome of interest: guerrilla attacks. Table 3 provides positive evidence of commerce mediating the relationship between road infrastructure and insurgent attacks. The ACME is positive and significant at conventional levels, accounting for a moderate proportion of the total effect of roads on guerrilla attacks.[11] This suggests that part of the way roads structure rebel behavior is via the effect they have on trade and commerce. By easing the movement of commercial traffic across a country's territory, roads shape where rebels stand to gain the most from carrying out disruptive attacks.

[Table 3 about here.]

Conclusion

Conflict scholarship has long recognized that terrain, access to resources, patterns of civilian support, and a host of other factors shape *how* wars are fought. In this paper, we propose that transportation infrastructure figures importantly into how rebel forces think about war tactics. We argue that insurgents seeking to impose high costs on the state focus their attacks on cities with higher levels of road infrastructure, as this makes their attacks more

[11] In this case, the outcome model is nonlinear, leading the ACME and ADE estimates to differ slightly between treatment and control conditions (Imai et al., 2011).

disruptive while also providing avenues to engage in looting. We leverage a rich and varied set of data to test the implications and mechanisms of our argument and find supportive evidence for our claims.

Two central points emerge from our findings that are relevant to the study of civil war tactics and dynamics. The first is that, while extant literature has spent considerable attention on understanding how armed actors contest territorial control and pursue conquest (Kalyvas, 2006; Steele, 2011; Balcells, 2016), much more attention needs to be paid to the work of disruption that insurgents typically engage in. In the classical model of guerrilla warfare, insurgents may not have strong expectations of being able to seriously contest and wrest control from the state (Taber, 1965). Instead, insurgents often pursue a war of attrition in hopes of turning popular support against the state, bringing it to the negotiating table, or other political goals short of conquest. Our project adds to a growing body of work seeking to understand the logic of disruptive violence (Condra et al., 2017; Trebbi et al., 2017).

The second point pertains to the broad and often contradictory literature on the nexus between roads, development and conflict. Much of the work in this vein argues the effect of transportation infrastructure on the incidence of violence occurs via the conflict-enhancing effects of poor infrastructure on grievances and worsened civilian life outcomes. We argue that in addition to these concerns, scholars and practitioners must think more seriously about how transportation infrastructure impacts conflict dynamics in already-existing conflicts. That is, roads do not just shape conflict-initiation, but also how conflict dynamics play out. These assertions are reflected in a growing body of research exploring roads and transportation logistics in the fighting of subnational conflicts (Zhukov, 2012; Toft and Zhukov, 2012; Hammond, 2018).

We are, of course, limited in the strength of our assertions by the observational nature of our data. However, our approach points the way forward for multiple avenues of future research. First, research that is able to exploit exogenous *changes* in the level or quality of subnational road infrastructure may shed more light on the nature of the roads-violence

nexus. One possibility is to consider variation in exposure of transportation infrastructure-boosting development programs in conflict-afflicted countries. Second, researchers could use geo-located conflict data and analyze events taking place specifically on roads, such as ambushes, or the looting behavior described here. Finally, future work should bridge extant research on the role of roads in territorial conquest (Zhukov, 2012; Hammond, 2018) with work on the relationship between conflict and illicit flows. If the production and movement of illicit trade requires that illicit actors hold particular points in a country's road network (Dell, 2015), then this should have broader implications for the behavior of armed actors in civil wars.

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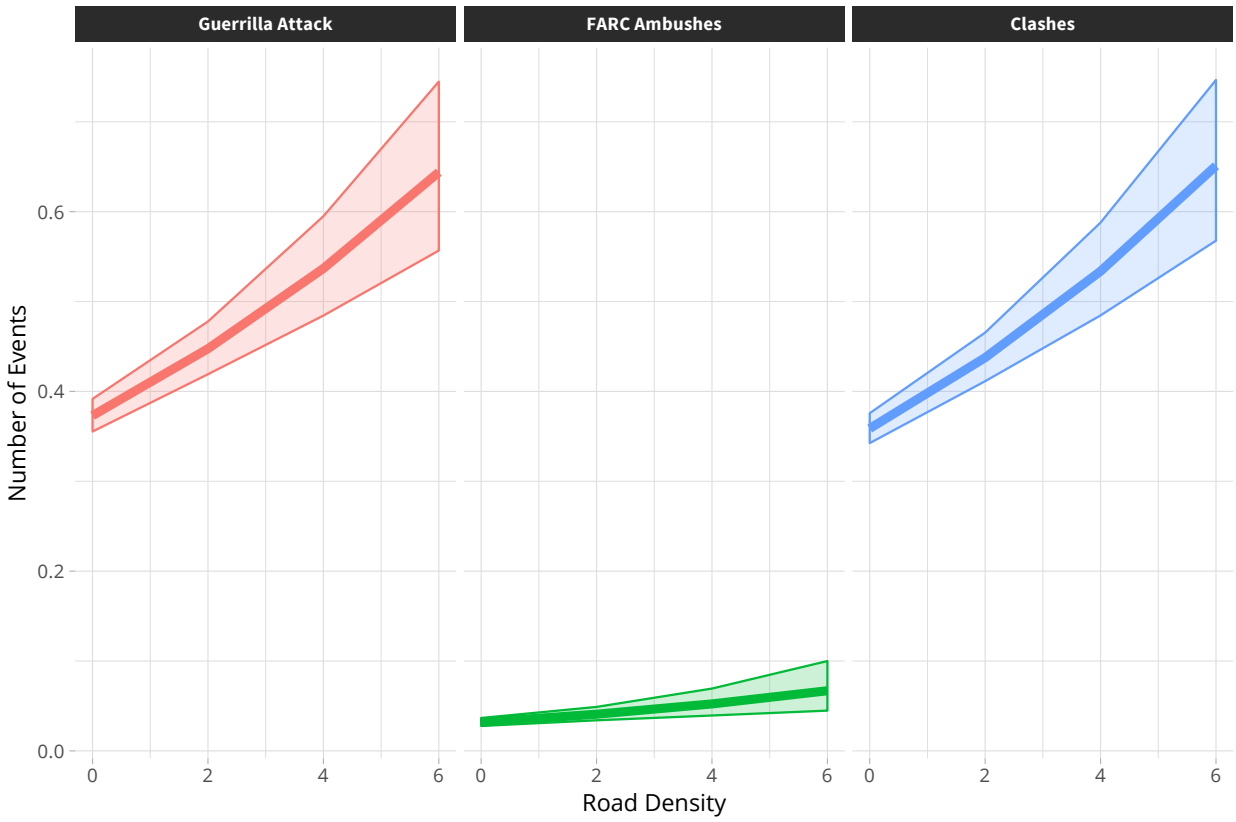

Figure 1. Marginal effect of road index on the number of violent events by type.

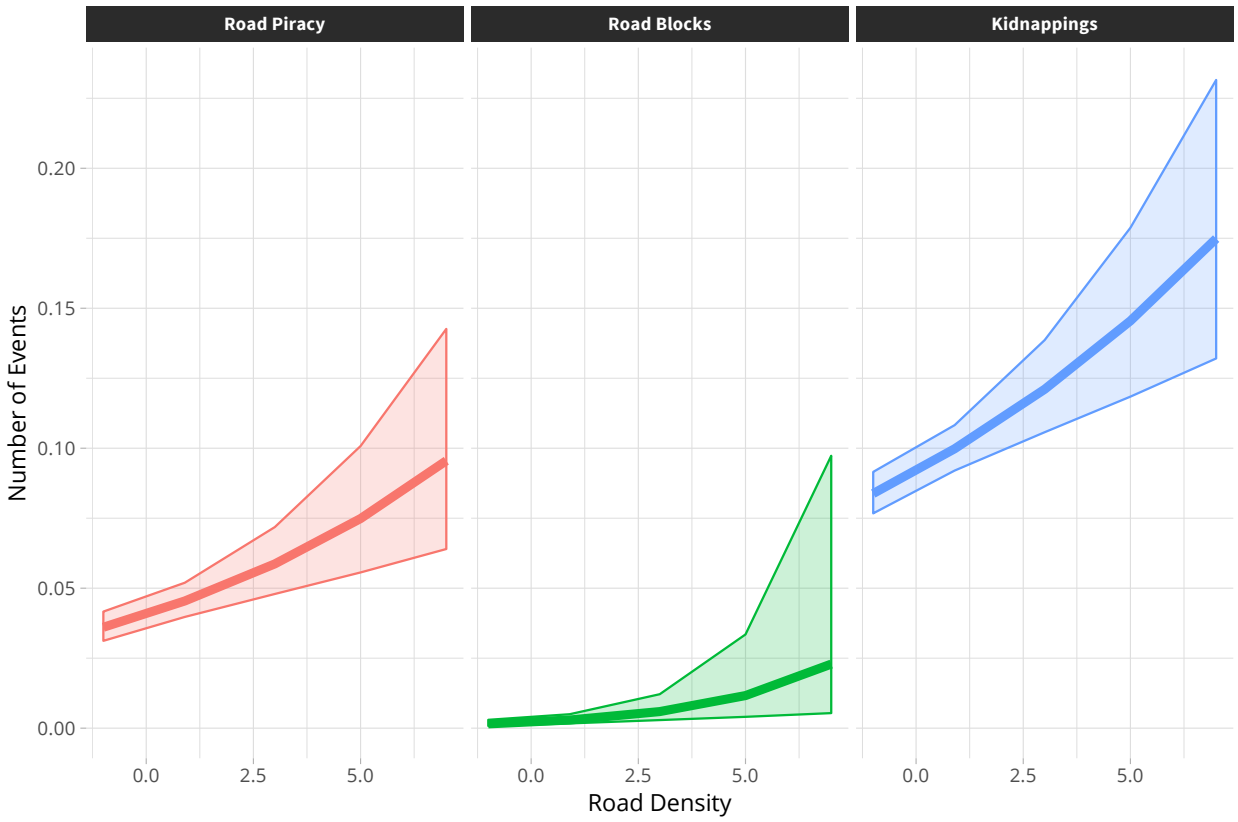

Figure 2. Marginal effect of road index on the number of violent events by type.

Table 1. Road density models. Standard errors clustered at the municipal level.

	Guerrilla Attacks	Clashes	FARC Ambushes
Intercept	-0.193	-0.427	-2.805^{***}
	(0.756)	(0.482)	(0.606)
Road Density	0.074^{**}	0.089^{***}	0.120^{*}
	(0.032)	(0.031)	(0.065)
Altitude	0.079^{**}	0.035	0.110^{**}
	(0.038)	(0.033)	(0.044)
Distance to Bogota	-0.0001	-0.001^{***}	-0.0002
	(0.0004)	(0.0003)	(0.001)
Municipal GDP/Cap	0.028^{***}	0.020^{***}	0.016
	(0.008)	(0.007)	(0.013)
Coca (Index)	0.050	0.078^{***}	0.250^{***}
	(0.042)	(0.026)	(0.054)
Population	0.735^{***}	0.715^{***}	0.748^{***}
	(0.086)	(0.067)	(0.123)
Poverty Index	0.024^{***}	0.035^{***}	0.026^{***}
	(0.004)	(0.004)	(0.006)
Paramilitary Attacks	0.379^{***}	0.363^{***}	0.248^{***}
	(0.035)	(0.037)	(0.065)
N:	16902	16902	12201
Notes:	$^{***}p < .01$; $^{**}p < .05$; $^{*}p < .1$		

Table 2. Rebel road looting models. Standard errors clustered at the municipal level.

	Road Theft	Road Blocks (count)	Road Blocks (binary)	Kidnappings
Intercept	-2.137^{***}	-4.792^{***}	-5.588^{***}	-1.058^{**}
	(0.640)	(1.312)	(1.281)	(0.462)
Road Density	0.124^{***}	0.338^{*}	0.244^{**}	0.093^{***}
	(0.046)	(0.185)	(0.112)	(0.034)
Altitude	0.111^{**}	-0.018	0.046	0.060
	(0.055)	(0.121)	(0.120)	(0.041)
Distance to Bogota	-0.0005	-0.001	-0.0003	-0.001^{**}
	(0.001)	(0.001)	(0.001)	(0.0004)
Municipal GDP/Cap	0.034^{***}	0.014	0.035^{*}	0.021^{***}
	(0.010)	(0.035)	(0.021)	(0.008)
Coca (Index)	0.172^{***}	-0.393	-0.295	-0.061
	(0.032)	(0.482)	(0.356)	(0.062)
Population	0.951^{***}	0.565^{**}	0.714^{***}	0.668^{***}
	(0.118)	(0.230)	(0.269)	(0.070)
Poverty Index	0.031^{***}	0.020	0.027^{*}	0.019^{***}
	(0.006)	(0.014)	(0.015)	(0.004)
Police Reinforcement	0.970^{***}	-0.030	0.227	0.313^{*}
	(0.237)	(0.672)	(0.700)	(0.184)
N:	12201	12201	12201	12201

Notes: $^{***}p < .01$; $^{**}p < .05$; $^{*}p < .1$

Table 3

Statistic	Estimate	95% CI Lower	95% CI Upper
ACME (control)	0.020	0.010	0.020
ACME (treated)	0.020	0.010	0.030
ADE (control)	0.090	0.040	0.130
ADE (treated)	0.090	0.040	0.140
Total Effect	0.110	0.060	0.150
Prop.Mediated (control)	0.150	0.090	0.320
Prop.Mediated (treated)	0.180	0.110	0.350
ACME (average)	0.020	0.010	0.020
ADE (average)	0.090	0.040	0.130
Prop.Mediated (average)	0.160	0.100	0.340