The Non-Linear Effect of Mass Media on Civil War Onset

Current research on the relationship between mass media and civil war onset is puzzling. From Rwanda and Yugoslavia in the early 1990s to Libya and Syria in 2011, civil wars often involve the use of mass media for belligerent purposes (Hubbard and Saad 2014; Kirkpatrick 2011; "Roads Sealed as Yugoslav Unrest Mounts" 1990; Simons 2002). While some scholars argue that mass media play a causal role in the outbreak of civil wars (Brass 1997; Des Forges 1999; Gagnon Jr 1994; Kellow and Steeves 1998; Metzl 1997; Tambiah 1996), others have argued that the negative effects of mass media have been overstated (Paluck 2009; Straus 2007). Making the puzzle even more acute, the most systematic evidence to date suggests that mass media induce satisfaction with the status quo (Kern and Hainmueller 2009) and decrease the likelihood of civil war onset (Warren 2014). Yet, as Figure 1 illustrates, at the global level the exponential increase in mass media beginning in the 1950s coincides with a similarly dramatic increase in civil wars at the global level.[1] If mass media decrease the probability of civil war, it is puzzling that the proliferation of mass media since the 1950s coincides with a surge in civil war prevalence beginning in the 1960s.

This research note advances a novel theoretical proposition on the relationship between mass media and civil war which accounts for previous qualitative findings of mass media fomenting civil war onset as well as recent quantitative evidence that mass media decrease the probability of civil war onset. Paradoxically, it is precisely because dense mass media systems strengthen the state that the first appearance and early spread of mass media within a country should *encourage* insurgencies. When mass media spreads enough within a country to constitute a mass communications system, this triggers communicative

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[1]For a description of the variables see Data and Method below.

economies of scale which so increase the payoffs of controlling the state that it incentivizes violent insurgency before the *ex ante* holders of state power become normatively locked-in and effectively impossible to challenge.[2] A key point of my account, however, is that the economies of scale peculiar to information production within a mass communications system represent a qualitative change which occurs only when the spread of mass media crosses a certain threshold. This is why there is an inflection point at which the effect of mass media should change from positive to negative beyond a certain level of mass media density. The counter-intuitive implication is that the very pacifying effect of a mass communications system charges the early spread of mass media with a bellicose effect until the threshold of mass communications is crossed.

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[2]As discussed below, beyond a certain threshold of mass media the probability of observing a civil war is effectively zero.
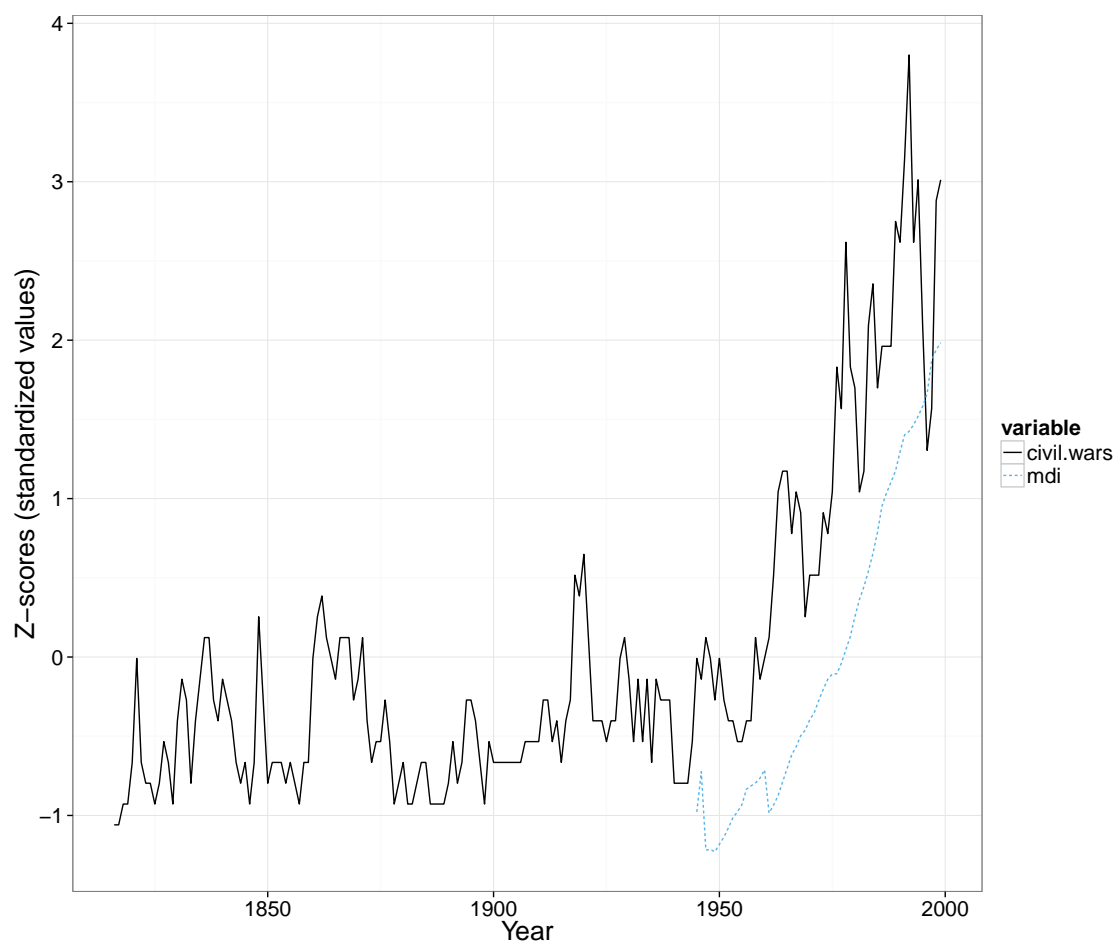
Figure 1: Mass Media Density and Civil Wars Globally, 1816-1999

To compare the non-linear, war-before-peace theory to the linear, general pacification theory, I generate causal leverage by deducing two new observable implications at two levels of analysis, within and outside the original sample used in the most recent and systematic study on this question (Warren 2014). I use a combination of parametric and semi-parametric regressions to compare linear and non-linear model fits on the original sample. I then consider long-term historical time-series at the international level, to examine whether the war-before-peace theory helps explain the empirical pattern of civil war prevalence at the international level.

The implications of this research note are twofold. First, this research note contributes to the project of building "rich theory" for the new and burgeoning research agenda on the ICT and political conflict nexus (Lyall and Dafoe 2015), demonstrating in particular the importance of non-linearities in this area.[3] Second, it contributes novel evidence regarding one important driver of civil war onsets, substantially revising the conclusion of a recent study and helping to explain one of the most lethal dynamics in the world since World War II: the increase in civil wars around the world beginning in the 1950s and 1960s (Fearon and Laitin 2003, 75).

This research note proceeds as follows. The first section provides a brief summary and critique of the general pacification theory, providing the basic rationale for why we should expect the relationship between mass media and civil war onset to be non-linear. The second section states the non-linear, war-before-peace theory and deduces two observable implications which are mutually exclusive with the general pacification theory. The third section explains the data sources, variables, and modeling strategy. A fourth section discusses the

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[3]Lyall and Dafoe advocate that research on the ICT and political conflict nexus should be increasingly "elaborate," focusing on the highly conditional effects of ICT, developing theories grounded in well-established findings, and tested for multiple observable implications. In particular, they highlight that for some causal processes, "Effects may not arise until some culminating point is reached," and they "may change in sign over time, as actors strategically adapt to their new information environment" (Lyall and Dafoe 2015, 3–4).

results and a fifth section concludes.

A Critique of the General Pacification Theory of Mass Media and Civil War

Many scholars of the modern nation-state have argued that by allowing political elites to communicate with subjects across large territories, the emergence of mass media technologies was a crucial condition for the emergence of the modern nation-state (Anderson 1983; Deutsch 1953). Within this tradition, contemporary political scientists often conceptualize mass media technologies as instruments which increase the state's "soft power" to induce loyalty and symbolic attachments (Keohane and Nye 1998; Nye 1990, 168–69, 2004, 47–48). Issuing from this perspective, one recent article argues that by increasing the state's communicative power, mass media deter potential insurgencies and therefore decrease the probability of civil war onset (Warren 2014).

According to Warren, technologies such as televisions, radios, and newspapers decrease the probability of civil war onset because they increase the state's communicative power more than the communicative power of potential challengers. While mass media technologies lower the costs of communication for the state and potential challengers alike, mass media technologies increase the normative influence of the state in particular because of economies of scale which are unique to the production of normative influence. Because a media message achieves a larger effect on receivers who believe the message was widely disseminated, the production of normative influence through mass media brings increasing marginal returns for each additional unit of effort, as each additional recipient receiving the message increases the effect of the message on the rest of the receivers. Because the state is inherently a larger-scale producer of symbolic content than potential insurgent groups, higher levels of mass media are expected to make stronger states and therefore lower the

probability of observing civil war.

Using state-level data for a large panel of countries from 1945 to 1999, Warren constructs a media density index (MDI) on a country-year basis capturing the total number of televisions, radios, and newspapers per 100 people.[4] Warren demonstrates that, after controlling for other predictors of civil war, mass media density is associated with more than a tenfold decrease in the likelihood of observing civil war in a particular country-year.

The general pacification theory has two key logical shortcomings. First, the unique logic of mass communications which is expected to benefit the state's inclusive national appeals more than insurgents' divisive appeals should not be linearly increasing with mass media density but should rather be contingent on a certain threshold of mass media density. To the degree mass media simply lower the costs of communication, they empower insurgents no less than the state (Warren 2014, 120). The crucial reason why mass media disproportionately amplify the normative influence of the state (why there are increasing marginal returns to the production of influence) is that receivers believe the message is widely spread (Chwe 1998, 2001; Mutz 1998), that mass media messaging is "known by all to have been seen by all" (Warren 2014, 120). The key point is that at very low levels of mass media density there is no reason one receiver of a message should be impressed by a very small number of others who may have received the message. Only after a certain threshold or "tipping point," at which a "critical mass" of receivers are expected to receive mass media messaging, should there be increasing marginal returns to the production of influence. National situations in this post-threshold situation I refer to as "mass communications systems." National situations below this threshold I refer to as "pre-mass communications systems."

Increases in mass media density only uniquely benefit the state's production of influence and therefore decrease the likelihood of civil war beyond the threshold at which mass

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[4]The measure is discussed in greater detail below.

media technologies are sufficiently widespread to effectively constitute a mass communications system.[5] When only a very small proportion of the population has access to mass media technologies, those technologies do not imply the presence of a mass communications system at merely low levels; they imply a country which still categorically lacks the infrastructural capacity for properly mass communications.[6]

Second, if the level of mass media increases state strength, then the *first appearance and early growth* of mass media within a country should increase the utility of controlling the state relative to other means of influencing it. The first appearance of mass media technology should increase the incentives of opposition groups to risk insurgency before the development of a mass communications system significantly increases the power of the incumbent and decreases the power of opposition groups outside the state. The closer a country's mass media density is to the threshold at which it will constitute a capacity for mass communications, the more attractive it will be for opposition groups outside the state to gain control of the state. It is increasingly urgent as the state becomes nearer to consolidating its normative power via mass communications and therefore significantly less vulnerable to insurgency; also, the closer a country is to the threshold the less time will a successful insurgency be vulnerable to yet another insurgency before its own normative power is consolidated by a mass communications system. Thus, if it is true that increasing mass media density makes state power increasingly safe from insurgency, then before media density crosses the threshold of constituting mass communications power, each increase in mass media density should further increase the payoffs to violent insurgency.

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[5]I assume throughout that mass media typically first appears within countries at very low levels relative to the population (low media density). I also assume throughout that, despite variable rates of change and short-run decreases, media density has a long-run tendency to increase. In other words, I assume that the dynamics of media density are non-stationary and trend upward. The Levin-Lin-Chu (2002) and Im-Pesaran-Shin (2003) tests for stationarity in panel data fail to reject the null hypothesis that media density is non-stationary ($p = 0.7473$ and $p = 0.1$, respectively). See Supplementary Information for details.

[6]There is no way to know *a priori* how many people need access to mass media technologies before they constitute a mass public network and therefore the categorical presence of a mass communications system. The question is pursued empirically below.

A Non-Linear Theory of Mass Media and Civil War

This section advances a modified theory of the relationship between mass media technology and civil war: while high levels of mass media density should indeed decrease the likelihood of civil war by increasing state power and deterring insurgents, for this very reason the *introduction and early growth* of mass media density within a country should *increase* rather than decrease the likelihood of civil war. Precisely because a capacity for mass communications increases state power and becomes a robust deterrent against insurgents, but low levels of mass media density do not yet constitute that power, year-to-year increases in mass media density up to a certain threshold should be positively associated with civil war onset. It is only beyond that threshold that a negative relationship between mass media density and civil war should hold.

To test whether this modified theory is preferable to the original, general pacification theory, I deduce two distinct observable implications which are mutually exclusive with the original theory, increasing causal leverage by exposing the new, modified theory to new opportunities for falsification (Ging King, Keohane, and Verba 1994, 30). If the modified, non-linear theory is correct, then each of the following should be true:

Hypothesis 1: There should exist a threshold of mass media density below which year-to-year increases in mass media density *increase* the probability of civil war. This implication flows directly from the logical critique of the original theory: If a system of mass communications constitutes a significant increase in the soft power of states and makes insurgency significantly more difficult, then every increase in mass media density (the dynamics of which are non-stationary and upward-trending) incentivizes insurgency without yet increasing the risks.

Hypothesis 2: Given that mass media density increased markedly after World War II from near-zero levels as measured at the international level, year-to-year increases in mass

media density at the international level should be associated with increases in the quantity of civil wars at the international level. On the contrary, if the general pacification theory is correct, then year-to-year increases in media density around the world should be associated with a decrease in civil war onsets, controlling for other determinants of civil war onset. Note, however, that the war-before-peace theory is consistent with the general pacification theory in the expectation that mass media density in the long run has a pacifying effect on the likelihood of civil war onset, after controlling for the bellicose implications of year-to-year changes.

Data and Method

The first investigation for H1 uses the replication data from Warren (2014), a panel dataset of country-level variables covering 175 countries over a maximum of 55 years in the period 1945-1999. As the variables used in the present analyses follow the original analyses as closely as possible, for the sake of consistency and comparison, readers may consult the original article for a more detailed discussion of the data. Briefly, the dependent variable in all analyses is *CIVIL WAR ONSET*, which takes a value of 1 for all country-years in which a civil war begins and zero otherwise. Civil wars are defined, following Sambanis (2004), as any armed challenge to state sovereignty with explicit political objectives, local recruits, and more than 500 deaths in the first year or more than 1,000 deaths within the first three years. The main indepdendent variable is *MDI,* which captures overall mass media density, or the total number of newspapers, televisions, and radios per 100 people. A battery of control variables which are believed to be associated with civil war onset include the following. *OIL EXPORTER* takes a value of 1 if greater than one-third of a country's total export revenus are from fossil fuels. *DEMOCRACY* is the traditional measure from the well-known Polity IV data set, on a scale from 1-21. *DEMOCRACYˆ2* is the square

DEMOCRACY, to control for the possibility of non-linear effects. *PEACE YEARS* counts the number of years since a previous civil war, and a natural cubic spline of peace years to control for temporal dependence. Finally, *GDP PER CAPITA*, *ETHNIC FRACTIONAL-IZATION*, *RELIGIOUS FRACTIONALIZATION*, and logarithms for *LAND AREA*, *MOUN-TAINOUS TERRAIN*, and *POPULATION* complete the main battery of controls dictated by previous research and employed in the original analyses. Also following the original analyses, all independent variables are lagged by one year.

Regarding Hypothesis 1, the typical procedure for testing the presence of curvilinear effects is to include in regression analysis a polynomial of the independent variable of interest; if both the linear term and the polynomial are differently signed and significant, it is taken as evidence of a curvilinear effect. The first problem with this convention is that it does not effectively inform us about the thresholds for the independent variable's heterogenous effects, and indeed is typically used as a substitute for having to do so. More importantly, however, parametric estimates can fail to detect important curvilinear effects (Frölich 2006). On the other hand, nonparametric regressions are significantly less theoretical and less parsimonious and therefore less valuable for theory testing.

To balance these trade-offs, analysis begins with a combination of simple graphical analysis and semi-parametric regression to test for the presence of a threshold at which the effect of mass media density changes, and then traditional parametric regressions will provide additional tests and more convenient estimates of effect sizes. For the semi-parametric regresion, I estimated a Generalized Additive Model (GAM) such that the effect of mass media density is estimated via nonparametric smooth but all other predictors are estimated traditionally. Estimation via non-parametric smooth allows for the maximum-likelihood estimate of a traditional logistic regression to inductively identify curvature in the relationship between the independent and dependent variable; the smoothness of the curves is determined by penalized regression splines which are estimated to maximize likelihood. While

the GAM model with non-parametric smoothing is a well-established tool for testing non-linear hypotheses, it is not readily interpretable because it lacks a parameter (coefficient) which could straightforwardly represent a hypothesized effect. Thus, a simple analysis of variance (ANOVA) is used to test whether a non-linear fit of mass media density better explains variation in civil war onset than a linear fit; and graphical visualization of the smooth terms will be used to further understand the threshold at which mass media density constitutes a mass communications system. If a non-linear fit of mass media density is superior to a linear fit and the graphical inspections reveal a non-trivial subset of civil war onsets increasing in mass media below an identifiable threshold at which mass media density is robustly associated with decreasing probability of civil war, this would represent evidence for Hypothesis 1.

To further explore Hypothesis 1, the analysis replicates a baseline model from Warren's original analysis (2014) and tests whether the pacification effect is observed even within the subset of country-years characterized by mass media density levels below the threshold (if any) identified in the first analyses. If Hypothesis 1 is shown to be consistent with the data in the first stage of analyses, it will be expected that the pacification effect of mass media density will not hold within the subset of country-years below the threshold at which it constitutes a mass communications system. On the contrary, the expectation advanced by the war-before-peace theory is that year-to-year increases in mass media density will *increase* the likelihood of civil war onset rather than decrease it.

Hypothesis 2 seeks causal leverage from a level of analysis distinct from the level at which the original theory was tested (country-level). Additionally, Hypothesis 2 permits examination of a substantially expanded historical range because for many of the key variables data are available beginning from the early nineteenth century. For the dependent variable, the Correlates of War data provide a comprehensive record of all intra-state wars since 1816. The Polity IV measure of democracy, discussed above, covers many coun-

tries as far back as 1800 and is commonly used for international-level estimates. For the other key determinant of civil war onset, GDP per capita, the Maddison Project provides widely-used estimates for all countries as far back as possible, in many cases extending well before 1800 (Bolt 2013). Finally, while no general measure of mass media density is available before 1945, I exploit a pecularity of television diffusion to reliably and substantially extend its time-series. Because the international mean for television density is zero in the earliest two years available (1945 and 1946) and the time-series of television density is an integrated (unit-root) process which trends upward, the international mean for television density in every year prior to 1945 is highly likely to be zero. Thus, I construct an historically-extended international-level variable for *TV* equivalent to the one discussed above but which takes a zero for all years prior to 1945.

To test Hypothesis 2, I estimate a series of regressions using the negative binomial distribution for count data, where the dependent variable is the total count of civil war onsets in the international system each year. One drawback to this strategy is that several of the other control variables in the main regressions are not available for such a long historical period and their omission could lead to biased or spurious estimates. Fortunately, there are several good reasons why the threat of omitted variable bias is outweighed by the leverage gained by testing these hypotheses at the international-level and with an elongated time-series. First, the variables related to physical geography such as *OIL EXPORTER*, *LAND AREA* and *MOUNTAINOUS TERRAIN* are unlikely to vary appreciably because, while in principle they can vary from changes in the number or size of states, they refer to quantities which are ultimately fixed at the international level. Second, while variables such as *RELIGIOUS FRACTIONALIZATION* and *ETHNIC FRACTIONALIZATION* are likely to have varied since 1816, a far greater proportion of their variance is likely to be cross-sectional and therefore irrelevant to modeling civil wars at the international level. Third, if one re-estimates the original models from the 1945-1999 period with only the democracy variables

and GDP per capita as the only control variables, the estimates are not substantially different than the full models with all controls, suggesting that time-series analysis excluding these variables is still a credible strategy for hypothesis testing. The fourth key reason why these risks of omitted variable bias are not prohibitive is that the theoretical and subsantive gains of extending the original sample to a long-run historical time-series analysis are great: theoretically it is necessary because the arbitrarily truncated nature of the original sample does not contain enough information regarding the key relevant comparison (namely, the difference between positive and zero mass media density), substantively because the most politically salient and puzzling stylized fact about civil war is its far greater prevalence in the period 1945-1999 compared to the previous period of modern world history.

Another drawback to this strategy is that considering only television density apart from newspaper and radio density may fail to capture mass media density in general. However, first, television density is highly correlated with mass media density (r = 0.9108). Second, television plausibly is subject to the greatest economies of scale among the three components of mass media density, which means it should be the most pacifying of the three. Therefore, it should be a relatively harder test of the war-before-peace theory than mass media density in general. If mass media density truly has a monotonic pacifiying effect on the likelihood of civil war rather than the non-linear effect hypothesized here, then a long-run time-series analysis of television density should be more likely to suggest monotonic pacification than mass media density in general. If the war-before-peace effect is observed, it would be stronger evidence of the hypothesis than would be a general index of mass media density. For these reasons, relying solely on television density to test Hypothesis 2 is a reasonable and conservative solution to the lack of historical time-series reflecting newspaper and radio density.

Modeling the international-level dynamics of civil war onsets, I also include controls for global events likely to shape the likelihood of civil war onsets. The variable *STATES*

controls for the number of states in the international system in each year (Correlates of War Project 2011) to control for the possibility that civil war prevalence is shaped by the number of units subject to the possibility of civil war. *WWI* is a dummy variable for the years 1914-1918, *WWII* is a dummy variable for the years 1939-1944, and *Cold War* is a dummy variable for the years 1947-1991. Finally, to check that results are not dependent on the years in which a value of 0 is imputed to televison density, I include the variable *IMPUTED* which is a dummy variable for all years before 1945. All dummy variables take a value of 1 when they are equal to the condition they state, and a value of 0 otherwise. A lagged dependent variable on the right-hand side of the regression equation controls for autocorrelation.

Analysis

To gain a better sense of the bivariate relationship between mass media density and civil war onset, while keeping the distributions in perspective, Figure 2 displays four violin plots (Hintze and Nelson 1998; Kastellec and Leoni 2007). The violin plots on the left display the distribution of mass media density for all country-years in which there is no civil war onset, while the violin plots on the left display the same distribution for all country-years in which there is a civil war onset. The violin plots in the top half of the figure are scaled by the total count of cases for all country-years whereas the plots in the bottom half are scaled with respect to the count of cases within each distribution. Each plot contains three points which indicate the 25th percentile, median, and 75th percentile within each distribution.
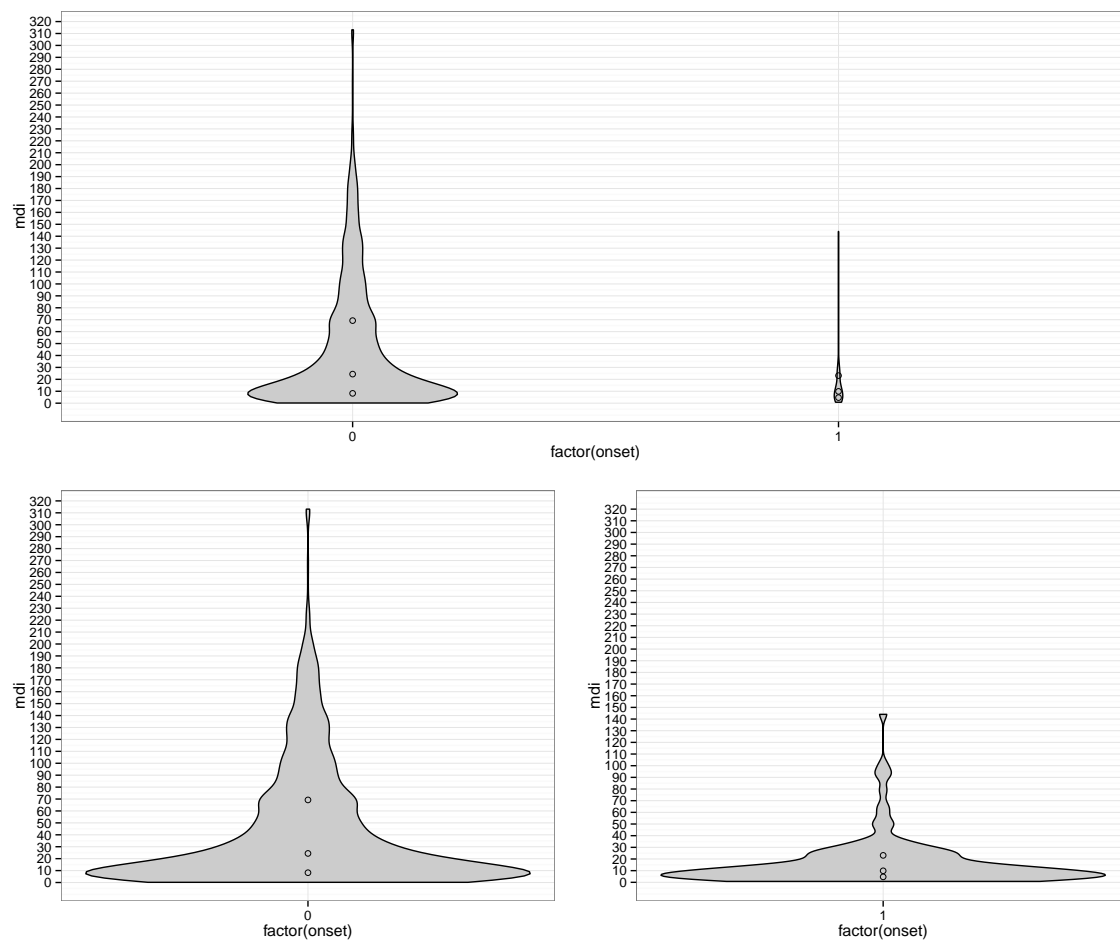
Figure 2: Violin plot of media density for all civil war onsets

These plots illustrate three important facts about the distributions of civil war onset and mass media density in this sample of countries between 1945-1999. First, these distributions challenge a key rationale for questioning the qualitative evidence that mass media plays a causal role in generating civil war onsets. Warren argues that those cases in which mass media are known to have played a significant role in civil war–cases such as Yugoslavia and Rwanda in the early 1990s (MDIs of 40.5 and 6.3, respectively) are unrepresentatively low levels of mass media density (Warren 2014, 132). Warren argues that because analysts have effectively selected these cases on the dependent variable, they "observe mass communication behavior only in those countries that are experiencing the outbreak of large-scale civil conflict" (Warren 2014, 132). The implication is that the positive association between mass media and civil war established by previous qualitative research is spurious and that "expanding our focus to the full universe of cases reveals quite a different picture" (Warren 2014, 123).

Illustrating the entire distribution of the full universe of cases, however, Figure 2 illustrates that cases such as Yugoslavia and Rwanda are indeed fairly typical country-years in the period 1945-1999. While it is true that in these cases mass media density is below the global average *in that year*, these cases bracket the global median of MDI (23.924) by less than half of one standard deviation (25.9347) on either side. Thus, some of the well-known cases which illustrate the bellicose effects of mass media are indeed highly representative of MDI levels globally in the post-war period until 1999.

Second, if there is a problem of unrepresentativeness it is that the extreme right-skew of MDI in peaceful country-years may drive a disproportionate amount of the negative association between levels of MDI and civil war. Figure 2 illustrates that no civil war has ever been observed in any country-year characterized by MDI greater than roughly 150, but these are highly unrepresentative cases (in the 94% percentile). This is important because it indicates that estimates of the relationship between mass media and civil war may be driven

by a minority of cases with uncommonly high values on the independent variable, leading to misleading inferences.

Finally, civil wars are most frequently observed at low but positive levels of MDI compared to the zero level. This is contrary to what we would expect from the general pacification theory; if the relationship between MDI and civil war onset is negative and monotonic, we would expect civil wars to be more frequent at the zero level of mass media density. Rather, the distribution suggests the possibility of non-linearity at low levels of mass media density, precisely as predicted by the war-before-peace theory.

Considering Non-Linearity with Semi-Parametric Regression

To test whether mass media density has a non-linear effect on civil war onset, this section compares the fit of a baseline logistic regression replicated from Warren (not displayed) with an additive semi-parametric regression model identical in every respect except that the effect of MDI is estimated with a nonparametric smooth allowing it to vary at different levels of MDI. Specifically, I estimate the model

$$Onset_{it} = \alpha + f_1(LogMDI_{it}) + Controls_{it}\beta + \varepsilon_{it}$$

where the partial-regression function $f_1(\cdot)$ is fit by a smoothing spline (Fox 2002; Wood 2000) and $CONTROLS_{it}$ is the vector of control variables used in Warren's original models. The number of smoothing splines is determined by generalized cross validation as part of the estimation procedure.[7]

Figure 3 plots the value of the smooth terms for each level of the logarithm of MDI, i.e. the estimated effect of the logarithm of MDI on the probability of civil war onset across its range. The result is consistent with Hypothesis 1: MDI is positively associated with

[7]The model was estimated using the function *gam* in the *mgcv* package for R.

civil war onset up to a threshold, the estimated effect slightly increasing up to that threshold, before changing direction and decreasing. To determine whether the non-linear fit is superior to the linear fit, a simple analysis of variance (ANOVA) can be used to contrast the deviance of each model. Table 1 displays the results, which suggest that the non-linear fit reduces the deviance by 18 and is statistically significant.
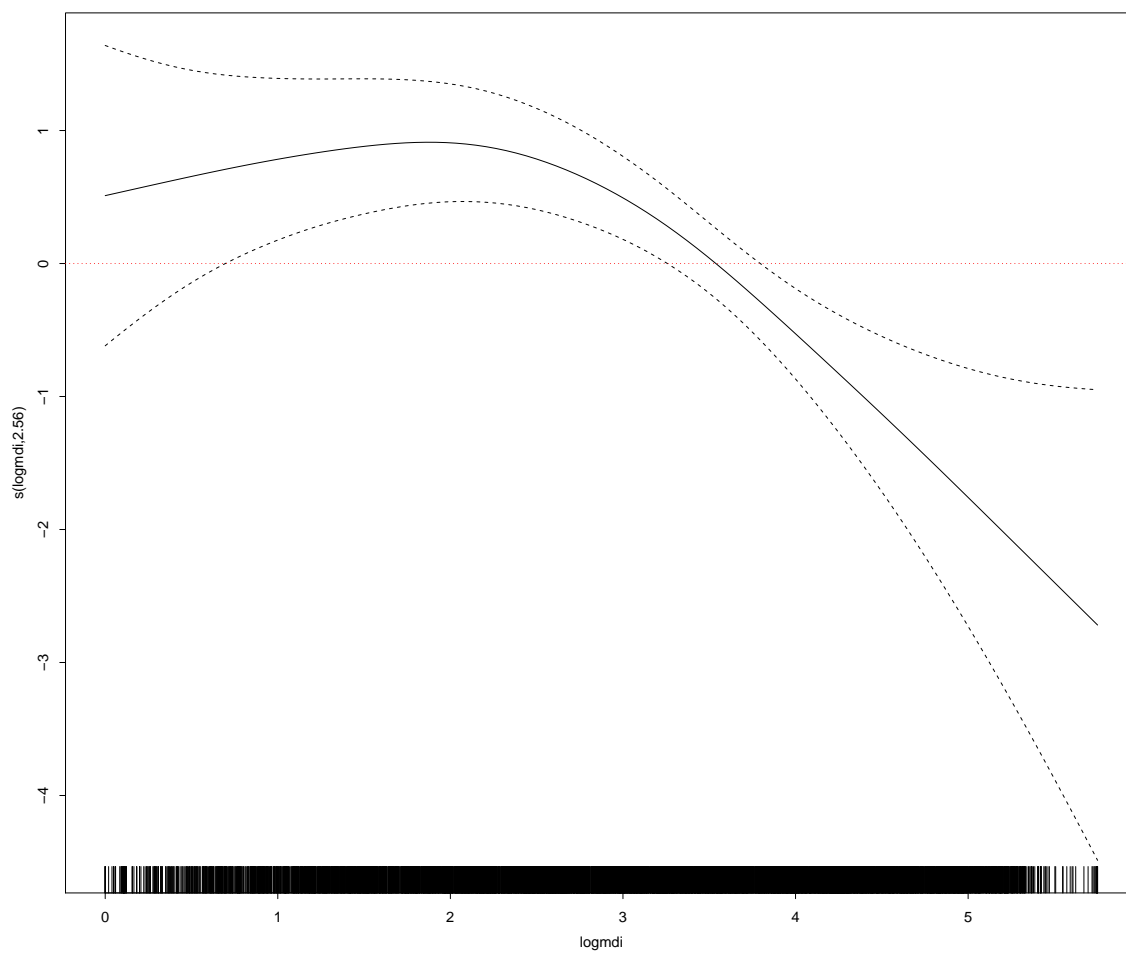
Figure 3: The Non-Linear Effect of MDI on Civil War Across Levels of MDI

Table 1: ANOVA Comparing Linear and Non-Linear Effects of MDI on Civil War Onset

	RESID. DF	RESID. DEV	DF	DEVIANCE	P-VALUE
1	$5,884$	$1,070.00$			
2	$5,882.00$	$1,052.00$	1.56	17.90	0.0001

Estimating the Effect of Mass Media Density Before and After the Threshold of Mass Communications

To further test the hypothesis that MDI increases the likelihood of civil war before it is sufficiently high to represent a mass communications system (and to obtain a parsimonious estimate of the effect size), I estimate a series of traditional parametric regressions. I begin by creating a subset of the original sample containing only country-years with MDI levels below the inflection point identified by the non-linear regression (when logged MDI is equal to about 2, or an MDI level of about 6.3885). While it is reasonable to think such a low threshold might only correspond to a substantively trivial number of cases, on the contrary, this subset contains 1360 cases or about 20% of the original sample. I estimate traditional logistic regressions all of which are variations on the form

$$Onset_{it} = \alpha + MDI_{it}\beta_1 + Controls_{it}\beta_2 + \varepsilon_{it}$$

and where all the variables are the same as in the previous equation, with the exception that *MDI* is not logged.

Table 2 displays the results with adjustment for rare events (Gary King and Zeng 2001).[8] Before analysis, I subtracted the mean from each continuous independent variable and then divided it by two standard deviations so that all resulting coefficients are readily comparable.[9]

The first two columns of the following table display the results of a baseline model

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[8]Traditional logistic regression estimated by maximum-likelihood would likely underestimate the probability of civil war onsets because civil wars begin in relatively very few country-years. There are 119 (2.0588%) onsets in the full sample and 41 (3.2437%) in the subset of low-MDI country-years.

[9]For continuous independent variables, the coefficient indicates the change in log-odds of a civil war beginning due to a two standard deviation increase from the mean of the independent variable; for dichotomous variables, the coefficient reflects the change in log-odds of a civil war beginning due to a change from 0 to 1 on the dichotomous variable, which is roughly equivalent to a two-standard deviation change in a continuous variable (Gelman 2008).

which replicates Warren's original findings (Model 1) and the same model estimated on the subset of country-years below the median level of MDI (23.924). While Model 1 successfully replicates Warren's main finding with a negative and statistically significant coefficient for MDI levels, Model 2 indicates that this coefficient is not statistically significant for country-years below the median level of MDI. The third column estimates a model nearly equivalent to the first two but only for country-years below the 20th percentile of MDI, roughly the inflection point suggested by the semi-parametric regression estimated in the previous stage of analysis (the logarithm of MDI equal to 2).[10] Distinct from Models 1 and 2, the independent variable of interest in Model 3 is the variable capturing year-to-year changes in MDI rather than levels of MDI. Levels of MDI are not included as an independent variable because Model 3 is effectively already controlling for the level of MDI by restricting attention to the 20th percentile of media density. The coefficient for ΔMDI_{t-1} is negative and statistically significant, as predicted by Hypothesis 1.

The results suggest that the general pacification theory would significantly underestimate the probability of civil war onset in countries first observing the introduction and early spread of mass media. Warren's baseline model (Model 1) would lead us to predict that a country moving from zero MDI to the 20th percentile (5.4992) would, on average, cause the probability of civil war onset to decrease by -0.0047, from an already quite low 0.0355. However, when we estimate the same model on only those country-years in the 20th percentile of mass media density (Model 3), simulations suggest an increase of 5.4992 would cause the probability of civil war onset to increase by an average of 0.6309, from 0.0208 to 0.6517.[11]

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[10]I use the 20th percentile of MDI because it is a convenient and conventional cutoff for segmenting distributions; it is slightly less than a logarithm of 2.

[11]All simulations and predicted probability plots were generated using the R package *Zelig* (Imai, King, and Lau 2009).

Table 2: Early Growth of Media Density Compared to Media Density in General

	Warren	<= Median MDI	<= 20th Percentile MDI
	(1)	(2)	(3)
MDI_{t-1}	−2.64***	−3.27	
	(0.71)	(2.38)	
ΔMDI_{t-1}			0.67**
			(0.31)
GDP PER CAPITA$_{t-1}$	−0.09	−0.33	−1.04**
	(0.36)	(0.48)	(0.45)
AREA$_{t-1}$	−0.31	−0.19	0.13
	(0.32)	(0.39)	(0.57)
MOUNTAINOUS$_{t-1}$	0.45*	0.41	−0.07
	(0.24)	(0.27)	(0.40)
POPULATION$_{t-1}$	0.80***	0.75***	0.78*
	(0.25)	(0.29)	(0.46)
OIL EXPORTER$_{t-1}$	0.76***	0.73**	1.74***
	(0.28)	(0.36)	(0.57)
DEMOCRACY$_{t-1}$	2.68**	2.68*	1.93
	(1.15)	(1.38)	(1.61)
DEMOCRACY$^2_{t-1}$	−2.54**	−2.19	−1.39
	(1.22)	(1.49)	(1.55)
ETHNIC FRAC.$_{t-1}$	0.11	−0.09	−0.40
	(0.21)	(0.24)	(0.41)
RELIGIOUS FRAC.$_{t-1}$	0.60***	0.56**	0.47
	(0.23)	(0.27)	(0.39)
PEACE YEARS$_{t-1}$	−1.89	−2.85	−0.20
	(2.57)	(2.94)	(2.92)
SPLINE 1	−0.55	−7.95	3.46
	(15.70)	(18.14)	(14.83)
SPLINE 2	−5.22	3.52	−5.29
	(18.23)	(21.66)	(16.95)
SPLINE 3	3.49	0.90	1.20
	(5.57)	(7.30)	(5.28)
CONSTANT	−4.54***	−4.66***	−3.86***
	(0.18)	(0.78)	(0.25)
Observations	5,899	2,950	1,220
Log likelihood	−527.50	−373.10	−148.00
Akaike information criterion	1,085.00	776.10	326.10
Notes:	***$p < .01$; **$p < .05$; *$p < .1$		

While the difference between zero MDI and the 20th percentile of 5.4992 is a useful yardstick with respect to the entire range of *levels* observed in the sample, the mean year-to-year change observed in the subset of pre-mass communications systems is only 0.2118 and the maximum is only 2.77. Thus, to gain a more realistic sense of how the early spread of mass media shapes civil war onset, and to better compare the substantive implications of the general pacification effect with the war-before-peace effect, Figures 4 and 5 display the predicted probability of civil war onset given different values of MDI levels and year-to-year MDI changes, respectively, across their historically observed ranges.

Considering all communications systems, the predicted probability of civil war onset decreases from about .03 at the zero level of MDI to roughly zero for any level of MDI greater than about 150, on average. However, considering only pre-mass communications systems, a 1-point change in MDI would cause the probability of civil war onset to increase by an average of 0.0311, from 0.021 to 0.052. A 2.5-point change in MDI would cause the probability of civil war onset to increase by an average of 0.1955, from 0.0206 to 0.2161. Figures 4 and 5 also highlight the essential asymmetry of estimating negative versus positive effects on a rare event. The pacifying effect of levels of MDI as identified by Warren is an inherently small effect because the probability of observing civil war onset is already very small in general. However, the size of the war-before-peace effect is notably larger and represents a more substantively salient risk for this same reason.
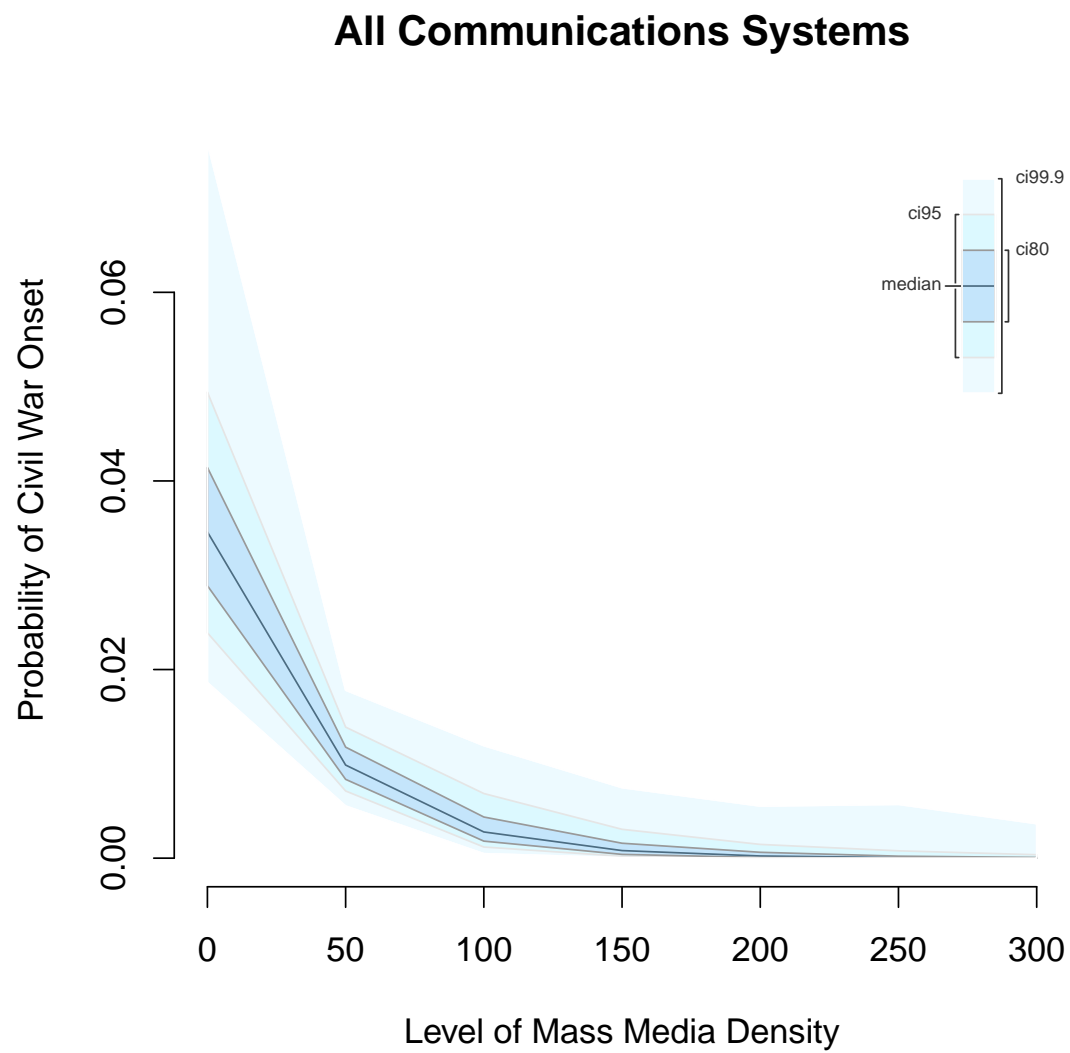
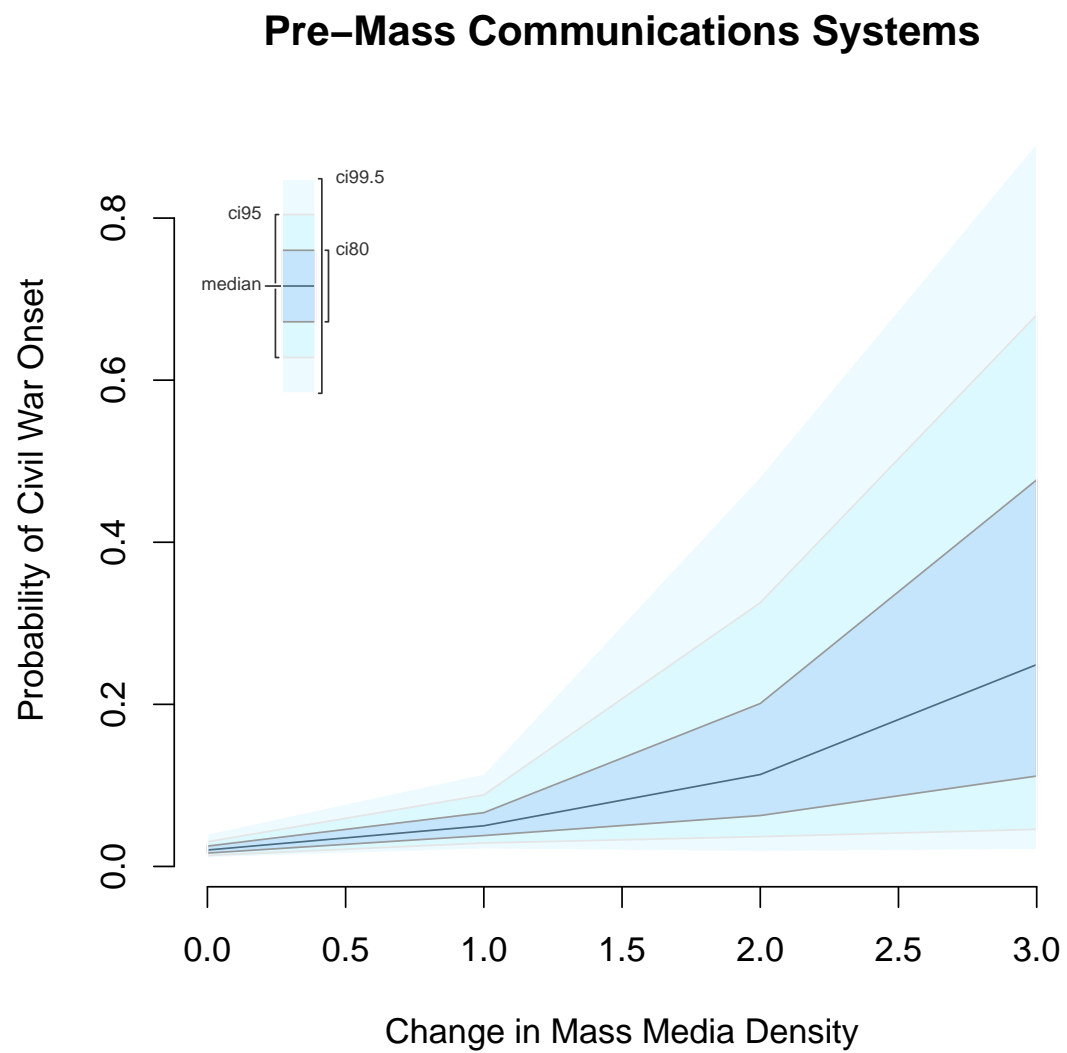Figure 4: Predicted probability of civil war onset given levels of media density

Pre−Mass Communications Systems

Figure 5: Predicted probability of civil war onset given changes in media density

Mass Media Density and Civil Wars at the International Level

Table 3 models the number of civil war onsets in the international system each year using the negative binomial distribution, the appropriate distribution for modelling event counts. Formally, the equation is

$$Onsets_i = \alpha + TV_i\beta_1 + \Delta TV_i\beta_2 + Controls_i\beta_3 + \varepsilon_i,$$

where the dependent variable *Onsets* is the number of civil wars which begin in year *i*, and the independent variables of interest are the levels and first differences of television density (*TV* and ΔTV, respectively).

Model 1 is a baseline model. Model 2 includes controls variables *WW1*, *WW2*, and *COLD WAR.* Model 3 adds to these the control variable *IMPUTED.* Each model provides evidence for Hypothesis 2, that with respect to the international system in historical perspective, year-to-year increases in television density are positively associated with the number of civil war onsets in the following year. Figure 6 illustrates the expected change in global civil war onsets for a range of changes in the global mean of television density. These results are consistent with the evidence presented above, reflecting that year-to-year increases in media density within low levels increase the likelihood of civil war, even if media density has a pacifying effect in the long-run. Interestingly, the international-level models do not provide much evidence for a long-term pacifying effect from levels of television density, as the negative effect is no longer statistically significant after controlling for *WW1*, *WW2*, and *COLD WAR*. However, this could be for the reason that global television density remains relatively low and has not yet reached the threshold at which its pacifying effects would become observable at the level of the international system.

Simulations suggest that a .5 increase in the global mean TV density (an increase equal to two standard deviations above the mean yearly increase) would generate approximately one extra civil war per year on average (0.9689, from 1.5175 to 2.4864).

Table 3: International-Level Regressions

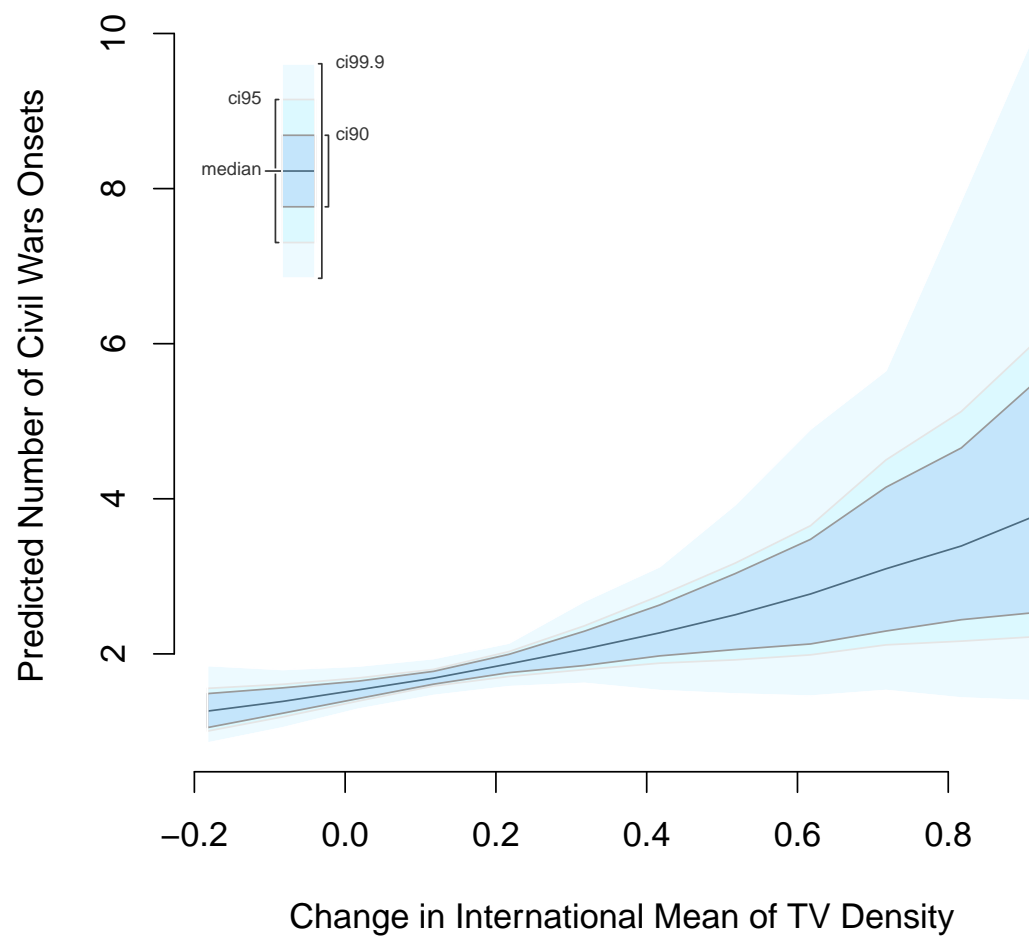|	onsets		
	(1)	(2)	(3)
TV_{t-1}	-0.91^{**}	-0.66	-0.60
	(0.37)	(0.40)	(0.40)
ΔTV	0.33^{**}	0.42^{***}	0.46^{***}
	(0.15)	(0.16)	(0.16)
GDP PER CAPITA$_{t-1}$	-0.07	-0.03	-0.24
	(0.51)	(0.57)	(0.57)
ΔGDP PER CAPITA	-0.01	-0.03	-0.06
	(0.06)	(0.06)	(0.06)
DEMOCRACY$_{t-1}$	0.25	0.94^{***}	0.99^{***}
	(0.19)	(0.27)	(0.27)
ΔDEMOCRACY	-0.19^{*}	-0.18^{*}	-0.21^{**}
	(0.10)	(0.11)	(0.11)
DEMOCRACY$^2_{t-1}$	0.20	0.36^{*}	0.41^{**}
	(0.16)	(0.20)	(0.19)
CIVIL WARS	0.91^{***}	0.93^{***}	0.95^{***}
	(0.24)	(0.25)	(0.25)
ONSETS$_{t-1}$	0.90^{***}	0.95^{***}	0.97^{***}
	(0.16)	(0.16)	(0.16)
ΔONSETS	0.16^{***}	0.17^{***}	0.17^{***}
	(0.02)	(0.02)	(0.02)
STATES	0.24	0.37	0.49
	(0.57)	(0.59)	(0.59)
YEAR	-0.28	-1.14^{*}	-1.05
	(0.56)	(0.69)	(0.69)
WWI		-0.12	-0.17
		(0.18)	(0.17)
WWII		0.41^{*}	1.57^{***}
		(0.22)	(0.34)
COLD WAR		-0.92^{***}	-1.01^{***}
		(0.22)	(0.22)
IMPUTED			1.23^{***}
			(0.36)
CONSTANT	0.53^{***}	0.57^{***}	-0.28
	(0.04)	(0.08)	(0.26)
Observations	182	182	182
Log likelihood	-260.00	-257.00	-256.10
θ	45,133.00 (484,186.00)	44,773.00 (456,964.00)	45,671.00 (465,362.00)
Akaike information criterion	545.90	546.00	546.20
Notes:	$^{***}p < .01;\ ^{**}p < .05;\ ^{*}p < .1$		

Figure 6: Predicted number of civil war onsets given changes in global TV density

Conclusion

This research note synthesizes conflicting evidence on the relationship between mass media and civil war onset by hypothesizing a non-linear relationship. After mass media density crosses the threshold constituting a mass communications system, communicative economies of scale are such that every further increase in mass media density increases the communicative powers of the state, further deterring insurgents, and thus further decreasing the likelihood of civil war onset. However, when mass media density is below the threshold constituting a mass communications system, increases in mass media density significantly increase the likelihood of civil war onset as the approach of a mass communications system represents a "now or never" situation for potential insurgents. The argument is supported by semi-parametric and traditional parametric regression analyses on a large panel of countries between 1945 and 1999 and international-level time-series beginning in 1816.

The implications are critical for political scientists as well as policymakers, activists, and other political actors concerned with issues of media, communications, and civil violence. First, the implications are substantively critical for scholars, policymakers and other political practitioners interested in the causes of civil war because the most recent previous evidence would lead observers to underestimate the risk of civil war within countries experiencing the early spread of mass media. By demonstrating the bellicose effects of mass media in precisely such situations, this research note draws attention to a unique source of civil war risk which has been poorly understood by previous research. Second, this research note highlights that in the politics of mass communications, considerations of non-linearity are likely to be especially important. Assuming linear relationships between independent and dependent variables is not always warranted and can lead to substantively different predictions than those generated by models which account for non-linearity. The findings presented here will be of interest in particular to those scholars in the burgeoning

field of ICT and political conflict research who are building an increasingly "rich theory" of context-conditional findings (Lyall and Dafoe 2015). This research note contributes to this current of research both theoretically and empirically, by highlighting the theoretical importance of non-linearities in these types of phenomena and by providing an improved empirical accounting of mass media in patterns of civil war onset.
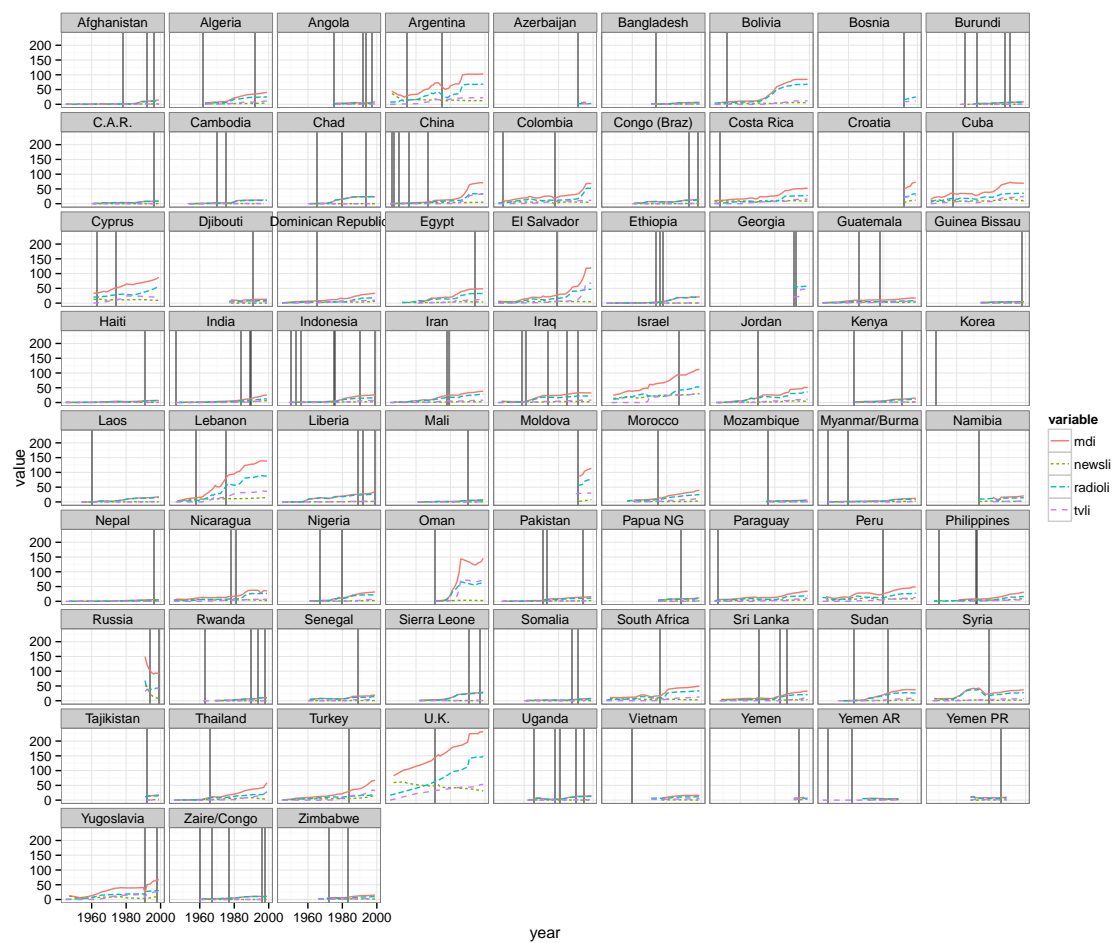
Supplementary Information

Figure 7: Disaggregated media density and all civil war onsets over time, by country

Tests of Stationarity   The Levin-Lin-Chu statistic is a standard test for the presence of a unit root, otherwise known as non-stationarity or integration of order I(1), in a time series vari-

able observed across multiple cross-sectional units. The Im-Pesaran-Shin test is a "second generation" test which is robust to cross-sectional dependence, common in cross-national panel data. For each test, the null hypothesis is the presence of a unit root. Because the tests require balanced panels, they were applied only to the 24 countries with the maximum time-series of 55 years, a subset which still contains significant variation in geography, income, regime type, and other factors. Specifically, the countries in this subset are: Canada, Cuba, Haiti, Dominican Republic, Mexico, Honduras, El Salvador, Nicaragua, Costa Rica, Uruguay, Ireland, Netherlands, Belgium, Luxembourg, France, Switzerland, Hungary, Romania, Finland, Sweden, Norway, Denmark, Afghanistan, China.

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Levin-Lin-Chu Unit-Root Test (ex. var. : Individual Intercepts
and Trend )
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data: unit$mdi z.x1 = -0.3222, p-value = 0.7473 alternative hypothesis: stationarity

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Pesaran's CIPS test for unit roots
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data: unit$mdi CIPS test = -2.064, lag order = 2, p-value = 0.1 alternative hypothesis: Stationarity

Semi-parametric regressions on disaggregated media density   The following plots display the smoothed terms for each of the components of MDI, controlling for all the independent variables of the baseline model and the other components of MDI. All of the components of MDI are logged before estimation. Each plot was generated by a semi-parametric regression in which all independent variables are estimated parametrically except the variable of interest. The dashed lines represent 95% confidence bands.

Figure 8: The non-linear effects of disaggregated media technologies on civil war onset
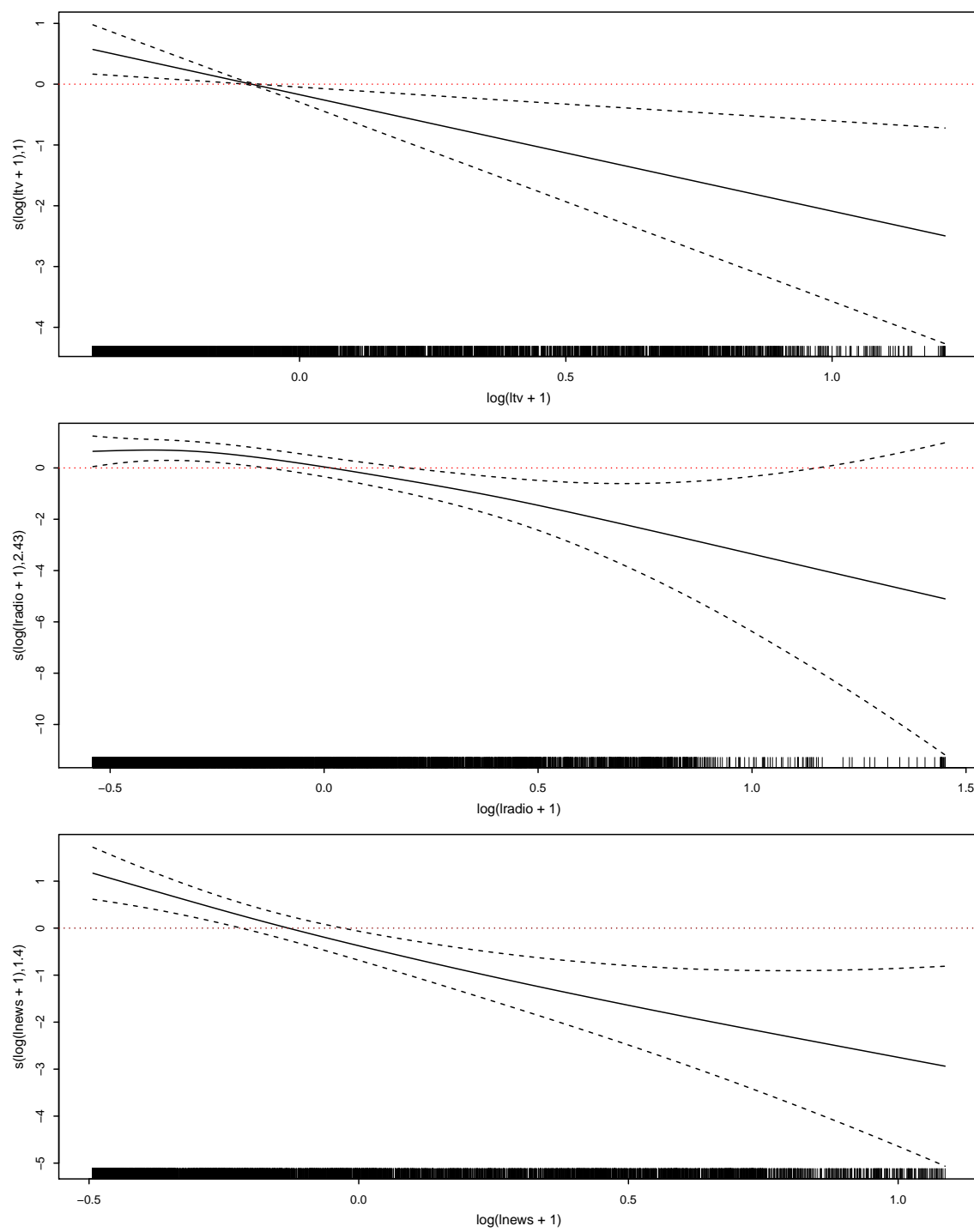
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