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Homicide and Social Media: Global Empirical Evidence

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Abstract

This study investigates the relationship between social media and homicide in a cross section of 148 countries for the year 2012. The empirical evidence is based on Ordinary Least Squares, Tobit and Quantile regressions. The findings from Ordinary Least Squares and Tobit regressions show a negative relationship between Facebook penetration and the homicide rate. The negative relationship is driven by the 75th quantile of the conditional distribution of the homicide rate. The negative nexus is also driven by upper middle income countries and "Europe and Central Asia". Three main implications are apparent when the findings are compared and contrasted. First, established findings from OLS and Tobit regressions are driven by countries with above-median levels of homicide. Second, such above-median countries are largely associated with upper middle income countries and nations in "Europe and Central Asia". Third, modelling the relationship between Facebook penetration and homicide at the conditional mean of homicide may be misleading unless it is contingent on initial levels of homicide and tailored differently across income levels and regions of the world.

JEL Classification: K42; D83; O30; D74; D83
Keywords: Homicide; Social media

1. Introduction

The positioning of this study is inspired by three main tendencies in scholarly and policy-making circles, notably: (i) rising levels of homicide in the world; (ii) the growing importance of social media in contemporary development and (iii) gaps in the literature. The points are expanded chronologically. First, as recently documented by Muggah and de Carvalho (2017) and Asongu and Acha-Anyi (2019), there is a murder epidemic because the rate of homicide has been increasing across the world. It is therefore relevant to assess policy instruments with which such a policy syndrome of homicide can be mitigated. One dimension worth considering is the prism of social media that has not received the scholarly attention it deserves, partly because it is a relatively new phenomenon, partly because of data availability constraints.

Second, the relevance of social media in addressing socio-economic perils has been the object of debate in both scholarly and policy circles. From the perspective of homicide, one strand of the debate maintains that social media fuels political instability, crimes and violent demonstrations. For instances: authorities in the United Kingdom are concerned as to whether social media is not responsible for the recent rise in murders in London (Browning, 2018) and Facebook streaming related murders in the United States (Dreyfuss, 2017). These concerns also pertain to, *inter alia*: the positive role of social media in youth violence (Patton *et al*., 2014); the positive effect of social media coverage of "Black Lives Matter" on the risk of fatal victimization of minorities and law enforcement officers (Bejan, 2018) and social media as an instrument of gang violence (Storrod & Densley, 2017). Conversely, another strand of the literature is of the position that social media can be used to alleviate social unrests through collaborative and networking mechanisms. This second angle of the debate is important because social media could enable broad discussions that evolve beyond geographically demarcated societies and bring rival factions together at a speed that was hitherto unimaginable (Parkyn, 2017). Unfortunately, literature is sparse on the perspective that social media decreases policy syndromes such as political instability, violence and homicide.

Third, contemporary literature on homicide has focused on, *inter alia*: the relevance of homicide and the economics on human and social biology (Bourne et al., 2015); the relationship between homicide and age (Rogers, 2014); a systematic survey of homicide from intimate partners (Stöckl et al., 2013); the nexus between homicide rates and police performance (Pare, 2014); international cross-national views on homicide and violence (Cole & Gramajo, 2009; Ouimet & Montmagny-Grenier, 2014); challenges in research on homicide

punishment in Europe (Liem & Campbell, 2014); the effects of economic development, income inequality and infant mortality on homicide (Ouimet, 2012); the relationship between homicide and inequality in developed nations (Chamlin & Cochran, 2006; Jacobs & Richardson, 2008) and meta assessments on cross-national determinants of homicide (Nivette, 2011)[1].

Noticeably from the above, the nexus between social media in the perspective of Facebook penetration and homicide has not been covered in recent empirical literature. This sparse empirical literature on the relevance of Facebook penetration is considerably traceable to the absence of data. As far as we know, there are currently only a few studies which have used a recent dataset on Facebook penetration as a proxy for social media. Kodila-Tedika (2018) has investigated if social media influences the governance of natural resources, Jha and Sarangi (2017) have investigated whether social media affects corruption whereas, Jha and Kodila-Tedika (2019) have examined if democracy is promoted by social media. Another stream of literature has assessed nexuses between social media, governance, tourism and terrorism (Asongu & Odhiambo, 2019a, 2019b; Asongu et al., 2019).

The present study extends this growing strand of literature by leveraging on the new Facebook dataset to investigate the nexus between social media and homicide. This positioning is consistent with a recent report from the World Bank which has established that studies on the relevance of social media on development outcomes, especially for developing countries are sparse (World Bank, 2016). The emphasis on developing countries is articulated in this study because the dataset is disaggregated into income levels and regions which distinguish developing countries from their more technically-advanced counterparts.

As discussed in more detail in Section 2, the three main categories of theoretical underpinnings linking social media to homicide pertain to the Wound Culture Theory (WCT), conflict management models and technology acceptance models. Accordingly, technology acceptance models translate the motivation behind adopting a new technology. The relevance of the WCT builds on the fact that such adoption of new technology can be motivated by negative intentions such as homicide while conflict management models translate a scenario where such adoption of new technology can be used for avoid homicide. Hence, this study builds on the premise that both positive and negative nexuses between Facebook and homicide can be apparent.

[1] The adopted elements of style in scholarly communication here are such that the cited studies on homicide are meant to articulate the perspective that the extant studies on homicide have not focused on the role of social media. Hence, providing the results of the works is not necessary in order to articulate the perspective.

The rest of the study is organized as follows. The theoretical underpinnings are covered in Section 2. The data and methodology are discussed in Section 3 while the empirical results are provided in Section 4. Section 5 concludes with implications and future research directions.

2. Theoretical underpinnings

There are three main theoretical views underpinning the linkage between social media and homicide, notably: the WCT if social media increases homicide; (ii) theories of social control and conflict management if social media decreases homicide and (iii) technology acceptance models upon which the two contending strands of theories rely. These three theoretical underpinnings are substantiated in chronological order.

First, the Wound Culture Theory (WCT) is one theoretical framework underpinning this study if social media fuels homicide. Within this framework, social media can be used to fuel conflicts, crimes, violence and homicide. In this section, sentences lifted verbatim are meant to be self-explanatory because they explicitly articulate features of a wound culture that can be linked to homicide. As elucidated by Gibson (2006), the WCT which was first developed by Mark Seltzer (1998) can summarized in the following (p. 19): *"killing has its place in a public culture in which addictive violence has become not merely a collective spectacle but one of the crucial sites where private desire and public fantasy cross. The convening of the public around scenes of violence–the rushing to the scene of the accident, the milling around the point of impact–has come to make up a wound culture; the public fascination with torn and open bodies and torn and open persons, a collective gathering around shock, trauma, and the wound".*

Consistent with the WCT, the desire to have the human body dismembered is harbored by individuals within a society. Such a will to destroy the human body is both literal (via mutilation) and figurative (through criticism). The relevance of serial murder is seen as a communal perspective which enables citizens to engage in wound appreciation: "*One discovers again and again the excitations in the opening of private and bodily and psychic interiors; the exhibition and witnessing, the endlessly reproducible display, of wounded bodies and wounded minds in public. In wound culture, the very notion of sociality is bound to the excitations of the torn and open body, the torn and exposed individual, as public spectacle*" (Seltzer, p. 137). Seltzer also observed that the wound theory has substantial repercussions in the formation of citizenry attitude: "*The spectacular public representation of violated bodies, across a range of official, academic, and media accounts, in fiction and in*

film, has come to function as a way of imagining and situating our notions of public, social, and collective identity" (p. 21).

Second, conflict management and social control theories can also be consistent with the relationship between Facebook penetration and the homicide rate if the nexus is negative. Consistent with recent literature on conflicts, crimes and murder (Asongu & Kodila-Tedika, 2017), theories surrounding this second strand have been aptly documented by Akinwale (2010), notably: the Social Control Theory (SCT) from Black (1990) and the Conflict Management Model (CMM) of Thomas-Kilman (1992). According to the SCT, relationships among groups and individuals influence the exercise of one among the five main channels of social control, namely: tolerance, self-help, negotiation, settlement and avoidance. One of these mechanisms can be used by social media to reduce homicide rates. Concerning the CMM, strategic intentions that oscillate around two dimensions (i.e. of cooperation and assertiveness) can yield five principal styles of conflict management when combined with collaboration, notably: compromise, accommodation, collaboration, competition and avoidance. These theoretical insights which are in line with the literature on the management of conflicts (Borg, 1992; Volkema & Bergmann, 1995; Asongu & Kodila-Tedika, 2017), are also in accordance with options available in social media for the management of conflicts, crimes and homicide.

Third, it is relevant to complement the two contending strands with technology acceptance models upon which these strands rely. According to recent social media (Nikiforova, 2013; Cusick, 2014; Lee & Lowry, 2015) and information and communication technology (Yousafzai *et al*., 2010; Asongu *et al*., 2018) literature, the dominant theories in this strand can be articulated within three frameworks, notably: the theory of reasoned action (TRA), theory of planned behavior (TPB) and technology acceptance model (TAM). In the light of attendant literature, a common framework of the underlying theories is that information technology is characterised by, *inter alia*: the customers' belief formation and composite aspects such as social, psychological, personal, behavioural and utilitarian traits.

The TRA is based on the assumption that customers are rational in relation to the acknowledgement of their actions (see Bagozzi, 1982; Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). The TPB which is an extension of the TRA articulates the absence of differences between customers who have some conscious influence on their actions and those that do not (see Ajzen, 1991). According to the TAM, the supposition underpinning the customer's adoption of a specific technology can be explained by both a voluntary motivation of the corresponding customer to accept and utilise a given technology (Davis, 1989). The

factors from the underlying theoretical framework motivate individuals and/or groups of individuals to adopt and use social media for various purposes, including: the fuelling and mitigation of homicide. Theories pertaining to positive and negative effects of social media are relevant in order to clearly articulate the interplay between social media and social phenomenon. This emphasis is consistent with De Sousa et al. (2009) who have cautioned that studies should clearly underline the theories underpinning the phenomena of violence, crime and political instability.

While criticisms of the theoretical underpinnings adopted in the study are understandable, to the best of our knowledge we found no other theories with which to build upon. Accordingly, technology acceptance models translate the motivation behind adopting a new technology and the relevance of: (i) the WCT builds on the fact that such adoption of new technology can be motivated by negative intentions such as homicide while (ii) conflict management models translate a scenario where such adoption of new technology can be used for avoid homicide. Hence, the study postulates that both positive and negative nexuses between Facebook and homicide can be apparent. Moreover, the study can also be positioned in an applied economics framework because it is based on sound intuition and the corresponding findings can be used to consolidate theory-building.

3. Data and methodology

3.1 Data

The study investigates a sample of 148 countries with data for the year 2012 from a plethora of sources, namely: Qualitative assessments by Economic Intelligence Unit (EIU) analysts' estimates; the Uppsala Conflict Data Program (UCDP) Battle-Related Deaths Dataset; the Institute for Economics and Peace (IEP); the United Nations Office on Drugs and Crime (UNODC) Surveys on Crime Trends; the Operations of Criminal Justice Systems (CTS); the International Institute for Strategic Studies (*IISS*) and the United Nations Committee on Contributions and Quintly.

The temporal and geographical scopes are restricted as a result of constraints in data availability. Data on Facebook penetration is only available for the year 2012. In order to measure social media, we use the share of population using Facebook. The Facebook data is from "Quintly" which is a social media benchmarking and analytics Solution Company[2]. The data has been used in recent Facebook literature on the consequences of social media, notably:

[2] The data was accessed from its website (http://www.quintly.com/facebook-countrystatistics?period=1year).

Jha and Sarangi (2017), Jha and Kodila-Tedika (2019), Kodila-Tedika (2018) and Asongu and Odhiambo (2019a, 2019b).

The main outcome indicator is the rate of homicide (per 100, 000 people). A homicide rate is calculated by dividing the number of reported homicides by the total population; the result is multiplied by 100,000. The data on homicides is jointly sourced from the UNODC, the CTS and EIU estimates. The adopted control variables are: access to weapons, violent crime, conflict intensity, political instability and "security officers and police". These indicators have been adopted as control variables in recent literature on the determinants of crimes, conflicts and homicide (Freytag *et al*., 2011; Blanco & Grier, 2009; GPI, 2016; Asongu & Acha-Anyi, 2019; Asongu & Kodila-Tedika, 2016, 2017)[3]. In the light of the attendant literature, with the exception of "security officers and police", all the variables are expected to increase homicide.

The definitions and sources of variables are disclosed in Appendix 1 while Appendix 2 provides the summary statistics (in Panel A) and sampled countries (in Panel B). The objective of the correlation matrix provided in Appendix 3 is to restrict issues of multicollinearity that are susceptible of influencing the signs of estimated coefficients when variables in the conditioning information set are characterised by a high degree of substitution. It is apparent from the summary statistics that the indicators are comparable. Furthermore, in the light of the corresponding standard deviations, we can be confident that reasonable estimated linkages will be obtained from the regressions.

3.2 Methodology

3.2.1 Ordinary Least Squares

This paper adopts an Ordinary Least Squares (OLS) estimation strategy because of the cross sectional nature of the data set. The empirical strategy is also adopted because it is in line with recent literature employing cross sectional data, notably: mobile phone penetration (Asongu, 2013a), inclusive development (Andrés, 2006) and financial development (Kodila-Tedika & Asongu, 2015) studies.

Equation 1 below examines the correlation between homicide and social media

$$H_i = \alpha_1 + \alpha_2 SM_i + \alpha_3 X_i + \varepsilon_i \ , \qquad (1)$$

[3] Political instability is defined as an "*Assessment of political instability ranked from 0 to 100 (very low to very high instability) by the EIU's Country Analysis team, based on five questions. This indicator aggregates five other questions on social unrest, orderly transfers, opposition stance, excessive executive authority and an international tension sub-index. Country analysts assess this question on a quarterly basis. The score provided for March 2015–March 2016 is the average of the scores given for each Quarter*" (GPI, 2016, p. 101).

where H_i represents the homicide rate while SM_i is the social media indicator for country i, α_1 is a constant, X is the vector of control variables, and ε_i the error term. X contains: access to weapons, violent crime, conflict intensity, political instability and "security officers and police".

3.2.2 Tobit regressions

The homicide rate is theoretically in the interval of 0 and 5. In the light of this theoretical range, a Tobit model may be used to complement the OLS approach. A double-censored Tobit approach has been documented in the literature to be consistent with outcome variables of limited range (Kumbhakar & Lovell, 2000; Koetter *et al.*, 2008; Ariss, 2010; Coccorese & Pellecchia, 2010). Furthermore, a double-censored Tobit model is similar to estimating by a linear regression model because the two likelihood functions coincide (Coccorese & Pellecchia, 2010; Asongu & Nwachukwu, 2016).

The standard Tobit model (Tobin, 1958; Carsun & Sun, 2007) is as follows:

$$y^*_{i,t} = \alpha_0 + \beta X_{i,t} + \varepsilon_{i,t}\ , \tag{2}$$

where $y^*_{i,t}$ is a latent response variable, $X_{i,t}$ is an observed $1\times k$ vector of explanatory variables and $\varepsilon_{i,t} \approx$ i.i.d. N(0, σ^2) and is independent variable of $X_{i,t}$. Instead of observing $y^*_{i,t}$, we observe $y_{i,t}$:

$$y_{i,t} = \begin{cases} y^*_{i,t,}\ if\ y^*_{i,t} > \gamma \\ 0,\ if\ y^*_{i,t} \le \gamma, \end{cases} \tag{3}$$

where γ is a non stochastic constant. In other words, the value of $y^*_{i,t}$ is missing when it is less than or equal to γ.

3.2.3 Quantile Regressions

The OLS and Tobit regressions discussed in the previous two sections provide parameter estimates at the mean of the homicide rate. Whereas these mean impacts are relevant, we complement the estimation strategies with Quantile Regressions which is an approach that provides parameter estimates throughout the conditional distribution of homicide. Hence, the relationship between Facebook and homicide is articulated with particular emphasis on countries with lower, intermediate and high levels of homicide. Hence, in OLS and Tobit regressions, the outcome variable is static. This is not the case with the Quantile estimation strategy because estimated parameters are provided at multiple points of the outcome variable (Koenker & Bassett, 1978). The QR technique is being increasingly used to complement other estimation techniques (which are based on mean effects) in order to

increase the policy relevance of studies, notably, in: finance (Asongu, 2014a), health (Asongu, 2014b), corruption (Billger & Goel, 2009; Okada & Samreth, 2012; Asongu, 2013b) research.

The θ^{th} quantile estimator of homicide is obtained by solving for the following optimization problem, which is presented without subscripts in Eq. (4) for the purpose of simplicity and readability.

$$\min_{\beta \in R^k} \left[\sum_{i \in \{i: y_i \geq x_i'\beta\}} \theta \left| y_i - x_i'\beta \right| + \sum_{i \in \{i: y_i < x_i'\beta\}} (1-\theta) \left| y_i - x_i'\beta \right| \right], \quad (4)$$

where $\theta \in (0,1)$. Contrary to OLS which is fundamentally based on minimizing the sum of squared residuals, with QR, the weighted sum of absolute deviations is minimised. For example the 10^{th} or 25^{th} quantiles (with θ=0.10 or 0.25 respectively) are estimated by approximately weighing the residuals. The conditional quantile of homicide or y_i given x_i is:

$$Q_y(\theta / x_i) = x_i'\beta_\theta \quad , \quad (5)$$

where unique slope parameters are modelled for each θ^{th} specific quantile. This formulation is analogous to $E(y / x) = x_i'\beta$ in the OLS slope where parameters are assessed only at the mean of the conditional distribution of homicide. For Eq. (5), the dependent variable y_i is the homicide rate while x_i contains: a constant term, *access to weapons, violent crime, conflict intensity, political instability, security officers* and *police.*

4. Empirical analysis

4.1 Presentation of results

The empirical results are presented in Table 1. Ordinary Least Squares (OLS) and Tobit regressions are disclosed respectively on the left-hand side (i.e. specifications I, II, III & IV) and right-hand side (i.e. specifications V, VI, VII & VIII) of the table. The regressions include both univariate estimations (i.e. specifications I & V) as well as regressions with variables in the conditioning information set (i.e. all specification with the exceptions of I & V). It is apparent from both sides of the table that from a univariate perspective, Facebook penetration has a negative relationship with homicide. However, with the inclusion of control variables in the conditioning information set, the negative nexus is only apparent in OLS regressions. It is also worthwhile to emphasis that the magnitude of the relationship is lower when more variables are included in the conditioning information set. This is not uncommon because in the real world, Facebook penetration and homicide do not interact in isolation, but

the interaction is contingent on other factors which are captured by the conditioning information set.

Most of the corresponding significant control variables display the expected signs, notably: access to weapons and violent crime are positively associated with homicides (i.e. specifications II, III, IV, VI, VII & VIII). The negative effect of political instability (which is included in the last specification) is due to the high correlation between political instability and other variables in the conditioning information set, namely: access to weapons and conflict intensity. Political instability is only included in the last specification because of this concern about multicollinearity. Accordingly, the unexpected sign of political instability can be explained from the fact that when two variables with a high degree of substitution are involved in the same specification, only one emerges from the regression output with the expected sign (Asongu, 2015: Beck *et al*., 2003).

Table 2 discloses results from Quantile estimations. It is apparent from the findings that the established negative relationship between social media and homicide is only significant in the 75th quantile. With the exception of political instability, the significant control variables display the expected signs.

Table 1: Ordinary Least Squares and Negative Binomial Regressions (Contemporary)

	Dependent variable: Homicides							
	Ordinary Least Squares				**Tobit Regressions**			
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**
Constant	**3.265*** **	**1.338*** **	**0.954** **	**1.282*** **	**3.304*** **	**1.156*** **	0.661	**1.068** **
	(0.000)	**(0.000)**	**(0.011)**	**(0.003)**	**(0.000)**	**(0.005)**	(0.108)	**(0.034)**
Facebook Penetration	**-0.023*** **	-0.006	-0.005	**-0.010** **	**-0.023*** **	-0.004	-0.002	-0.009
	(0.000)	(0.171)	(0.311)	**(0.051)**	**(0.000)**	(0.432)	(0.729)	(0.148)
Access to Weapons	---	**0.519*** **	**0.312*** **	**0.362*** **	---	**0.577*** **	**0.332*** **	**0.393*** **
		(0.000)	**(0.003)**	**(0.001)**		**(0.000)**	**(0.004)**	**(0.001)**
Violent Crime	---	---	**0.458*** **	**0.463*** **	---	---	**0.548*** **	**0.562*** **
			(0.000)	**(0.000)**			**(0.000)**	**(0.000)**
Conflict Intensity	---	---	-0.126	-0.031	---	---	-0.140	-0.017
			(0.123)	(0.767)			(0.186)	(0.879)
Political instability	---	---	---	**-0.298** **	---	---	---	**-0.383*** **
				(0.019)				**(0.007)**
Security Officers & Police	---	---	---	0.046	---	---	---	0.061
				(0.613)				(0.531)
Fisher	**38.48*** **	**47.81*** **	**34.59*** **	**25.39*** **				
Adjusted R²	0.131	0.285	0.386	0.409				
LR Chi-Square					**16.93*** **	**46.23*** **	**72.15*** **	**79.63*** **
Pseudo R²					0.034	0.094	0.147	0.163
Log Likelihood					-235.743	-221.094	-208.134	-204.391
Observations	148	148	148	148	148	148	148	148

***,**,*: significance levels at 1%, 5% and 10% respectively.

Table 2: Quantile Regressions

	Dependent variable: Homicides				
	Q.10	**Q.25**	**Q.50**	**Q.75**	**Q.90**
Constant	**1.165*** **	0.739	1.207	**1.635*** **	**2.014** **
	(0.000)	(0.195)	(0.131)	**(0.006)**	**(0.018)**
Facebook Penetration	0.0002	-0.005	-0.012	**-0.019** **	-0.016
	(0.947)	(0.364)	(0.231)	**(0.041)**	(0.210)
Access to Weapons	**0.151***	**0.280** **	**0.340***	**0.593*** **	0.368
	(0.063)	**(0.017)**	**(0.083)**	**(0.000)**	(0.116)
Violent Crime	**0.149** **	**0.271*** **	**0.605*** **	**0.433*** **	**0.452*** **
	(0.043)	**(0.003)**	**(0.000)**	**(0.002)**	**(0.004)**
Conflict Intensity	**0.154***	0.093	-0.006	-0.169	-0.214
	(0.054)	(0.407)	(0.972)	(0.261)	(0.389)
Political instability	-0.127	-0.222	**-0.425***	-0.281	0.060
	(0.195)	(0.144)	**(0.068)**	(0.122)	(0.825)
Security Officers & Police	**-0.154** **	0.047	0.023	0.102	0.110
	(0.044)	(0.629)	(0.888)	(0.388)	(0.494)
Pseudo R^2	0.150	0.210	0.262	0.294	0.273
Observations	148	148	148	148	148

*, **, ***: significance levels of 10%, 5% and 1% respectively. OLS: Ordinary Least Squares. R² for OLS and Pseudo R² for quantile regression. Lower quantiles (e.g., Q 0.1) signify nations where Homicides is least. The table values refer to estimated coefficients, information criterion and number of countries or observations. Pseudo R² is the information criterion.

4.2 Extension with fundamental characteristics

In order the address the concern of the World Bank (World Bank, 2016) that the effects of social media have not been substantially documented, especially in developing countries, the dataset is decomposed into regional and income characteristics. Such decomposition which is relevant in order to provide findings with more policy options is consistent with recent literature on the determinants of homicides in the world (Asongu & Acha-Anyi, 2019). Accordingly, in order to articulate developing countries, decomposition by: (i) regions is consistent with Asongu and Acha-Anyi (2019) and (ii) income levels is from the World Bank's classification of income groups[4].

In Table 3, the findings based on income levels and regions are presented on the left-hand side and right-hand side respectively. The pattern of presentation is respected both in Panel A (i.e. Ordinary Least Squares regressions) and Panel B (i.e. Tobit regressions). From the findings, it is apparent that the established negative relationship is driven by upper middle income countries and "Europe and Central Asia" (i.e. second and fifth specifications). The findings are robust to Tobit regressions (i.e. second and fifth specifications).

[4] There are four main World Bank income groups: (i) high income, $12,276 or more; (ii) upper middle income, $3,976-$12,275; (iii) lower middle income, $1,006-$3,975 and (iv) low income, $1,005 or less.

Table 3: Comparative evidence based on income levels and regions

	Dependent variable: Homicides								
	Ordinary Least Squares (OLS)								
	Income Levels				Regions				
	HI	UMI	LMI	LI	ECA	EAP	MENA	SSA	LA
Constant	0.807	**4.024*** **	1.195	**3.380** **	**1.742*** **	-0.189	3.661	**3.922*** **	-0.927
	(0.185)	**(0.001)**	(0.256)	**(0.015)**	**(0.001)**	(0.854)	(0.105)	**(0.005)**	(0.661)
Facebook Penetration	-0.00002	**-0.029*** **	0.017	-0.0004	**-0.016** **	0.004	-0.018	-0.024	0.007
	(0.995)	**(0.007)**	(0.359)	(0.997)	**(0.024)**	(0.831)	(0.280)	(0.701)	(0.662)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fisher	**2.38** **	**12.29*** **	**3.57*** **	0.59	**3.53*** **	**17.36*** **	1.23	1.60	**4.98*** **
Adjusted R²	0.334	0.526	0.302	0.135	0.462	0.550	0.247	0.180	0.597
Observations	42	34	39	33	47	15	17	38	22
	Tobit Regressions								
	Income Levels				**Regions**				
	HI	UMI	LMI	LI	ECA	EAP	MENA	SSA	LA
Constant	0.576	**3.997** **	1.046	**3.493*** **	**1.725*** **	-1.023	**3.354***	**4.287*** **	-9.765
	(0.283)	**(0.021)**	(0.313)	**(0.007)**	**(0.004)**	(0.545)	**(0.058)**	**(0.002)**	(0.043)
Facebook Penetration	0.002	**-0.034** **	0.020	0.003	**-0.017** **	0.012	-0.015	-0.025	0.056
	(0.744)	**(0.023)**	(0.326)	(0.978)	**(0.011)**	(0.497)	(0.324)	(0.667)	(0.103)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
LR Chi-Square	**18.12*** **	**29.06*** **	**14.72*** **	5.15	**29.25*** **	**13.03** **	4.18	9.50	**24.53*** **
Pseudo R²	0.188	0.253	0.117	0.056	0.253	0.289	0.102	0.086	0.446
Log Likelihood	-38.894	-42.889	-55.048	-42.825	-43.180	-16.011	-18.276	-50.197	-15.200
Observations	42	34	39	33	47	15	17	38	22

***,**,*: significance levels at 1%, 5% and 10% respectively. HI: High Income countries. UMI: Upper Middle Income countries. LMI: Lower Middle Income countries. LI: Low Income countries. ECA: Europe & Central Asia. EAP: East Asia & the Pacific. MENA: Middle East & North Africa. SSA: Sub-Saharan Africa. LA: Latin America. The table values refer to estimated coefficients, information criterion and number of countries or observations. LR Chi-Square, Pseudo R² and Log Likelihood are the information criteria.

5. Concluding implications and future research directions

This study has investigated the relationship between social media and homicide in a cross section of 148 countries for the year 2012. The empirical evidence is based on Ordinary Least Squares, Tobit and Quantile regressions. The findings from Ordinary Least Squares and Tobit regressions show a negative relationship between Facebook penetration and the homicide rate. The negative relationship is driven by the 75^{th} quantile of the conditional distribution of the homicide rate. The negative nexus is also driven by upper middle income countries and "Europe and Central Asia". Three main implications are apparent when the findings are compared and contrasted. First, the established findings from OLS and Tobit regressions are driven by countries with above-median levels of homicides. Second, such above-median countries are largely associated with upper middle income countries and nations in "Europe and Central Asia". Third, modelling the relationship between Facebook penetration and homicide at the conditional mean of homicide may be misleading unless it is contingent on initial levels of homicides and tailored differently across income levels and regions of the world.

The established negative relationship between facebook penetration and homicide can be explained from a plethora of perspectives. Compared to other income levels and regions, in upper middle income countries as well as countries in Europe and Central Asia, policies governing information technology may be such that social media platforms are used in avoiding social ills and enhancing social cohesion. This may further imply that some form of harmonization in social media policies could be apparent in these countries such that country-specific policies are not enough because issues pertaining to social media can also be of international and regional nature. Given that the 75th quantile is indicative of countries in which the homicide rate is above the median, it could also be inferred that the underlying countries (i.e. upper middle income, European and Central Asian) may be more advanced in the adoption of policies that are tailored towards leveraging on social media to improve social cohesion and minimize social concerns.

In order for the appealing influence of social media on homicide to be extended to other regions and income levels in which the relationship is not significant, the adoption of common policies could be vital. For example, regions sharing similar economic policies can benefit from adopting the same legal framework, information system community and prevention channels. These, *inter alia*, can involve common actions prompting Facebook to delete unhealthy content from its social media platform as well improved tracking systems that identify messages and information susceptible of creating circumstances that are favorable to the occurrence of homicide.

The established findings run contrary to concerns from policy and scholarly circles that Facebook penetration is fuelling murders, conflicts and homicides around the world (see Browning, 2018; Dreyfuss, 2017; Patton *et al*., 2014; Bejan, 2018; Storrod & Densley, 2017). From a theoretical perspective, the findings are inconsistent with the Wound Culture Theory (Seltzer, 1998; Gibson, 2006), but in line with the theoretical underpinnings related to social control and conflict management (Black, 1990; Thomas-Kilman, 1992). A possible reason the association between Facebook penetration and homicide is negative is because social media also provides platforms of sensitization through which conflicts are resolved and citizens are better informed on the importance of using social media for productive ends. Hence, while we have observed from the introduction of the study that Facebook penetration has been responsible for a number of homicides; the discourses do not withstand empirical scrutiny. In summary, the study is broadly consistent with contemporary literature on the importance of information technology in positive development outcomes (Afutu-Kotey et al., 2017; Bongomin et al., 2018; Asongu & Boateng, 2018; Humbani & Wiese, 2018; Gosavi,

2018; Isszhaku et al., 2018; Muthinja & Chipeta, 2018; Minkoua Nzie et al., 2018; Abor et al., 2018; Tchamyou et al., 2019; Tchamyou, 2019).

The main caveat of this study is that only relationships have been established due to the cross sectional nature of the dataset. As more data become available, assessing if the established findings withstand empirical scrutiny within the framework of causality is worthwhile. Moreover, it is also important to engage country-specific studies in order to establish findings that reflect more targeted country-specific implications. Another caveat in this study is that Facebook is not the only measurement of social media. However, only Facebook penetration is used owing do data availability constraints at the time of the study. This implies that the nexus between homicide and Facebook penetration is limited to certain countries. For instance, Facebook has limited penetration in China and Russia partly because these countries have alternative social media platforms and alphabet. Hence, in future studies, engaging country-specific studies with particular emphasis on country-specific dominant social media platforms is worthwhile.

6. Compliance with Ethical Standards

The authors are self-funded and have received no funding for this manuscript.

The authors also have no conflict of interest. This article does not contain any studies with human participants or animals performed by the authors.

Appendices

Appendix 1: Definitions of variables

Variables	Definition of variables and sources
Homicides	Number of homicides per 100,000 people United Nations Office on Drugs and Crime (UNODC) Surveys on Crime Trends and the Operations of Criminal Justice Systems (CTS); EIU estimates
Facebook Penetration	Facebook penetration (2012), defined as the percentage of total population that uses Facebook. From Quintly.
Access to Weapons	Ease of access to small arms and light weapons Qualitative assessment by EIU analysts
Violent crime	Level of violent crime Qualitative assessment by EIU analysts
Conflict Intensity	Conflict Intensity, GPI
Political instability	Political instability Qualitative assessment by EIU analysts
Security Officers & Police	Number of internal security officers and police per 100,000 people UNODC; EIU estimates

Uppsala Conflict Data Program (UCDP). The Institute for Economics and Peace (IEP). The Economic Intelligence Unit (EIU). United Nations Peacekeeping Funding (UNPKF). GDP: Gross Domestic Product. The International Institute for Strategic Studies (*IISS).* GPI: Global Peace Index.

Appendix 2: Summary Statistics and presentation of countries

Panel A: Summary Statistics

Variables	Mean	Standard dev.	Minimum	Maximum	Obsers
Homicides	2.799	1.170	1.183	5.000	148
Facebook Penetration	19.868	18.566	0.038	97.636	148
Access to Weapons	3.118	1.077	1.000	5.000	148
Violent Crime	2.774	1.109	1.000	5.000	148
Conflict Intensity	2.432	1.164	1.000	5.000	148
Political Instability	2.546	1.004	1.000	5.000	148
Security Officers & Police	2.728	0.919	1.081	5.000	148

Panel B: Sampled countries (148)

"Afghanistan; Albania; Algeria; Angola; Argentina; Armenia; Australia; Austria; Azerbaijan; Bahrain; Bangladesh; Belarus; Belgium; Benin; Bhutan; Bolivia; Bosnia and Herzegovina; Botswana; Brazil; Bulgaria; Burkina Faso; Burundi; Cambodia; Cameroon; Canada; Central African Republic; Chad; Chile; China; Colombia; Costa Rica; Croatia; Cyprus; Czech Republic; Democratic Republic of the Congo; Denmark; Djibouti; Dominican Republic; Ecuador; Egypt; El Salvador; Equatorial Guinea; Eritrea; Estonia; Ethiopia; Finland; France; Gabon; Georgia; Germany; Ghana; Greece; Guatemala; Guinea; Guyana; Haiti; Honduras; Hungary; Iceland; India; Indonesia; Iraq; Ireland; Israel; Italy; Jamaica; Japan; Jordan; Kazakhstan; Kenya; Kuwait; Kyrgyz Republic; Laos; Latvia; Lebanon; Lesotho; Libya; Lithuania; Macedonia (FYR); Madagascar; Malawi; Malaysia; Mali; Mauritania; Mauritius; Mexico; Moldova; Mongolia; Montenegro; Morocco; Mozambique; Namibia; Nepal; Netherlands; New Zealand; Nicaragua; Niger; Nigeria; Norway; Oman; Pakistan; Panama; Papua New Guinea; Paraguay; Peru; Philippines; Poland; Portugal; Qatar; Republic of the Congo; Romania; Russia; Rwanda; Saudi Arabia; Senegal; Serbia; Sierra Leone; Singapore; Slovakia; Slovenia; Somalia; South Africa; South Korea; Spain; Sri Lanka; Swaziland; Sweden; Switzerland; Tajikistan; Tanzania; Thailand; The Gambia; Togo; Trinidad and Tobago; Tunisia; Turkey; Turkmenistan; Uganda; Ukraine; United Arab Emirates; United Kingdom; United States of America; Uruguay; Uzbekistan; Venezuela; Vietnam; Yemen and Zambia"

Standard dev: standard deviation. Obsers: Observations.

Appendix 3: Correlation matrix

Weapons	Crime	Conflict Intensity	Political Instability	Security	Facebook	Homicides	
1.000	0.636	0.605	0.615	-0.0006	-0.545	0.527	Weapons
	1.000	0.563	0.492	-0.094	-0.449	0.578	Crime
		1.000	0.685	0.038	-0.531	0.337	Conflict Intensity
			1.000	0.039	-0.650	0.263	Political Instability
				1.000	0.083	-0.031	Security
					1.000	-0.363	Facebook
						1.000	Homicides

Weapons: access to weapons. Crime: violent crime. Security: Security Officers & Police.

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