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Crime and Social Media

Forthcoming: Information Technology & People

Simplice A. Asongu

Development Finance Centre, Graduate School of Business,
University of Cape Town Cape Town South Africa.

&

Department of Economics & Development Studies,
Covenant University, Ota, Ogun State, Nigeria

E-mails: asongusimplice@yahoo.com /
asongus@afridev.org

Jacinta Nwachukwu

Lancashire School of Business and Enterprise,
University of Central Lancashire

Preston PR1 2HE

United Kingdom

Email: jcnwachukwu@uclan.ac.uk

Stella-Maris I. Orim

School of Engineering, Environment and Computing,
Coventry University, Priory Street, Coventry CV1 5DH, UK

E-mail: S.Orim@coventry.ac.uk

Chris Pyke

Lancashire School of Business and Enterprise

University of Central Lancashire

Preston, PR2 2HE

United Kingdom

Email: cpyke2@uclan.ac.uk

Abstract

Purpose-The study complements the scant macroeconomic literature on the development outcomes of social media by examining the relationship between Facebook penetration and violent crime levels in a cross-section of 148 countries for the year 2012.

Design/methodology/approach-The empirical evidence is based on Ordinary Least Squares (OLS), Tobit and Quantile regressions. In order to respond to policy concerns on the limited evidence on the consequences of social media in developing countries, the dataset is disaggregated into regions and income levels. The decomposition by income levels included: low income, lower middle income, upper middle income and high income. The corresponding regions include: Europe and Central Asia, East Asia and the Pacific, Middle East and North Africa, Sub-Saharan Africa and Latin America.

Findings-From OLS and Tobit regressions, there is a negative relationship between Facebook penetration and crime. However, Quantile regressions reveal that the established negative relationship is noticeable exclusively in the 90th crime decile. Further, when the dataset is decomposed into regions and income levels, the negative relationship is evident in the Middle East and North Africa (MENA) while a positive relationship is confirmed for sub-Saharan Africa. Policy implications are discussed.

Originality/value- Studies on the development outcomes of social media are sparse because of a lack of reliable macroeconomic data on social media. This study primarily complemented three existing studies that have leveraged on a newly available dataset on Facebook.

JEL Classification: K42; D83; O30; D74; D83

Keywords: Crime; Social media; ICT; Global evidence; Social networks

1. Introduction

In every corner of the earth, there are a growing number of citizens who considerably rely on social media for information and discussion. The knowledge gained could either moderate their position on some conflicting interests or consolidate their radical standpoint. Discussions may be within personal networks as well as individuals without any prior ties with whom offline interactions would have been impossible owing to, *inter alia*: distances and asymmetric daily schedules (Barberá, 2015). In the light of the growing relevance of social media platforms in everyday corporate and household activities, a recent World Bank report on digital dividends has recommended more research on the socio-economic and development consequences of social media (World Bank, 2016).

In response to above policy concern, the positioning of this study on the relationship between social media and crime is motivated by the growing cost of crime and violence on the one hand and gaps in the literature, on the other. These two issues are substantiated below in this order.

First, a substantial part of annual global wealth is increasingly being spent by governments in the prevention and mitigation of violence, crimes, political-instability with consequent externalities (Asongu, 2018; GPI, 2016; Anderson, 2015; Asongu and Kodila-Tedika, 2017). According to the attendant policy and scholarly literature, the underlying annual global wealth spent is about 14.3 trillion USD and represents the combined Gross Domestic Product (GDP) of the following advanced countries, namely: Brazil, Canada, France, Germany, Spain and the United Kingdom (UK). This policy effort can be considerably improved with evidential insights into the relationship between social media and crime across the world. Unfortunately, the extant macroeconomic contemporary literature on this interconnection is rare because of a lack of appropriate data.

Second, the existing literature on crimes can be summarized in two main strands, notably: (i) studies on crime and (ii) literature on the relationship between social media and crime. The former strand has largely focused on: risk evaluations in decisions on sentencing (Kopkin *et al.*, 2017); assessment of parallels between mass incarceration and mass deportation (Tanya, 2017); determinants of drug use after sentencing (Rao *et al.*, 2016); the relevance of legal origins in cross-country consequences of crime (D'Amico and Williamson, 2015); the role of restorative justice in crime prevention (Wood, 2015); the imprisonment of adolescents that are traumatized (Mallet, 2015); drivers and deterrents of juvenile delinquency after sentencing (Olashore *et al.*, 2017); the relationship between inequality, imprisonment and public health (Wilderman and Wang, 2017) and strategies designed to support families and children whose parents have been imprisoned (Kjellstrand, 2017). The strand of literature on the association between social media and crime has focused on: developing social media-based suicide prevention messages (Robinson *et al.*, 2017); the use of Twitter to monitor mental health discussions (McClellan *et al.*, 2017); examining suicide risks and emotional distress in Chinese social media (Chen *et al.*, 2017); social media and the emerging suicide death rate among military personnel (Bryan *et al.*, 2018) and the designing of microblog direct messages used in the engagement of users of social media who have suicide intentions (Tan *et al.*, 2017).

Noticeably, the foregoing literature has the shortcoming of being too exploratory and country-specific. For instance, the study by Robinson *et al.* (2017), Tan *et al.* (2017) and Chen *et al.* (2017) were focused on China while, Bryan *et al.* (2018) was concerned with the United States

of America. The present study addresses this country-specific shortcoming by employing a global dataset of 148 countries on the one hand and on the other, decomposing the dataset into regions and income levels, in order to increase the policy relevance of the study. The disaggregation is also motivated by the imperative of articulating developing countries, in order to address a concern by the World Bank which maintains that the development consequences of social media, especially in developing countries have not been substantially researched and documented (World Bank, 2016)¹.

In the light of the observation of the World Bank, a reason for the scant empirical analyses on the macroeconomic consequences of social media is the lack of relevant data. As far as we have reviewed, only three studies have employed a recent Facebook penetration dataset to assess the association between social media usage and development outcomes. Kodila-Tedika (2018) has investigated the link between Facebook penetration and the governance of natural resources, Jha and Sarangi (2017) have examined if Facebook penetration influences corrupt behavior while Jha and Kodila-Tedika (2018) have investigated if democracy is promoted by Facebook penetration.

The current study improves this strand of literature by evaluating the strength of the connection between Facebook penetration and crime. The empirical evidence is based on Ordinary Least Squares (OLS), Tobit and Quantile regressions and data from 148 countries for the year 2012. From OLS and Tobit regressions, there is a negative relationship between Facebook penetration and crime. From Quantile regressions, the established negative relationship is apparent exclusively in the 90th decile. When the dataset is decomposed into regions and income levels, the negative relationship is obvious in the Middle East and North Africa (MENA) while a positive relationship is established for sub-Saharan Africa.

The results of our empirical analyses have significantly improved the narratives in the aforementioned exploratory and country-specific studies in three key ways. *First*, they complemented the description by Tan *et al.* (2017) and other country-specific studies by confirming the policy relevance of the negative association between social media and crime. This global dimension can lead to the adoption of more holistic policies that are applicable to a

¹The positioning and design of this paper is consistent with the extant recent empirical and theoretical studies on the relevance of information technology in: (i) enhancing conditions for human development (Afutu-Kotey et al., 2017; Bongomin et al., 2018 ; Asongu and Boateng, 2018; Gosavi, 2018; Hubani and Wiese, 2018; Minkoua Nzie et al., 2018; Isszhaku et al., 2018; Abor et al., 2018; Muthinja and Chipeta, 2018; Asongu and Nwachukwu, 2018a, 2018b) and improving society with opportunities for human emancipation (Kreps and Kimppa, 2015; Tatnall, 2015; Lennerfors et al., 2015; Patrignani and Whitehouse, 2015; Aricat, 2015; Lahtiranta et al., 2015; Tchamyou, 2017, 2018; Tchamyou and Asongu, 2017).

wide variety of countries. *Second*, the findings improve exploratory studies (e.g. Robinson *et al.*, 2017) by establishing that the hypothetical negative relationship between social media and crime withstands empirical scrutiny within the framework of Facebook penetration. *Third*, contrary to the previous studies, our findings do not support a “one size fits all implications for policy” because they are articulated along two main dynamics: on the one hand, income levels and regions and on the other hand, initial levels of crime. Accordingly, beyond the emphasis on income levels and regions, the fact that the estimated negative relationship is exclusively apparent at the highest quantile of the crime distribution is an indication that blanket policies on the nexus between Facebook penetration and crime cannot be effective unless they are contingent on initial levels of crime and tailored differently across countries with low, intermediate and high initial levels of crime.

Overall, the findings are broadly consistent with the existing literature. According to Chen *et al.* (2017), social media can be used to effectively assess emotional distress and suicide risk. Robinson *et al.* (2017) concluded that social media could potentially be an important mechanism for the prevention and moderation of distress as well as suicidal behavior and thoughts. This is consistent with the position of Bryan *et al.* (2018) who subsequently found that certain sequences in the content of social media could predict the cause and timeline of death by suicide. The conclusions of Bryan *et al.* (2018) are in line with Tan *et al.* (2017) who reported that whereas web-based interventions can be effective in the prevention of online suicide, it is also imperative to increase user engagement with online information and discussion groups.

The rest of the study is structured as follows. Section 2 dwells on the theoretical underpinning whereas the data and methodology are covered in Section 3. The empirical results are presented in Section 4 while Section 5 concludes.

2. Theoretical underpinnings

The theoretical connection between social media and crime can be elucidated from three main perspectives, notably: (i) a Wound Culture Theory (WCT) if Facebook penetration positively affects crime; (ii) social control and conflict management theories in a scenario where Facebook penetration reduces crime and (iii) irrespective of the direction of effect (i.e. whether positive or negative), both strands of theoretical underpinnings rely on technology acceptance models. The three theoretical frameworks are expanded in chronological order.

The WCT can be used to elicit some negative socio-economic signals such as crimes, political instability and violence. The WCT was developed by Mark Seltzer (1998) and later summarised by Gibson (2006) as follows:

“Serial 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” (p.19).

According to the WCT, the desire to inflict harm on humans in society is both literal (via mutilation) and figuration (via criticism). The relevance of crime is considered within the theoretical framework as a common focus 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).* The author has further observed that the wound theory has considerable implications 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 (Seltzer, p.21)”*. Social media can be used to fuel the wound culture because it is a mechanism by which information is exchanged to either increase contention or hatred among users or improve harmony and moderation among them. In the latter scenario, conflict management and social control models are more relevant.

Social control and conflict management models have been used to substantiate theoretical underpinnings in recent conflict management literature (Asongu and Kodila-Tedika, 2017), namely: the Conflict Management Model (CMM) of Thomas-Kilman (1992) and the Social Control Theory (SCT) Black (1990). The SCT maintains that relationships between organisations, groups and individuals typically affect the exercise of one among five fundamental channels of social control, notably: self-help, settlement, avoidance, tolerance and negotiation. Conversely, the CMM argues that strategic ambitions that are very likely to centre on a two dimensional matrix (of cooperation and assertiveness), when merged with collaboration could result in five principal styles in the management of conflicts, namely: avoidance, compromise, collaboration, competition and accommodation. These theoretical insights are broadly in line with the conflict management literature (Borg, 1992; Volkema and Bergmann, 1995; Akinwale, 2010; Asongu and Kodila-Tedika, 2017). Social media provides

the platforms which underpin the conflict management and social control theories herein discussed.

The effectiveness of either the WCT or social control theories depends on technology acceptance models. In accordance with recent social media (Nikiforova, 2013; Lee and Lowry, 2015; Cusick, 2014) and information technology (Yousafzai *et al.*, 2010; Asongu *et al.*, 2018a) studies, technology acceptance models are dominated by three principal theories which justify the adoption and use of specific types of communication tools. They are: (i) the theory of reasoned action (TRA), (ii) theory of planned behavior (TPB) and (iii) technology acceptance model (TAM).

Consistent with the TRA, the underpinning hypothesis is that, when the acknowledgement of actions come into play, customers display rational features (Fishbein and Ajzen, 1975; Ajzen and Fishbein, 1980; Bagozzi, 1982). Given the context of the study, these rational traits could motivate new ideas, notably: either to the resolution of conflicts or in the perception of crime as a solution to conflicts. The TPB is an extension of the TRA which articulates the absence of a difference between customers who are conscious of the ramifications of their actions and those that are lacking in this consciousness (Ajzen, 1991). The theory is in accordance with social media because crime prevention or crime propagation can be done by users with or without, adequate certainty on the soundness of the information being shared. Concerning the TAM, the principal driver behind a customer's motivation to adopt a specific technology is traceable to preferences and the will of a client to adopt and use a specific means of communication (Davis, 1989). Hence, the selection of social media platform by a user is contingent on the relevance of the social media network in attenuating or fuelling crime.

The three strands of theories, which were discussed in the previous paragraphs, are also relevant to the positioning of this study because: (i) Facebook penetration entails the adoption and usage of a specific type of social media (which is consistent with technology acceptance models) and (ii) Facebook can either be used to fuel or deter crime. On the one hand, the use of Facebook to fuel crime is consistent with Wound Culture Theory while the use of the Facebook to mitigate crime is in line with the Social Control Theory and the Conflict Management Model. On the other, the common features among technology acceptance models merit contextualisation. Accordingly, the TRA, TPB and TAM articulate the perspective that the use and adoption of particular types of communication mechanisms encompass a multitude of traits, namely: (i) the formation of customer belief and (ii) the composite elements which entail,

utilitarian, behavioural, psychological and social characteristics. In what follows, these common features are contextualised.

Within the specific context of this study; (i) the utilitarian view is apparent when a social media platform is adopted by an individual because he/she presumes that such a platform is relevant in enhancing his/her opportunities for fuelling or preventing crime; (ii) with regard to the behavioural view, even in a scenario where personal motivation is not apparent, an individual can still take the decision to use social media if he/she already has some degree of awareness that adopting social media for crime-related purposes is a social norm; (iii) psychological and personal motivations can also be important in the decision of an individual to adopt a social media platform for crime-related concerns if the person is motivated by private potential rewards in crime prevention and/or crime instigation by means of social media and (iv) the importance of belief formation in a individual is consolidated by the view that it is an accepted social norm that social media can either be used to prevent crime or instrumented to fuel crime.

In the light of the above concepts, the decision by an individual to adopt Facebook for a crime-related ambition can be inspired by both idiosyncratic (or individual) and systemic (or social) factors as well as the potential advantages of using the social media platform to realise his/her crime-related objective.

The choice of variables in the conditioning information set is consistent with wound culture (i.e. for the Wound Culture Theory), conflict management (i.e. for the Conflict Management Model) and social control (i.e. for the Social Control Theory). These control variables which are discussed in the data section include: (i) access to weapons, (ii) homicide rate, (iii) prison incarcerations, (iv) violent demonstrations and (v) conflict intensity.

3. Data and methodology

3.1 Data

The study focuses on a cross-section of 148 countries for the year 2012. The selected geographic and temporal scopes are due to data availability constraints. The data comes from variables sources, notably: the Uppsala Conflict Data Program (UCDP) Battle-Related Deaths Dataset; Qualitative assessments by Economic Intelligence Unit (EIU) analysts' estimates; the Operations of Criminal Justice Systems (CTS); the International Institute for Strategic Studies (IISS) the Institute for Economics and Peace (IEP); the United Nations Office on Drugs and Crime (UNODC) Surveys on Crime Trends, Quarterly and the United Nations Committee on Contributions. The selection of these sources is motivated by recent literature on crime and

violence (Asongu and Acha-anyi, 2018; Asongu, 2018). Moreover, to the best of our knowledge, the sources are used by authoritative scholarly and policy reports and datasets on crime and peace. These include: reports on the global peace index and the global terrorism database.

The dependent variable is the level of violent crime from the Qualitative assessment by the EIU analysts' estimates while the data on Facebook penetration (which is a proxy of social media usage) is from Quintly, which is a social media benchmarking and analytics Solution Company². This data on social media is consistent with recent literature on the consequences of social media on development outcomes (Jha and Sarangi, 2017; Jha and Kodila-Tedika, 2018; Kodila-Tedika, 2018). Such confirms the authenticity of our source of data on Facebook penetration. However, as in the case of these other previous studies, the findings are interpreted as simple correlations without causal inferences. This is due to, the cross sectional nature of the dataset. This caveat is also disclosed in the concluding section. In summary, in the absence of panel data, the use of cross-sectional data to inform scholars and policy makers on the relationships between a new phenomenon (such as social media penetration) and social outcomes (such as crime), is a useful initial scientific activity.

Five main control variables are adopted in this study. They are: (i) access to weapons; (ii) homicide; (iii) incarcerations; (iv) violent demonstrations and (v) conflict intensity. The selection of the variables to be included in the conditioning information set is supported by the findings of recent studies on the determinants of conflicts, crime, incarcerations and violence (Asongu and Acha-anyi, 2018; Asongu and Kodila-Tedika, 2016, 2017; GPI, 2016; Freytag *et al.*, 2011; Blanco and Grier, 2009). They commonly advised that variables which are most likely to be associated with crime (as documented in the attendant literature) should be used as control variables. In accordance with the existing literature, we expect these variables to positively influence the crime rate. This is essentially because they reflect conditions that are favorable to criminality and violence. The choice of these control variables is also consistent with the aforementioned theories because they are by definition concomitant with wound culture, conflict management and social control. Appendix 1 provides the definitions of variables while Appendix 2 discloses the summary statistics (in Panel A) and the sampled countries (in Panel B). A correlation matrix is also provided in Appendix 3.

Secondary data is used for the study. Hence, contrary to the requirement of discussing how the data is collected as it is the case of primary data, the study defines the variables, justifies

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

the reliability of their sources and articulates how the choice of the variables are in conformity with existing literature and the problem statement being investigated. The interested reader is advised to obtain further information on how data on each variable was collected by referring to the original sources identified in the previous paragraph

3.2 Methodology

3.2.1 Ordinary Least Squares

Borrowing from recent literature based on cross-sectional observations, the Ordinary Least Squares (OLS) estimation strategy is considered because the underlying assumptions are in agreement with the nature of the dataset. The latest articles have advised the use of this estimation approach on cross-sectional data (Andrés, 2006; Asongu, 2013a; Kodila-Tedika and Asongu, 2015). The following equation illustrates the relationship between Facebook penetration and crime.

$$C_i = \alpha_1 + \alpha_2 F_i + \alpha_3 X_i + \varepsilon_i, \quad (1)$$

where C_i and F_i represents the crime and Facebook penetration indicator for country i in that order, α_1 is a constant, X is a vector of control variables, and ε_i the error term. X contains the following five variables: (i) *access to weapons*; (ii) *homicide*; (iii) *incarcerations*; (iv) *violent demonstrations* and (v) *conflict intensity*.

3.2.2 Tobit regressions

The level of violent crime as rated by the EIU analysts' varies from 0 to 5. Theoretically, the OLS approach could be complemented with Tobit regressions because the dependent variable has a restricted range (Kumbhakar and Lovell, 2000; Koetter *et al.*, 2008; Ariss, 2010; Coccoresse and Pellecchia, 2010). Moreover, a double-censored Tobit approach is the same as estimating with a linear regression technique because the two likelihood functions coincide (Coccoresse and Pellecchia, 2010; Asongu and Nwachukwu, 2016; Ajide *et al.*, 2018).

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

$$y_{i,t}^* = \alpha_0 + \beta X_{i,t} + \varepsilon_{i,t}, \quad (2)$$

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

$$y_{i,t} = \begin{cases} y_{i,t}^*, & \text{if } y_{i,t}^* > \gamma \\ 0, & \text{if } y_{i,t}^* \leq \gamma, \end{cases} \quad (3)$$

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 are based on the conditional mean of the dependent variable. In order to address this static concern, the Quantile regression approach is adopted to estimate parameters throughout the conditional distribution of the dependent variable (Koenker and Bassett, 1978). While mean effects in the previous two estimation techniques are relevant, the Quantile regression technique articulates lower, intermediate and higher levels of crime. The Quantile regression strategy is increasingly being employed in the empirical literature in order to provide more policy implications. Most notable studies are in: health (Asongu, 2014a), finance, (Asongu, 2014b) and corruption (Billger and Goel, 2009; Asongu, 2013b; Okada and Samreth, 2012).

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

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

where $\theta \in (0,1)$. Contrary to OLS method which is fundamentally based on minimizing the sum of squared residuals, the QR approach focuses on minimising the weighted sum of absolute deviations for different quantiles such as the 50th quantile or 90th decile (with $\theta = 0.50$ or 0.90 respectively). The conditional quantile of the crime rate or y_i given x_i is shown as:

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

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 the crime rate. For Eq. (5) the dependent variable y_i is

crime whereas x_i is a vector contain in the following control variables: a constant term, *access to weapons*; *homicide*; *incarcerations*; *violent demonstrations* and *conflict intensity*

4. Empirical analysis

4.1 Presentation of results

The empirical results pertaining to OLS and Tobit regressions are presented in Table 1. Findings reported on the left-hand side (LHS) and right-hand side (RHS) are respectively from OLS and Tobit regressions. The following outcomes are observable from the table. *First*, Facebook penetration is negatively correlated with the crime rate. The negative relationship is robust to the first-three specifications on the LHS and the first-two specifications on the RHS. It is important to note that the best specification is the third because concerns of multicollinearity are less noticeable. Putting aside the concern of multicollinearity, univariate regressions depict a negative correlation between the two variables of interest. However, the magnitude of negative relationship decreases as the number of variables in the conditioning information set is increased. This change is normal because in the real world, Facebook penetration and crime do not interact in isolation, but the connection is contingent on other determinants of crime. Moreover, as more control variables are added to the specifications, the coefficient of adjustment (i.e., adjusted R-squared) increases. The significant determinants of crime (or control variables) in the conditioning information set have the expected positive signs.

Table 1: Ordinary Least Squares and Negative Binomial regressions

	Dependent variable: Crime							
	Ordinary Least Squares				Tobit Regressions			
Constant	3.322*** (0.000)	1.176*** (0.000)	0.860** (0.019)	-0.081 (0.822)	3.426*** (0.000)	0.858** (0.026)	0.436 (0.303)	-0.710 (0.122)
Facebook Penetration	-0.027*** (0.000)	-0.008** (0.032)	-0.006* (0.087)	0.0009 (0.798)	-0.033*** (0.000)	-0.010* (0.056)	-0.008 (0.135)	0.0007 (0.888)
Access to Weapons	---	0.579*** (0.000)	0.412*** (0.000)	0.218*** (0.006)	---	0.687*** (0.000)	0.495*** (0.000)	0.266** (0.010)
Homicide	---	---	0.316*** (0.000)	0.324*** (0.000)	---	---	0.360*** (0.000)	0.368*** (0.000)
Incarcerations	---	---	-0.047 (0.559)	-0.023 (0.752)	---	---	-0.022 (0.821)	0.005 (0.951)
Violent Demonstrations	---	---	---	0.294*** (0.000)	---	---	---	0.378*** (0.000)
Conflict Intensity	---	---	---	0.193** (0.010)	---	---	---	0.207** (0.023)
Fisher	15.36***	65.84***	41.01***	37.20***				
Adjusted R ²	0.202	0.419	0.496	0.576				
LR Chi-Square					33.38***	78.44***	97.57***	123.06***
Pseudo R ²					0.069	0.162	0.202	0.255
Log Likelihood					-224.597	-202.069	-192.501	-179.757

Observations	148	148	148	148	148	148	148	148
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***, **, *: significance levels at 1%, 5% and 10% respectively.

Table 2 provides the Quantile regressions results which are based on the third specification of OLS and Tobit regressions in Table 1. As discussed previously, this third specification in Table 1 provides our best Facebook estimator because issues of multicollinearity are more apparent in the fourth specification. Consistent differences in the estimated Facebook coefficients between the OLS/Tobit and Quantiles regressions (in terms of sign, magnitude and significance) provides justification for our decision to employ the three separated estimation methods in this study. The main finding in the Quantile regression in Table 2 is that, the established negative relationship between Facebook penetration and crime is highest in the 90th decile. Again, the significant control variables display the expected signs.

Table 2: Quantile Regressions

	Dependent variables: Crime				
	Q.10	Q.25	Q.50	Q.75	Q.90
Constant	0.614 (0.328)	0.348 (0.473)	0.743 (0.100)	1.428* (0.077)	1.952*** (0.001)
Facebook Penetration	-0.008 (0.168)	-0.003 (0.533)	-0.005 (0.344)	-0.007 (0.421)	-0.018*** (0.003)
Access to Weapons	0.308*** (0.008)	0.364*** (0.001)	0.449*** (0.000)	0.449** (0.014)	0.399*** (0.001)
Homicide	0.154* (0.066)	0.315*** (0.000)	0.278*** (0.003)	0.389** (0.018)	0.356*** (0.002)
Incarcerations	-0.034 (0.830)	-0.011 (0.914)	-0.029 (0.780)	-0.160 (0.309)	0.023 (0.819)
Pseudo R ²	0.264	0.248	0.293	0.310	0.376
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 Crime is least.

4.2 Extension with fundamental characteristics

As an extension of our empirical analysis, a recent concern raised by a World Bank report is addressed in this section. This relates to the poor coverage in the literature of the importance of social media in development outcomes, especially for developing countries (World Bank, 2016). In order to articulate the relevance of our analysis for developing nations, the dataset is disaggregated into regions and income levels. This decomposition by regions and income groups is in accordance with the World Bank's classification of income groups and a recent stream of development studies (Narayan *et al.*, 2011; Beegle *et al.*, 2016; Asongu and Nwachukwu, 2017; Mlachila *et al.*, 2017; Asongu and Le Roux, 2017)³. The decomposition by income levels comprises: low income, lower middle income, upper middle income and high

³ 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.

income. The corresponding regions include: Europe and Central Asia, East Asia and the Pacific, Middle East and North Africa, Sub-Saharan Africa and Latin America.

Table 3 : Comparative evidence on social media and political instability

	Dependent variable: Crime								
	Ordinary Least Squares (OLS)								
	Income Levels				Regions				
	HI	UMI	LMI	LI	ECA	EAP	MENA	SSA	LA
Constant	0.513 (0.429)	1.818* (0.085)	0.938 (0.304)	1.060 (0.249)	0.798* (0.078)	0.394 (0.780)	0.983 (0.506)	0.472 (0.581)	0.711 (0.686)
Facebook Penetration	-0.003 (0.421)	0.0008 (0.937)	0.015 (0.337)	0.053 (0.549)	-0.002 (0.572)	0.00008 (0.995)	-0.049*** (0.001)	0.054*** (0.003)	-0.011 (0.567)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fisher	5.87***	6.20***	2.46***	5.85***	13.60***	2.40***	12.20***	7.46***	6.34***
Adjusted R ²	0.421	0.451	0.231	0.293	0.564	0.469	0.551	0.379	0.391
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	0.061 (0.931)	1.094 (0.489)	0.345 (0.742)	0.493 (0.671)	0.753 (0.220)	-0.314 (0.850)	0.582 (0.740)	-0.336 (0.784)	-1.134 (0.677)
Facebook Penetration	-0.007 (0.461)	-0.0001 (0.991)	0.017 (0.433)	0.073 (0.559)	-0.005 (0.418)	0.003 (0.863)	-0.065** (0.018)	0.077** (0.047)	-0.027 (0.415)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
LR Chi-Square	17.47***	14.69***	11.04***	11.60***	37.10***	9.48***	12.94***	17.92***	12.12***
Pseudo R ²	0.158	0.149	0.089	0.122	0.303	0.184	0.233	0.165	0.176
Log Likelihood	-46.563	-41.830	-56.168	-41.455	-42.608	-21.015	-21.245	-45.326	-28.262
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: Little Middle Income countries. LI: Low Income countries. ECA: Europe and Central Asia. EAP: East Asia and the Pacific. MENA: Middle East and North Africa. SSA: Sub-Saharan Africa. LA: Latin America.

4.3 Discussion

The negative relationship between social media and violent crime can be elucidated from two main perspectives: (i) friendly interactions for ideological moderation and (ii) ideological harmonisation. These two perceptions are expanded in chronological order.

First, a possible reason for the negative association between Facebook penetration and crime is because the information sharing platform does not exclusively connect people with problems in the society– the kind of disputes that could motivate them to resort to crime as a means to resolving them. Hence, diverse information on how to solve corresponding issues may provide Facebook users with avenues and solutions to the concerns that otherwise would have been resolved through violence and crime.

The consumption of conflicting information from social media (Kaplan and Haenlein, 2010) is not exclusively limited to interactions between acquaintances, co-workers, family and

friends. This narrative is consistent with the literature maintaining that, selectivity of information is restricted because users of social media platforms are exposed to all types of information on conflict resolution and crime prevention from friends and acquaintances (Brundidge, 2010). As recently explained by Barberá (2015), in accordance with the Pew Research Centre, as of 2013, approximately half of the users of social media (i.e. Facebook and Twitter), received information from a plethora of sites while about 78% of the underlying users were exposed incidentally to information. In summary, a social media platform is a mechanism by which friendly interactions and ideological moderation can assuage violent intensions. The medium of exchange and moderation has been generally supported by the mainstream literature on this channel. Most notably: (i) Burke and Kraut (2014) who concluded that there is a considerable overlap between offline and personal networks; (ii) Gilbert and Karahalios (2009) and Jones *et al.*, (2013) who remarked that social media interactions facilitate the consolidation of interpersonal relationships (iii) Mutz, (2006) who asserted that online information sharing platforms promote ties between social media users (iv) Messing and Westwood (2014) who suggested that friendly recommendations by social media users are indications that reduce conflicting situations and (v) Barberá, (2015) who proposed that individuals are more likely to use information from people sharing the same social media platform even if they disagree with them. Such diversity in views provides a gateway to ideological moderation.

Secondly, ideological moderation is facilitated by social media because users of social media are exposed to information from people with different ideologies and network heterogeneity (Mutz, 2006; Barberá, 2015). This is contrary to a contending proposition in the literature that the exchange of information on social media is often between users of the same belief (Conover *et al.*, 2012; Colleoni *et al.*, 2014; Smith *et al.*, 2014; Barberá and Rivero, 2014). The position supported by findings in this study is that exposure to social media can moderate violent dispositions because of among others reasons relating to: “political tolerance” (Mutz, 2002), “*greater awareness of rationales for oppositional views*” (Mutz, 2002, p.114), a learning framework of socialization (Stoker and Jennings, 2008) and mitigation in overconfidence in ideological positions (Iyengar *et al.*, 2012; Ortoleva and Snowberg, 2015).

5. Concluding implications and future research directions

The study has examined the relationship between Facebook penetration and violent crime in a cross-section of 148 countries for the year 2012. The empirical evidence is based on three estimation methods: (i) Ordinary Least Squares (OLS), (ii) Tobit and (iii) Quantile regressions. From OLS and Tobit regressions, there is a negative relationship between Facebook penetration

and crime. From Quantile regressions, the established negative relationship is apparent exclusively in the 90th decile. When the dataset is disaggregated into regions and income levels, the negative relationship is noticeable in the Middle East and North Africa (MENA) while a positive relationship is confirmed for sub-Saharan Africa.

The findings have also contributed to the policy literature on the concern that the literature on the consequences of social media is sparse, especially in developing countries (World Bank, 2016). Furthermore, when existing levels of crime are taken into account in the modelling exercise, the fact that social media is most effective in countries where the crime rate is highest. Such, is an indication that blanket policies on the interconnections between Facebook penetration and crime rates are ineffective unless the application is tailored distinctly across countries with high, intermediate and low levels of crime.

The findings of the study also have implications on the social theory literature because they complement the existing studies on the importance of social networks in the behaviour of citizens (Tufekci and Wilson, 2012; Bond *et al.*, 2012; Vaccari *et al.*, 2013). As discussed in Section 4.3, our findings also clarify the relevance of social media in modulating violent tendencies owing to information diversity, ideological moderation and ideological harmonisation, when messages are disseminated via social media platforms such as the Facebook (McClurg, 2006; Klofstad, 2009; Barbera, 2015).

In the light of the above, it is also worthwhile to emphasise that, with the exception of the Sub-Saharan African region, the findings in this study challenge the mainstream wisdom that social media fuels violence. The corresponding caveat is that, the established negative link between Facebook penetration and crime is not causal. However, in the absence of panel data, the use of cross-sectional data to inform scholars and policy makers on the interconnections between a new phenomenon (such as social media) and social outcomes (such as crime), is a worthwhile initial empirical exercise.

In the light of the above shortcomings, improving the findings with panel data in the assessment of whether the relationships extend to causality is advisable. Moreover, examining the feasibility of the suggested channels of association (i.e. ideological moderation and ideological harmonisation) is another interesting future research area.

Appendices

Appendix 1: Definition of variables

Variables	Definition of variables and sources
Violent Crime	Level of violent crime Qualitative assessment by EIU analysts
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
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
Incarceration	Number of jailed population per 100,000 people World Prison Brief, International Centre for Prison Studies, University of Essex
Violent Demonstrations	Likelihood of violent demonstrations Qualitative assessment by EIU analysts
Conflict Intensity	Conflict Intensity, GPI

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
Violent Crime	2.774	1.109	1.000	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
Homicides	2.799	1.170	1.183	5.000	148
Incarceration	2.209	0.902	1.174	5.000	148
Violent Demonstrations	2.950	0.983	1.000	5.000	148
Conflict Intensity	2.432	1.164	1.000	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	Homicide	Incarcerations	Demonstrations	Conflict Intensity	Facebook	Crime	
1.000	0.527	-0.105	0.525	0.605	-0.545	0.636	Weapons
	1.000	0.186	0.256	0.337	-0.363	0.578	Homicide
		1.000	-0.160	-0.071	0.121	-0.028	Incarcerations
			1.000	0.531	-0.473	0.552	Demonstrations
				1.000	-0.531	0.563	Conflict Intensity
					1.000	-0.449	Facebook
						1.000	Crime

Weapons: Access to weapons. Homicide: Homicide rate. Incarcerations: Incarceration rate. Demonstrations: Violent demonstrations. Facebook: Facebook penetration. Crime: Violent crime.

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