

DOES INTERNET CENSORSHIP REDUCE CRIME RATE?

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Abstract—The study examines the relationship between Internet censorship and crime rate. Classical views of censorship suggest that filtering contents that are perceived as negative such as violence and pornography can have a negative impact on crime rate. However, there is no evidence to suggest any causal relationship between censorship and crime rate. The Internet has made it easier for individuals to access any information they want, and hence Internet Censorship is applied to filter contents that are deemed negative. We discussed several approaches that may be used to estimate the relationship between Internet Censorship and Crime Rate, and we decided to use OLS. We found that Conflict Internet Censorship is the only type of Internet censorship that has a significant negative impact on Crime Rate. Furthermore, it only significantly affects Crime Rate for highly educated countries.

Keywords: Internet Censorship; Crime Rate; Education; Conflict Censorship

I. INTRODUCTION

The debate for and against censorship has been going on for decades. By removing contents that are deemed inappropriate, it is reasonable to suggest that censorship may be able to control a person's behavior, including his or her likeliness to participate in crime. However, it is questionable whether or not the impact of censorship is significant enough, and censorship is not without its disadvantages. With the introduction of the Internet, everyone can access any information in an instant, and thus Internet censorship was born to control the information that is shared on the World Wide Web.

In Section II, we discuss about the definition of Internet censorship, its advantages and disadvantages. Furthermore, we discuss the theoretical relationship between Internet censorship and crime rate. We argue that although it is reasonable to suggest that Internet censorship has a negative impact on crime rate, there is no sufficient evidence to suggest that claim.

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In Section III, we discuss several approaches that can be used to estimate the relationship between Internet censorship and crime rate. We consider several methods such as OLS, fixed effects and 2SLS, but we decide to settle on OLS method. In Section IV, we talk about the obtained data regarding their sources and measurements. Furthermore, we discussed reasons why we wanted to include the obtained variables to our model.

In Section V, we estimate the relationship between Internet Censorship variable and Crime Rate variable using OLS. We conclude that only conflict Internet Censorship variable is likely to have an impact on Crime Rate variable. Furthermore, we introduce several interaction variables between each of the Internet Censorship variables and a high education dummy. We find that the impact of Internet penetration and censorship are more significant for highly educated countries. In Section VI, we summarize our results and stated several limitations of our analysis.

II. LITERATURE REVIEW

A. What is Internet Censorship?

Internet censorship refers to the act of filtering and controlling what can be accessed on the Internet, usually done by the government to control the public. There are several approaches to Internet censoring (Ref. [1]):

- **Technical Blocking.** Technical Blocking simply refers to the act of blocking access to Internet sites such as IP blocking, DNS tampering, and URL blocking using a proxy. This also includes keyword blocking, which is a method used to block access to sites that have specific words in their URLs.
- **Search Result Removals.** Search Result Removals is a common censorship approach applied by Internet search engines such as Google and Yahoo.

Instead of blocking access to specific sites, this approach makes finding them much more difficult. In many cases, this is used to make finding pirated contents much harder to do.

- Takedown. The takedown approach simply demands specific sites to be removed from the Internet.
- Induced Self-censorship. In many cases, individuals will stay away from several websites that may question the authorities, even when these sites are not restricted e.g. porn sites that include child pornography.

Furthermore, Ref. [1] divided Internet censorship into four types based on their themes:

- Political Internet Censorship. Political Internet Censorship includes censoring contents related to views that oppose the current political regime. Censorship regarding to contents related to human rights, minority rights, religious movements and freedom of speech are also included in this group. Countries with high-level Political Internet Censorship include Vietnam and Uzbekistan.
- Social Internet Censorship. Social Internet Censorship includes censoring contents that are deemed inappropriate by several religious or political groups, such as pornography, violent materials, gambling websites and any other contents that may not be suitable for children. Countries with high-level Social Internet Censorship include Saudi Arabia and United Arab Emirates.
- Conflict (Security) Internet Censorship. Conflict Internet Censorship deals with contents including separatist movements, border issues and any other military movements that may jeopardize the security and safety of the country. Countries with high-level Conflict Internet Censorship include China and South Korea.
- Internet Tools Censorship. Internet Tools Censorship covers blocking and censoring tools that are used by Internet users such as e-mail, Internet hosting, translation, search engines and any other communication tools that use the Internet. Countries with high-level Internet Tools Censorship include Saudi Arabia and United Arab Emirates.

B. Advantages and Disadvantages of Internet Censorship

The debate in censorship has never been resolved, and it only amplifies after the introduction of the Internet. There are several advantages of Internet censorship:

- It protects individuals from incorrect and biased information. According to Ref. [2] there is

no sufficient evidence to suggest that children can differentiate credible information from non-credible ones. This can be dangerous as biased and incorrect information can affect a child's perspective in a very significant way.

- It protects individuals from contents that can be deemed inappropriate such as pornography. Besides religious and ethical reasons, pornography may have negative impacts towards young men and women, as they are more likely to engage in risky sexual behaviors when they are exposed to high-level of pornography (Ref. [3]).
- It battles piracy by blocking contents that may violate intellectual property rights.
- It protects individuals from online scams.
- It can protect individuals from cyber-bullying, cyber-racism, cyber homophobia and cyber-sexism (Ref. [4]).

However, Internet censorship is not without any disadvantages. Some of these disadvantages include:

- It limits freedom of speech. According to Ref. [5], the Computer Crime Act in Thailand has been criticized for its excessive Internet censorship.
- It gives government too much power and control over information. This has been considered as a huge issue in China, as it may delay the radical change that China needs (Ref. [6]).

C. How Internet Censorship May Relate to Crime Rate?

The possible relationship between Internet censorship and crime rate stems from the relationship between crime rate and media censorship in general. The classical notion argued by most people is that violence and pornography in media have significant impacts on an individual's violent behavior. However, a study by Ref. [7] concluded that there is no sufficient evidence to suggest any relationship between media violence effects and violent crime. Furthermore, Ref. [8] argued that pornography does not lead to an increase in violent sexual behavior.

The Internet takes information sharing to a different level, and its introduction to the public makes media censorship so much more complicated. With the Internet, any individual can access any information they want, and without any restrictions these information include child pornography, drug market and any other contents that are not only deemed inappropriate but are also expected to increase criminal intent. Along with Internet usage, Internet censorship has also been increasing and it is gaining attention from scholars from different disciplines such as media and communication, information technology, law, political science

and economics (Ref. [9]). In the next section, we are going to use several approaches that can be used to inspect the relationship between Internet censorship and crime rate.

III. EMPIRICAL STRATEGY

A. Using OLS: Possible Endogeneity Problem

One way to estimate the relationship between Internet censorship and crime rate is by using Ordinary Least Squares (OLS). Consider the following equation:

$$\text{crime}_i = \beta_0 + \beta_1 \cdot \text{conflict}_i + \beta_2 \cdot \text{political}_i + \beta_3 \cdot \text{social}_i + \beta_4 \cdot \text{tools}_i + e_i, \quad (1)$$

where crime_i is the crime rate in country i , conflict_i is the level of conflict Internet censorship in country i , political_i is the level of political Internet censorship in country i , social_i is the level of social Internet censorship in country i , tools_i is the level of Internet tools censorship in country i and e_i captures all unobserved influences on crime rate in Eq. (1). In order to consistently estimate Eq. (1), the error term e_i must not be correlated with any of the regressors in the equation. If e_i is correlated to any of the regressors in Eq. (1), then the correlated regressors are endogenous in the equation and their respective parameters will be biased. For example, if conflict_i is correlated with e_i in the equation, then conflict_i is endogenous in the equation and β_1 is biased. When the parameter is biased, any inferences and tests such as t-tests and F-tests will be invalid. Thus, OLS can only consistently estimate the parameters in Eq. (1) when all regressors in the equation are exogenous.

However, there are reasons to believe that the regressors in Eq. (1) may be endogenous:

- Internet censorship is expected to be correlated with Internet penetration. When a country is more exposed to the Internet, there are many complications that come with it and hence it is normal for the government to pay more attention to media censorship. Furthermore, Bitso et al (2012) reported that Internet censorship has been increasing together with Internet penetration. Access to Internet may have an impact on crime rate, as the Internet makes it easier to obtain illegal weapons.
- A country’s openness may be correlated with Internet censorship, as they both can represent a country’s attitude towards other countries and global information. Such general behavior of a country may have an impact on its crime rate.

Furthermore, it is possible that Internet censorship may be correlated with other influences on crime rate such as economic growth, population and land area.

Taking these variables into account, we consider the following equation:

$$\begin{aligned} \text{crime}_i = & \beta_0 + \beta_1 \cdot \text{conflict}_i + \beta_2 \cdot \text{political}_i \\ & + \beta_3 \cdot \text{social}_i + \beta_4 \cdot \text{tools}_i \\ & + \beta_5 \cdot \text{internet_penetration}_i \\ & + \beta_6 \cdot \text{gdp_growth}_i + \beta_7 \cdot \text{land_area}_i \\ & + \beta_8 \cdot \text{population}_i + \beta_9 \cdot \text{openness}_i + u_i \quad (2) \end{aligned}$$

where $\text{internet_penetration}_i$ is the number of internet users per 100 people in country i , gdp_growth_i is the annual GDP growth of country i , land_area_i is the land area of country i , population_i is the population of country i , openness_i is the sum of exports and imports of goods and services measured as a share of GDP of country i and u_i captures the unobserved influences on crime rate in Eq. (2).

B. Other Approaches to Consider

Another way to consistently estimate the impact of Internet censorship on crime rate is to use the fixed effect model. We consider the following equation

$$\begin{aligned} \text{crime}_{it} = & \beta_0 + \beta_1 \cdot \text{conflict}_{it} + \beta_2 \cdot \text{political}_{it} \\ & + \beta_3 \cdot \text{social}_{it} + \beta_4 \cdot \text{tools}_{it} + \beta_5 \cdot X_{it} \\ & + h_i + \varepsilon_{it} \quad (3) \end{aligned}$$

where crime_{it} is the crime rate in country i at time t , conflict_{it} is the level of conflict Internet censorship in country i at time t , political_{it} is the level of political Internet censorship in country i at time t , social_{it} is the level of social Internet censorship in country i at time t , tools_{it} is the level of Internet tools censorship in country i at time t , X_{it} is a vector of observed influences on crime rate for country i at time t (such as Internet penetration), h_i is the fixed effect and ε_{it} is the error term in Eq. (3). In this case, h_i represents any unobserved influences of crime rate that vary across countries, but not across time.

In this fixed effect model, we are allowing the regressors, including the Internet censorship variables to be endogenous. In other words, the regressors are allowed to be correlated with the fixed effect h_i . However, in order to consistently estimate equation Eq. (3), there are two conditions that should be satisfied:

- 1) It requires a panel data set.
- 2) The following assumption needs to be satisfied

$$E(\varepsilon_{it} | \text{conflict}_i, \text{political}_i, \text{social}_i, \text{tools}_i, X_i, h_i) = 0, \quad i = 1, 2, \dots, N, \quad t = 1, 2, \dots, T \quad (4)$$

Therefore, we are not going to use the fixed effect model in this case due to the following conditions:

- We do not have a panel data set for Internet censorship available.
- The Internet censorship variables do not vary highly across time. This can create a problem when we estimate Eq. (3), as we cannot include regressors that do not vary across time in a fixed effect model.
- The assumption Eq. (4) is a very restrictive assumption. It requires the regressors to be uncorrelated with the error term ε_{it} for all time periods.

Another approach to consider is to use a Two-Stage Least Squares (2SLS) model. However, at this point we do not have an Instrument Variable (IV) available, as more analysis regarding the topic is still needed. In the next section, we are going to discuss the data that we are going to use and how we are going to use them.

IV. DATA

A. Data Description

In this article, we are using a cross-sectional data set for the year of 2013, consisting of 60 countries; thus, $i = 1, 2, \dots, 60$.

The dependent variable, crime_i is obtained from Ref. [10]. The crime index is an estimation of overall level of crime in a given country (Ref. [10])¹. It is used a proxy for a country's crime rate. The range for this variable is from 0 to 100.

The Internet censorship variables conflict_i , political_i , social_i and tools_i are obtained from Ref. [1]. The value that these Internet censorship variables can take is either 0, 1, 2, 3 or 4. The Internet censorship variables take a higher value as a country's level of Internet censorship becomes more intense.

The Internet censorship variables take the value of 0 if there is no evidence of filtering. For example, $\text{conflict}_i = 0$ when there is no evidence of Conflict Internet Censorship.

The Internet censorship variables take the value of 1 if there is suspected filtering; that is when even though there is no confirmation of Internet censorship, there are connectivity problems that suggest its presence. For example, $\text{conflict}_i = 0$ when there is evidence of Suspected Conflict Internet Censorship.

The Internet Censorship variables take the value of 2 if there is selective filtering, that is censoring a few specific sites within a category or targeting a single category. For example, $\text{conflict}_i = 2$ when there is evidence of Selective Conflict Internet Censorship.

The Internet censorship variables take the value of 3 if there is substantial filtering, that is censoring

several categories at a medium level or filtering many categories at a low level. For example, $\text{conflict}_i = 3$ when there is evidence of Substantial Conflict Internet Censorship.

The Internet censorship variables take the value of 4 if there is pervasive filtering, that is censoring sites at a high level, targeting a large portion of several categories. For example, $\text{conflict}_i = 4$ when there is evidence of Pervasive Conflict Internet Censorship.

Internet penetration, $\text{internet_penetration}_i$, is obtained from Ref. [11]. It represents the number of Internet users per 100 people in a country. It is measured in proportion, with values ranging from 0 to 100.

GDP Growth, gdp_growth_i , is obtained from Ref. [11]. It is the annual percentage growth rate GDP at market prices based on constant local currency. In this model, we are using GDP growth of a country as a proxy of its economic growth. It is measured in percentage.

Land area, land_area_i , is obtained from Ref. [11]. It is a country's total area, excluding area under inland water bodies, national claims to continental shelf, and exclusive economic zones. It is measured in squared kilometers.

Population, population_i , is obtained from Ref. [11]. It is the de facto definition of population, which counts all residents regardless of legal status or citizenship, except for refugees. It is measured in number of people.

Openness, Openness_i , is obtained from Ref. [11]. It is known as Trade, which is the sum of exports and imports of goods and services measured as a share of gross domestic product. In this model, we are using trade as a proxy for a country's general openness towards other countries. It is measured in percentage of GDP.

The Internet censorship variables conflict_i , political_i , social_i , and tools_i are measured by Ref. [1] as ordinal, numerical variables. In this model, we are going to use them as they are. We considered transforming them into binary variables for each level of censorship, but we decided against it due to the following reasons.

None of the 60 countries sampled have a censorship value of 1, that means none of the 60 countries have any evidence of suspected Internet censorship. Furthermore, the dummy variables together have a near-singular matrix.

If we transform each Internet censorship variables into binary variables, we are going to end up with $4 \times 4 = 16$ variables, or at least $3 \times 4 = 12$ variables if we do not add the Suspected Internet censorship variables. Since our sample size is only 60 countries, it is not a good idea to have too many variables as it would use

¹For a detailed calculation of Crime Index, see the Numbeo website.

too many of our degrees of freedom. Furthermore, we want to have enough degrees of freedom if we want to add more variables into the model.

The Internet censorship variables are obtained from the same source (Ref. [1]), and it is reasonable to assume the relationship between the levels of censorship to be approximately linear.

B. Preliminary Analysis

The dependent variable $crime_i$ represents the crime rate of 60 countries with an average of 44.577. It can be seen from Fig. 1 that the distribution is approximately bell-shaped. Furthermore, the Jarque-Bera probability is 0.381051, which means there is no sufficient evidence to suggest that crime rate is not normally distributed. Our independent variables of interest, the Internet censorship variables $conflict_i$, $political_i$, $social_i$, and $tools_i$ have an average of 0.516667, 0.883333, 0.8 and 0.566667, respectively

It can be seen from Fig. 2–5 that each of the Internet censorship variables seem to have a negative correlation with crime rate, as each of their linear trend is going downwards. We can interpret the regression lines as of the following. An increase of 1 point in conflict Internet censorship is expected to decrease crime rate, on average, by 4.7231 points. An increase of 1 point in political Internet censorship is expected to decrease crime rate, on average, by 1.8523 points. An increase of 1 point in social Internet censorship is expected to decrease crime rate, on average, by 3.3102 points. An increase of 1 point in tools Internet censorship is expected to decrease crime rate, on average, by 3.6239 points. The negative correlations between each of the Internet censorship variables and crime rate are reasonable, as we expect censorship to decrease a person’s criminal intent, or at least prevent it from going higher. In the next section, we are going to see if there is a deeper relationship between Internet censorship and crime rate.

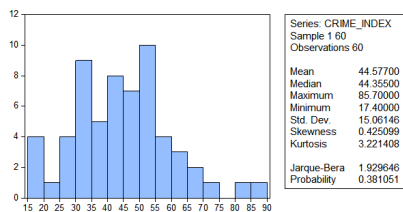


Fig. 1. The Bell-shaped Distribution of the Crime Rate Index.

V. ESTIMATION, RESULTS, AND DISCUSSION

A. Ordinary Least-Squares Estimation

The simplest way to estimate the relationship between Internet Censorship and Crime Rate is to use the ordinary least-squares (OLS) method. In the following, we define Eq. (1) as Model A and Eq. (2) as Model B.

The results of the statistical analysis for Models A and B are shown in Table I. In the table, the values in round parenthesis are standard errors and in square parenthesis are t -statistics. The key findings are of the following. In both models, none of the internet censorship variables are individually and jointly, significant statistically at 1%, 5% and 10% level of significances. At the same time, if we do a one-tail test for the Conflict Internet Censorship variable for both models, we have sufficient evidence to suggest that there is

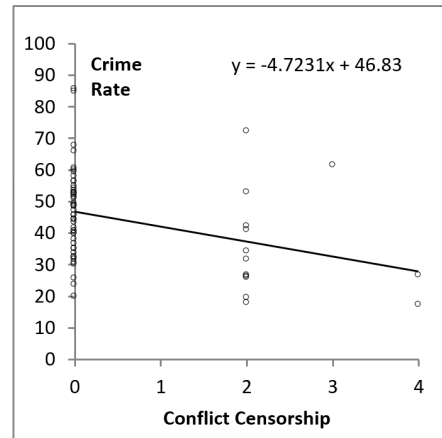


Fig. 2. The Correlation Between Conflict Censorship Variable and Crime Rate Variable.

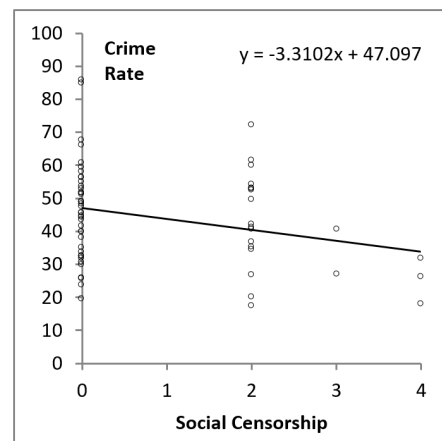


Fig. 3. The Correlation Between Social Censorship Variable and Crime Rate Variable.

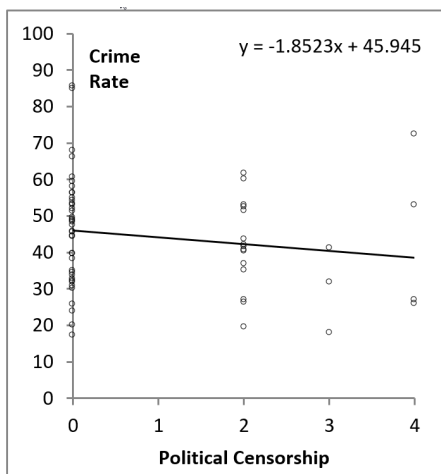


Fig. 4. The Correlation Between Political Censorship Variable and Crime Rate Variable.

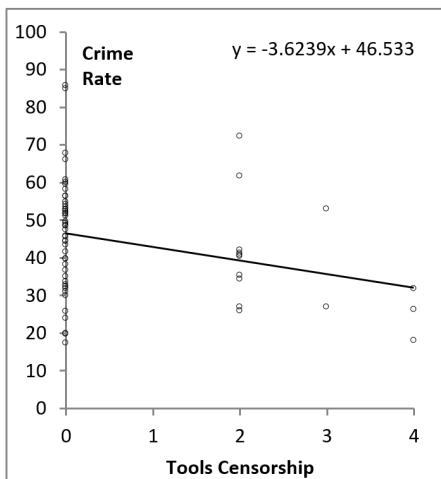


Fig. 5. The Correlation Between Tools Censorship Variable and Crime Rate Variable.

a significant negative relationship between Conflict Internet Censorship variable and Crime Rate variable at 10% level of significance, but not at 5% and 1%. For Model A, an increase of 1 point in Political Internet Censorship variable is expected to increase Crime Rate variable on average by 1.90 points, ceteris paribus. This is unexpected, as we would expect that the Internet Censorship variable to be negatively correlated to Crime Rate. In Model A, the other Internet censorship variables are expected to decrease Crime Rate variable. None of these variables are statistically significant. For Model B, an increase of 1 point in Social Internet Censorship variable is expected to increase Crime Rate variable, on average, by 0.69 point, ceteris paribus. This is unexpected, as we would expect Internet Cen-

TABLE I
THE RESULTS OF THE STATISTICAL ANALYSIS USING THE ORDINARY LEAST-SQUARES METHOD FOR MODEL A (EQ. (1)) AND MODEL B (EQ. (2)).

Estimation	Model A	Model B
Constant	46.81 (2.43) [19.29]	63.46 (6.66) [9.52]
Conflict	-4.17 (2.55) [-1.63]	-3.77 (2.45) [-1.54]
Political	1.90 (2.31) [0.82]	-0.08 (2.37) [-0.03]
Social	-1.31 (2.62) [-0.50]	0.69 (2.49) [0.28]
Tools	-1.26 (3.46) [-0.36]	-1.63 (3.24) [-0.50]
Internet Penetration	-	-0.22 (0.09) [-2.53]
GDP Growth	-	0.15 (0.87) [0.17]
Land Area	-	0.00 (0.00) 0.45
Population	-	0.00 (0.00) [-0.53]
Openness	-	-0.07 (0.04) [-1.73]
F-stat for Internet Censorship	2.12	1.50
Sample Size	60	60
R ²	0.11	0.34
SE of Regression	14.70	13.28

sorship variable to be negatively correlated with Crime Rate variable. In Model B, the other Internet censorship variables are expected to decrease Crime Rate. None of these variables are statistically significant.

The marginal effect of the Internet Censorship variables on Crime Rate variable is lower on Model B, except for the Tools Internet Censorship variable. For Model B, an increase of 1 point in Internet Penetration variable is expected to decrease Crime Rate variable, on average by 0.22 points, ceteris paribus. This is economically significant. It is also statistically significant at 5% and 10% level of significance, but not at 1%.

For Model B, an increase of 1% point in GDP growth is expected to increase Crime Rate variable, on average, by 0.15 points, ceteris paribus. It is not statistically significant at 1%, 5% and 10% level of significance. This is unexpected, as common sense suggests that a country's economic growth is significantly and negatively correlated with crime rate. For

Model B, both Land Area and Population variables are economically and statistically insignificant. An increase of 1% point in trade is expected to decrease Crime Rate variable, on average, by 0.07 points, *ceteris paribus*. While this is economically not too significant, it is statistically significant at 10% level of significance.

It can be seen that GDP growth, Land Area and Population variables are not statistically or economically significant. Thus, we consider the following model and estimate the parameters using OLS. We call it Model C.

$$\begin{aligned} \text{crime}_i = & \beta_0 + \beta_1 \cdot \text{conflict}_i + \beta_2 \cdot \text{political}_i \\ & + \beta_3 \cdot \text{social}_i + \beta_4 \cdot \text{tools}_i \\ & + \beta_5 \cdot \text{internet_penetration}_i \\ & + \beta_6 \cdot \text{openness}_i + u_i. \end{aligned} \quad (5)$$

The results of the statistical analysis using Model C are shown in Table II. From the model, we conclude: An increase of 1 point in Conflict Internet Censorship variable is expected to decrease Crime Rate,

TABLE II
THE RESULTS OF THE STATISTICAL ANALYSIS USING THE ORDINARY LEAST-SQUARES METHOD FOR MODEL C (EQ. (5)).

Estimation	Model C
Constant	63.78 (4.54) [14.06]
Conflict	-4.19 (2.26) [-1.86]
Political	0.29 (2.11) [0.14]
Social	0.86 (2.37) [0.36]
Tools	-2.03 (3.05) [-0.66]
Internet Penetration	0.22 (0.07) [-3.13]
GDP Growth	-
Land Area	-
Population	-
Openness	-0.07 (0.04) [-2.00]
F-stat for Internet Censorship	2.41
Sample Size	60
R ²	0.34
SE of Regression	12.94

on average, by 4.19 points, *ceteris paribus*. Unlike Model B, a one-tail *t*-test will conclude that Conflict Internet Censorship variable has a significant negative relationship with Crime Rate variable at 10% and 5% level of significances, but not at 1%.

An increase of 1 point in Political Internet Censorship variable is expected to increase Crime Rate, on average, by 0.29 points, *ceteris paribus*. Compared to Model B, the parameter estimate for Political Internet Censorship variable is now positive instead of negative. It is statistically insignificant at 1%, 5% and 10% level of significances.

Political, Social and Tools Internet Censorship variables are still statistically insignificant in Model C. Internet Penetration and Openness variables are still statistically significant, and the values of the parameter estimates are approximately the same as in Model B. The R² coefficient for Model C is approximately the same as Model B, even after we drop three variables.

The standard error of regression for Model C is lower than Model B. This shows that by dropping statistically irrelevant variables such as GDP growth, Land Area and Population variables from Model B, we allow more degrees of freedom and hence increasing the efficiency of the model. Based on Models A, B, and C, we conclude that there is a statistically significant negative relationship between Conflict Internet Censorship variable and Crime Rate variable. However, we have no evidence to support any causal relationship between Political, Social -r Tools Internet Censorship variable and Crime Rate variable.

B. The Education Effect

One variable that is expected to be correlated with Internet Usage, Internet Censorship, and Crime Rate variable is Education variable. Common sense suggests that an educated individual is more likely to use the Internet than a non-educated individual. Furthermore, Ref. [12] stated that education could significantly reduce a person’s participation in crime. Education can increase a person’s wage and that may reduce an individual’s motivation to participate in crime. Furthermore, education can change an individual’s aversion to risk, making him or her more risk averse and hence less likely to participate in crime.

We are interested to see whether Internet penetration and Internet censorship affect crime rate differently for highly educated countries, compared to poorly

educated countries. We consider the following equation

$$\begin{aligned} \text{crime}_i = & \beta_0 + \beta_1 \cdot \text{conflict}_i + \beta_2 \cdot \text{political}_i \\ & + \beta_3 \cdot \text{social}_i + \beta_4 \cdot \text{tools}_i \\ & + \beta_5 \cdot \text{conflict}_i \cdot \text{high_education}_i \\ & + \beta_6 \cdot \text{political}_i \cdot \text{high_education}_i \\ & + \beta_7 \cdot \text{social}_i \cdot \text{high_education}_i \\ & + \beta_8 \cdot \text{tools}_i \cdot \text{high_education}_i \\ & + \beta_9 \cdot \text{internet_penetration}_i \\ & + \beta_{10} \cdot \text{internet_penetration}_i \cdot \text{high_education}_i \\ & + \beta_{11} \cdot \text{openness}_i + u_i \end{aligned} \quad (6)$$

where high_education_i takes the value of 1 if country i is a highly educated country and 0 otherwise. A country is considered highly educated when its education index is 0.75 or higher. Education index is an index that represents the education quality of a country, based on adult literacy rate (with two-third weighting) and the combined primary, secondary, and tertiary Gross Enrollment Ratio (GET) (with one-third weighting)². It is obtained from Ref. [13] and the value range is in between 0 and 1. We estimate the parameters in Eq. (6) by OLS and the results are summarized in Table III.

Table III shows the parameter estimates of Eq. (6) (Model D). The key result are of the following. None of the Internet Censorship variables are statistically insignificant by themselves, at 1%, 5% and 10% level of significance. This means there is no sufficient evidence to suggest that there is a significant relationship between Internet censorship and crime rate in poorly educated countries. The interesting part about this is that conflict Internet censorship is no longer expected to have a significant negative impact on crime rate. The Internet censorship variables and their interaction dummies are jointly significant at 5% level of significance. The interaction term between conflict Internet censorship and high education is economically and statistically significant at 10% level of significance, but no at 5% and 1%. The marginal effect of conflict Internet censorship on crime rate is expected to be lower (more negative) for highly educated countries, on average, by 8.36 points than for poorly educated countries, *ceteris paribus*. The other interaction variables are statistically insignificant at 1%, 5% and 10% level of significance. The Internet penetration variable is no longer statistically significant by itself at 1%, 5% and 10% level of significance. This means there is no evidence to suggest that there is a causal relationship between Internet censorship and crime rate for poorly

²For a detailed calculation of Education Index, see the United Nation Development Programme website

educated countries. The marginal effect of Internet penetration on crime rate is expected to be lower (more negative) for highly educated countries, on average, by 0.19 point than for poorly educated countries, *ceteris paribus*. It is economically and statistically significant at 10% and 5% level of significance, but not at 1%. Openness variable is statistically significant not only at 10%, but also at 5% level of significance. It is still not statistically significant at 1% level of significance. The standard error of Model D is lower than that of Model C.

C. Discussion and Recommendation

Common sense suggests that Internet Censorship would have a negative impact on crime rate. However,

TABLE III
THE RESULTS OF THE STATISTICAL ANALYSIS USING THE ORDINARY LEAST-SQUARES METHOD FOR MODEL D (EQ. (6)).

Estimation	Model D
Constant	59.84 (4.67) [12.82]
Conflict	0.97 (3.44) [0.28]
Political	-0.02 (2.31) [-0.01]
Social	-0.08 (3.23) [-0.03]
Tools	-5.92 (4.33) [-1.37]
Conflict · High Education	-8.36 (4.60) [-1.82]
Political · High Education	-1.43 (4.89) [-0.29]
Social · High Education	4.18 (5.09) [0.82]
Tools · High Education	4.13 (8.63) [0.48]
Internet Penetration	-0.01 (0.11) [0.48]
Internet Penetration · High Education	-0.19 (0.08) [-2.22]
Openness	-0.08 (0.04) [-2.06]
F-stat for Internet Censorship	2.44
F-stat for Interaction Dummies	1.83
Sample Size	60
R ²	0.44
SE of Regression	12.46

It can be seen from Model A to D that there is no sufficient evidence to suggest that there is a causal relationship between Political, Social or Tools Internet censorship and crime rate. It is interesting to see that we have no evidence suggesting any relationship between social Internet censorship and crime rate. Internet pornography and violence are not likely to decrease crime, but perhaps they do not significantly increase crime either.

Based on Models A to D, it can be seen that Conflict Internet Censorship has a more significant impact on crime rate than the other forms of Internet censorship. In models A to C, at 10% level of significance, there are sufficient evidence to suggest that there is a significant negative relationship between Conflict Internet Censorship and Crime Rate. In Model D, Conflict Internet Censorship seems to only have a significant negative impact on Crime Rate for highly educated countries. It can also be seen from Model D that there is sufficient evidence to suggest that Internet Penetration has a significant negative impact on crime rate for highly educated countries, but not poorly educated countries. In contrast, Political, Social and Ttools Internet Censorship do not have any statistically significant impact on crime rate for either highly educated or poorly educated countries.

The main idea that deduced from Model D is that perhaps all the Internet variables are more impactful for highly educated countries. It is reasonable to suggest that educated individuals are more familiar with the Internet, and are more able to use it effectively. For example, not only a highly educated person can use the Internet to communicate with others, but they can also use it to open their online business. With more income opportunities and more things to do, individuals are less likely to participate in criminal activities. Furthermore, the Internet open more ways to obtain information, and it can boost the education level of a country significantly. As stated by Ref. [12], education makes a person to be more risk averse, and hence less likely to be participating in crime.

However, educated individuals are also more able to use the Internet for negative activities. Whether it is for a good reason or not, rebels can use the Internet to contact each other and initiate some violent activities such as separatist movements and border issues movements. It is reasonable to suggest that conflict Internet censorship can prevent such activities from happening, and perhaps it lowers crime rate in the process.

Based on these points, it is important to rethink the impact of Internet censorship and who are affected by it. If most Internet users are educated individuals

who are risk averse, preventing them to access violent and pornographic media will not significantly change anything. In fact, censorship in general may not be very useful for individuals who are not likely to be a criminal in the first place, and perhaps that is just what Internet censorship is doing.

Unless the contents are about concrete violent plans such as separatist movements, Internet censorship may not be a very good idea as not only it jeopardizes a country's freedom of speech, it can also be misused by the political party running the government. Perhaps a better idea is to focus on increasing a country's education level, as it makes individuals more "immune" to these perceived negative contents. Instead of focusing on filtering information, we should focus on helping residents to be able to process information correctly.

VI. CONCLUSIONS

In summary, the main results that can be obtained from our analysis are of the following. There is no sufficient evidence to suggest that there is a causal relationship between political, social or tools Internet censorship and crime rate. There is sufficient evidence to suggest that conflict Internet censorship has a negative impact on crime rate for highly educated countries, but not for poorly educated countries. There is sufficient evidence to suggest that Internet penetration has negative impact on crime rate for highly educated countries, but not for poorly educated countries. However, there are limitations to our analysis in the following aspects. The data obtained may not be the correct proxy for the data we wanted. For example, the crime index calculated may not be the best overall estimate of a country's crime rate. Our sample size is only 60 countries because of the unavailability of the data. If we can get a larger sample size, we can make the models more efficient.

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