Does internet usage decrease corruption?

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Abstract

By using cross-country and dynamic panel estimation strategies, I provide evidence that higher internet usage implies less corruption in a country. I find that countries with higher internet usage are less corrupt and that countries that increase their internet usage the most have lower corruption levels. These results are robust to the inclusion of controls, different specifications and various dependent variables. In order to address reverse causality and omitted variable concerns, I also estimated each model with instrumental variables. The instrumental variables were created using data on submarine fiber optic cables, which are used to carry telephone, internet and private data across the planet. Furthermore, the instruments suggest that internet usage has a negative effect on corruption via the internet usage and institutional quality of the countries each country is connected by submarine cables.

Introduction and Motivation

Very few would argue against the negative effects of corruption on the economic and political outcomes of a country. While authors like Mauro (1995), Hung Mo (2001), Olken and Rohini (2011) have shown that corruption undermines economic growth, according to the World Economic Forum, the cost of corruption equals more than 5% of global GDP (US$ 2.6 trillion) with more than US$ 1 trillion paid in bribes each year. Along similar lines, Kar and Spanjers (2015) estimate that around $1 trillion in illicit flows leave poor nations annually. In addition, corruption issues are not confined to underdeveloped countries or just a handful of countries worldwide. According to Transparency International (2016), in 2015, 53% per cent of countries worldwide had serious corruption problems, which accounts to more than 6 billion people around the world.

Notwithstanding the consensus about the harmful effects of corruption in academic and public policy circles, there still exists an ongoing debate as to how to properly cope with it. As an inertial and persistent over time phenomenon, it is not simple to pinpoint variables or policies that can mitigate its negative effects and foster positive political and economic outcomes. The following research contributes to the emergent literature of the determinants of corruption and to the public policy literature dedicated to tackle it by addressing the question: Does internet usage in a country affect its corruption level?

In the past decade, the internet and social media in particular have played a central role in various political and social events such as the "*Arab Spring*", "*Occupy Wall Street*"and other country specific political scandals. Furthermore, recent research also shows that internet use and social media can have significant political, economic and social impacts. From fostering economic growth as pointed by Czernich et al (2011), influencing voting behavior as found by Falck et al (2014), Miner (2015) and Chong et al (2014) , predicting politically motivated social events as argued by Acemoglu et al (2015) and Qin et al (2016), to impacting market returns of firms as found by Acemoglu et al (2015) and Enikolopov et al (2016).

Therefore, as a tool that provides fast and updated access to information, it is reasonable to hypothesize that higher internet usage might affect a country's corruption level by providing extra information about political malfeasance and thus fostering civic surveillance. Said hypothesis is the one undertaken in this research. Hence, this paper sheds some light on this public policy debate by providing evidence that internet usage could be an effective public policy instrument to tackle corruption. Other works have addressed this question, like the ones by Bologna (2014), Garcia-Murillo (2012), Chi Lio et al (2011) and Andersen et al (2011). But in comparison to these studies, this paper follows a different methodological approach that suggests short and medium term mechanisms through which internet usage can affect corruption in a country and also addresses reverse causality issues, while correcting for methodological flaws in previous studies.

More specifically, this study contributes to the literature by providing statistical evidence of causality of internet usage on corruption and a possible mechanism by which this causal effect works. Method-wise, I perform a cross-country and dynamic panel econometric analysis, where I proxy the level of corruption of a country using six different measurements of corruption and use two different instrumental variables to address endogeneity concerns. Furthermore, my identification strategy involves the use of optical fiber submarine cable data to construct my instrumental variables, where I argue in favor of a "*good neighbor hypothesis*". More specifically, in order to identify the causal effect from higher internet usage to reduction of corruption, I claim that the information availability and internet usage is influenced by the institutional and internet conditions specific to the countries each country is connected to via submarine cables. Up to this date and to the best of my knowledge, this is the only study that has undertaken such methodological approach.

The paper is structured as follows: The first section of the paper discusses the relevant literature about determinants of corruption and how internet usage could affect the corruption levels of a country. The second section discusses the data used, the empirical approach and the identification strategy. In the third section, I discuss and interpret my results. Finally, in the fourth section I present my conclusions and discuss further research possibilities.

Literature Review

Determinants of Corruption

As proposed in the seminal paper on the determinants and general analysis of corruption by Becker (1968), the determinants of corruption can be seen as factors that exogenously affect the costs of undertaking corrupt activities through the role of the government and the socio-cultural environment, where the socio-cultural environment in a country may be shaped by historical and country-specific influences. Similarly, research by authors like Goel et al (2010) and Serra (2006) find that the determinants of corruption have a strong historical component, where the current level of corruption is shaped by institutions, history of democracy, colonial heritage, political history and the role of government over time. Furthermore, as noted by Pande (2007) and Olken and Rohini (2011), corruption can become institutionalized and inertial in a country, implying that it has long-run lasting effects and determinants that make it hard to eradicate.

An important consensus in the corruption literature, is the existence of a strong negative relationship between the income or economic development of a country and its level of corruption. However, causality can be found and justified in any direction. On the one hand, it can be argued that corruption is a phenomenon that affects the efficient allocation of goods and services in an economy and it also incentivizes political wrongdoing which negatively affects the economic performance of a country. Research done by Mauro (1995) and Hung Mo (2001) fit with this explanation by showing that corruption lowers investment, which undermines economic growth. Another possible mechanism is the one noted by Olken and Rohini (2011), where corruption may raise the marginal tax rate of firms, decrease business activity, raise the marginal costs of public funds, make certain government projects economically unviable, and undo the governments ability to correct externalities, leading to inefficient outcomes.

The other direction of causality, where income determines the level of corruption of a country is not as evident. It can be the case that the existence of more rents to be expropriated provides incentives to be corrupt or that additional rents makes it easier for countries to tackle corruption. A good example of the former is the "*Resource Course*"literature where authors like Sachs and Warner (1995), Bulte and Damania (2008), Pendergast et al (2008) and Leite and Weidmann (1999) show how income shocks in the form of natural resource abundance creates opportunities for rent-seeking behavior. As for the latter possibility, Treisman (2000), Treisman(2007) and Lalountas et al (2011) argue that more complex business relationships and higher income make a country demand for a better governance because higher income implies higher levels of education, bureaucratic quality and effective judicial systems as pointed out by Evrensel (2010).

Another important determinant of the level of corruption in a country is the political stability and its media and press freedom. Political stability can be associated with checks and balances over government officials, democratic accountability and how the citizens can affect the political outcomes of a country and hence impose constraints on corrupt activities. As noted by Treisman (2007) and Chowdhury (2004), highly developed, long-established liberal democracies, with a free and widely read press, high democratic participation, a high share of women in government, and a history of openness to trade, are perceived as less corrupt. Another possibility is that a politically unstable country can make the benefit of corrupt activities more valuable to those with worse outside options; i.e. individuals of lower quality are attracted into politics as suggested by Brollo et al (2010).

As for the free and independent press, this can form an important part of the detection process of government malfeasance and therefore act as a deterrent to corruption by providing up to date and reliable information to the citizens of a country and thus encourage civic monitoring. This view has found support in papers by authors like Freille et al (2007), Stapenhurst (2000), Brunetti and Weder (2003) and Chowdhury (2004) where they argue that the more access to information and freedom of expression decreases corruption by allowing media to promote good governance, report incidences of corruption and raise public awareness. Although the idea that more freedom of press lowers corruption has a vast empirical support of the negative effect of media and press freedom on corruption is complementary to the existence of conditions that allow for an effective monitoring of government activities, Ahrend (2002) adds the caveat that civic monitoring is insufficient on its own; as for effective monitoring a society also requires

an adequate level of education an capabilities to process information.

Internet and corruption

The most straightforward mechanism by which internet can affect the corruption level in a country is by providing more information to its citizens and thus changing their knowledge about the activities of their government and encouraging civic monitoring. More explicitly, internet provides information that facilitates the discovery of corruption and it also fosters accountability and checks and balances among branches of government, law enforcement, voting elections and government officials. Consequently, this affects civic surveillance and corruption awareness, which might imply more enforcement and punishments against corrupt acts. Along these lines, Djankov et al (2009) argue that public disclosure is associated with lower corruption in democratic but not in undemocratic countries, which points to complementarity of transparency and democratic governance. Similarly, Kolstad and Arne (2009) argue that transparency or access to information under certain circumstances and conditions -like an adequate level of education and an appropriate political climate- can facilitate cooperation over opportunistic rent-seeking and help maintain norms of integrity and trust and hold a government accountable for its actions. Also, since information may change voters preferences for politicians, as argued by Pande (2011), limited availability of information is an explanation as to why low-quality politicians persist and the existence of identity politics and electoral malpractices. This point is further strengthened by the research done by Chong et al (2014), where the authors conducted a field experiment in Mexico to determine up to what extent providing information about the incumbents performance strengthens electoral accountability. The authors find no evidence of higher turnout and higher support for the challenger, while they suggest that voters may respond to this information by withdrawing from the political process.

In regards to the direct effect of internet on the level of corruption in a country, Barnebeck (2009) argues that e-government eliminates opportunities for corruption by reducing discretion by government officials and therefore curbing some opportunities for arbitrary action. Additionally, e-government also increases chances of exposure by maintaining detailed data on transactions, making it possible to track and link the corrupt agents and their unlawful acts. Goel et al (2012), find that internet search hits about corruption per capita correlate negatively with corruption perceptions and corruption incidence. Even though it is suggested that the use of internet could tackle corruption, their research does not directly address potential endogeneity issues regarding their econometric specifications. Nonetheless, causality can go the other way, i.e. corruption may determine the level of internet usage in a country. For instance, Kyu-Nahm (2014) find for China, that frequently visiting public government websites to obtain public service information has a positive effect on citizens perceptions of government transparency. Similarly, Qin et al (2016) argue with their findings that the Chinese government regulates social media to balance threats to regime stability against the benefits of utilizing bottom-up information.

In relation to estimating the direct effect of internet usage on corruption, Bologna (2014), Garcia-Murillo (2012) and Chi Lio et al (2011) find that there is indeed a negative effect. However, the first two did not consider the possibility of endogeneity and how this effect might change over the years, while the latter do address endogeneity and find a very small effect of internet usage on corruption. By the same token, Andersen et al (2011) find that Internet diffusion has reduced the extent of corruption across countries and across U.S. states. The authors address endogeneity by instrumenting internet diffusion with lightning activity, arguing that lightning damages digital equipment and consequently places with more lightning activity have lower rates of internet diffusion.

Regarding the effect of social media on corruption, recent research also shows that it can have significant political and social impacts. Qin et al (2016) find that Sina Weibo - the most prominent Chinese microblogging platform - content predicts collective action events one day before their occurrence and corruption charges one year in advance, and also that said platform can predict events such as protests, strikes, demonstrations and corruption charges. Acemoglu et al (2015) show that social media may have played an important role in mobilizing protesters, and that it could predict future returns of firms connected to President Mubarak during the protest demonstrations in Egypt in 2011-2012. Along similar lines, Enikolopov et al (2016) show that anti-corruption blog posts exposing corruption in Russian state-controlled companies, had a negative causal impact on their market returns.

Data, Instrumental Variables and Empirical Specifications

The empirical strategy consists of panel, dynamic panel and cross-country OLS regressions. All of these along with their instrumental variables counterparts provide evidence of causality running from internet usage to corruption level, where every estimation has robust errors clustered by country. In this section, I first describe the variables used in my estimations, then I explain the endogeneity concerns and argue that my instruments are appropriate for my models, and finally, I present the econometric specifications used in this research.

Data

In Table 1 below, I show summary statistics for the whole period of the variables used in this research. My dataset is an unbalanced dataset of 189 countries, ranging from 2000 to 2013. Below, I provide a brief description of the variables, their limitations and mention their sources.

Table 1: Summary of Statistics and year availability

Variables	Observations	Mean	Standard Deviation	Year availability
Dependent Variables				
Transparency	2228	0	1	2000-2014
World Bank	2906	0	1	1996-2014
ICRG	2085	0	1	2000-2014
Diversion	1359	0	1	2006-2015
Trust	1359	0	1	2006-2015
Favoritism	1359	0	1	2006-2015
Independent Variables				
Internet usage	3000	26.83383	26.98153	2000-2014
Income	2817	9.043474	1.25307	2000-2014
Size of government	2630	16.53229	8.779308	2000-2014
Resource Rents	2491	10.99945	15.9225	2000-2013
Democracy	2400	0	1	2000-2014
Freedom of Media	2872	0	1	2000-2014
Education	2288	8.094238	2.855848	2000-2015
Instrumental Variables				
Neighbors' average internet usage	2726	29.42254	22.05054	2000-2014
Neighbors' average Rule of Law	2762	0.0339359	0.6976375	1996-2014

Dependent Variables: Measurements of corruption

For this paper, I use six different measures of corruption. All of them are indexes created from opinion surveys completed by experts. Although this can be considered a weakness since these are measures of perceived corruption rather than measures of actual corruption, I argue that these are the best and most reliable measures for the research question at hand for two main reasons. Firstly, these types of measures are the ones that have best availability across countries and over time. Hence, in order to make the most complete and thorough analysis over time and countries, these indexes are the best publicly available option. Secondly, what could be considered as objective measures of corruption, might not be capturing the real desired underlying phenomenon of interest. As stated by Transparency International on their website:

"Corruption generally comprises illegal activities, which are deliberately hidden and only come to light through scandals, investigations or prosecutions. There is no meaningful way to asess absolute levels of corruption in countries or territories on the basis of hard empirical data. Possible attempts to do so, such as by comparing bribes reported, the number of prosecutions brought or studying court cases directly linked to corruption, cannot be taken as definitive indicators of corruption levels. Instead, they show how effective prosecutors, the courts or the media are in investigating and exposing corruption. Capturing perceptions of corruption of those in a position to offer assesments of public sector corruption is the most reliable method of comparing relative corruption levels across countries."

Therefore, instead of relying on one objective measure of corruption, I use six in this research. This is done to show that most of my results results do not greatly vary on the dependent variable used. The six

measures used are the following:

Corruption Perception Index: elaborated by *Transparency International*, it is a simple average of scores given by institutions specialized in governance and business climate around the world. For the year 2000, it covered 89 countries and by 2013, it covered 178 countries. This index measures the perceived levels of public sector corruption in a country by giving it a score that ranges from 0 to 10, where 0 is an extremely corrupt country and 10 is country with no corruption. However, starting in 2011, the index ranges from 0 to 100, where the higher the score, the less corrupt the country is. For a more intuitive interpretation of this indicator, this variable has been redefined so 0 is a country with no corruption and 10 is an extremely corrupt country and also normalized so it has a mean of zero and a standard deviation of one.

World Bank's Control of Corruption: elaborated by Kauffman and Kraav (2015) as part of the *World Governance Indicators* of the world bank. The indicator is based on data gathered from surveys to institutes, think tanks, non-governmental organizations, international organizations, and private sector firms. The index reflects perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as capture of the state by elites and private interests. The value of the index ranges from -2.5 to 2.5, where the higher the score the better governance the country has regarding corruption. The index considers 215 countries since 1996. Again, for a more intuitive interpretation of this indicator, this variable has been normalized so it has a mean of zero and a standard deviation of one and the higher the score, the more corrupt the country is.

International Country Risk Guide's Corruption: a measure of corruption elaborated by the *International Country Risk Guide*. This is a measure of how corruption within the political system is a threat to foreign investment by distorting the economic and financial environment, reducing the efficiency of government and business by enabling people to assume positions of power through patronage rather than ability, and introducing inherent instability into the political process. The dataset covers 140 countries since the 1980's and it scores countries from 0 to 1, where the higher the score, the less corrupt the country is. This variable has been normalized and inverted, in order to work with a variable with mean zero, standard deviation of one and where the higher the score, the more corrupt a country is.

Diversion of public funds: a variable constructed by the *World Economic Forum* for the *Global Competitiveness Report*. Respondents of their survey answer the question: In your country, how common is illegal diversion of public funds to companies, individuals, or groups? The index ranges from 1 to 7, where 1 means that said event very commonly occurs and a 7 means that it never occurs. The variable has been inverted and normalized, in order to work with a variable with mean zero, standard deviation of one and where the higher the score, the more common the illegal activity is, and hence the more corrupt a country is.

Public trust in politician: a variable constructed by the *World Economic Forum* for the *Global Competitiveness Report*. Respondents of their survey answer the question: In your country, how do you rate the ethical standards of politicians? The index ranges from 1 to 7, where 1 means that said event very commonly occurs and a 7 means that it never occurs. The variable has been inverted and normalized, in order to work with a variable with mean zero, standard deviation of one and where the higher the score, the more common the illegal activity is, and hence the more corrupt a country is.

Favoritism in decisions of government officials: a variable constructed by the *World Economic Forum* for the *Global Competitiveness Report*. Respondents of their survey answer the question: In your country, to what extent do government officials show favoritism to well-connected firms and individuals when deciding upon policies and contracts? The index ranges from 1 to 7, where 1 means that said event very commonly occurs and a 7 means that it never occurs. The variable has been inverted and normalized, in order to work with a variable with mean zero, standard deviation of one and where the higher the score, the more common the illegal activity is, and hence the more corrupt a country is.

Although it is true that these variables do not intend to measure corruption in the same way or answer the same questions, they are all positively correlated as shown in Table 2 below. Thus, it is safe to assume that it is a valid group of variables that jointly point to a same underlying phenomenon. Nevertheless, it is

Table 2: Correlations between dependent variables

Variables	Transparency	World Bank	ICRG	Diversion	Trust	Favoritism
Transparency	1	0.9856	0.8862	0.8991	0.7552	0.8118
World Bank	0.9856	1	0.9019	0.8944	0.7473	0.8044
ICRG	0.8862	0.9019	1	0.8017	0.6718	0.7387
Diversion	0.8991	0.8944	0.8017	1	0.891	0.9299
Trust	0.7552	0.7473	0.6718	0.891	1	0.9284
Favoritism	0.8118	0.8044	0.7387	0.9299	0.9284	1

worth pointing out that throughtout this study, the corruption perceptions index by Transparency International, the World Bank's control of corruption indicator and the International Contry Risk Guide's (ICRG) corruption indicator are my preferred dependent variables for two reasons. First, they cover more countries and a longer period. And second, these attempt to proxy more general phenomenons rather than specific ones.

Independent Variables

Internet Usage: This is the main independent variable of this research. I use the variable "*Percentage of Individuals using the Internet* "by country, provided by World Bank and the International Telecommunications Union (ITU).

Income: As a proxy on income for each country, I use the logarithm of the "*GDP per capita in constant 2011 international US dollars*, "obtained from the World Bank development indicators.

Size of government: to proxy the size of government in a country, I use the "*General government final consumption expenditure as percentage of the Gross Domestic Product* ". Obtained from the World Bank development indicators.

Resource Rents: to proxy the potential resource rents in a country, I use the "*Total natural resources rents as percentage of the Gross Domestic Product* ". More specifically, this is the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents in each country. Obtained from the World Bank development indicators.

Freedom of Media: to proxy the freedom of media and information in a country, I use the "*Freedom of Press Index* "elaborated by Freedom House. Originally, the index scores range from 0 to 100, where 0 means the press is free wheareas 100 means that there is no freedom of press. For this paper, I have inverted this index and normalized it in order to have a more intuitive interpretation of its coefficient.

Democracy: to proxy the level of democrcy in a country, I use the "*Polity IV democracy measure* "elaborated by the Polity IV project. Originally, the index scores range from -10 to 10, where 0 means no democracy and 10 is a fully democratic country, I have inverted this index and normalized it in order to have a more intuitive interpretation of its coefficient.

Education: average years of schooling in a country, estimated by Barro and Lee (2010). The original data set only provides data every five years, where the last estimation is for 2015. In order to have a full set for every year, I have linearly interpolated this variable.

Submarine Cables and Instrumental Variables

Besides shedding light on what control variables are relevant for this research, the previously discussed literature review also shows that all of these control variables are potentially endogenous to the corruption levels in a country. Hence, this paper follows an instrumental variable technique in order to identify the causal effect from internet usage to corruption. For said purpose, I propose two instrumental variables

which I constructed from the data sources mentioned in the previous section and data on optic fiber submarine cables to create exogenous determinants of internet usage in a country. To explain my methodological approach step by step, I will first explain and describe the use of the submarine cable map data and then I will return to discuss my instruments and their validity.

Submarine Cable Data

Submarine communications cables are cables laid on the sea bed between land-based stations to carry telecommunication signals across stretches of ocean. The first communications cables carried telegraphic data in the late ninetheenth century, and nowadays, optical fiber cables are used to carry telephone, Internet and private data across the globe. According to TeleGeography - a telecommunications market research and consulting firm - there exist nearly 350 cables, where some cross oceans and others follow coasts down along continents. The whole network of submarine cables spans more than 550,000 miles, with some being buried as far underwater as Mount Everest towers above ground [1]. As of today, it is estimated that 99% of international data is transmitted by these submarine communications cables [2]. In a nutshell, these submarine cables are the backbone of our modern information revolution.

The submarine cable data needed to generate my instrumental variables was obtained from the *Submarine cable map* website[3]. The data includes information for all the currently active submarine cables around the world. More specifically, for each cable, it provides the following information: the year it became active, the countries where it has landing stations, its owner and its length.

Instrumental Variables

With the submarine cables data I proceeded to construct two instrumental variables for each country, which depend on the institutional and internet features of countries it is connected to by a submarine cable. A natural shortcoming is that landlocked countries do not have landing stations. To overcome this issue, I also consider the countries that have geographical borders for the creation of my instruments. The underlying idea of the instruments is that what determines the availability of information and internet usage in a country is influenced by whom said country is connected to directly. More intuitively, what matters for the internet usage in a country and its information availability is not how much cable or how many landing stations it has, what really matters is to whom each country is connected. If a country is connected to another with good institutions and that allows a free flow of information, it is reasonable to assume that both countries share up to certain extent similar institutions and an interest in exchanging information. On the other hand, not many countries would want to connect to a country with bad institutions or bad information exchange. On such cases, *bad countries* will tend to connect with other *bad countries*, whereas *good countries* will tend to do the same with other *good countries*. And thus, a country's institutional quality and internet usage will influence the countries it is connected to, but also, each country will be influenced by the countries it is connected to. Putting it more graciously, this is what I call "*The good neighbor effect*".

Similar ideas but in a context of international trade have been used and formulated by authors like Acemoglu et al (2008), Hochman et al (2013), Kim et al (2008), Francois and Manchin (2013) and Krenz (2016). These authors show that international trade between countries is influenced by institutions and vice-versa. However, up to this date and to the best of my knowledge, such logic and methodology has not been extended to the realm of submarine cables and exchange of information between countries. In this regard, this study is an innovation.

More precisely, my instruments are: the average rule of law score [4] and the average internet usage of the countries each country is connected to via submarine cables or share a geographical border. As for the exclusion restriction, it could very well be the case that the decision to which country connects through a submarine cable can be influenced by a corrupt government. However, once connected, a corrupt

[1] www.telegeography.com

[2] www.nec.com

[3] www.submarinecablemap.com .The information on this website is updated on a regular basis, so I used the data available until March 1, 2016

[4] Taken from the World Governance Indicators of the World Bank, elaborated by Kauffman and Kraav (2015)

government no longer has influence on the internal institutional situation of a country or its internet usage. Therefore, these changes within the countries each country is connected to constitute exogenous variations over time. To account for this and strenghten my exclusion restriction, I create my instrumental variables in two steps.

As a first step, I assume that a country has always been affected by the institutional and internet features of the countries it shares a border with. Hence, the value of the instrumental variables will always consider neighboring countries. As for the second step, I assume that a country is affected by the countries it is connected with via submarine cables from the year the cable that connects them started operating and from there on. To put this more clearly, consider the following example. Bangladesh shares borders with India and Myanmar and its first internet cable started to function in 2005. From 2000 and until 2005, the instrumental variables for Bangladesh are the average values of the rule of law score and internet usage of India and Myanmar. Since 2005 Bangladesh has been connected via submarine cables with: France, Italy, Algeria, Tunisia, Egypt, Saudi Arabia, United Arab Emirates, Pakistan, India, Thailand and Singapore. Ergo, since 2005, the instrumental variables for Bangladesh are the average values of the rule of law and internet usage of all this countries in addition to India and Myanmar.

Econometric Specifications

The most basic specification along with its instrumental variable first stage regression is the following cross sectional model:

$$Corruption = \alpha + \beta InternetUsage + \pi X + \varepsilon \tag{1}$$

$$InternetUsage = \delta + \lambda Instrumentalvariable + \psi X + \rho \tag{2}$$

This basic model addresses the question: Do countries with more internet usage have lower corruption levels? Where "*Corruption*"is one of the six indicators of corruption used in this paper and "*Internet* Usage"is the percentage of population in a country that use internet, X are the control variables mentioned in pevious sections and "*Instrumental Variable*"is either one of the two instrumental variables explained above.

The second econometric specification along with its IV first stage is:

$$Corruption = \alpha + \beta ChangeinInternetUsagesince2003 + \pi Xsince2003 + \varepsilon \tag{3}$$

$$ChangeinInternetUsageSince2003 = \delta + \lambda ChangeinInstrumentalVariableSince2003 + \psi Xsince2003 + \rho \tag{4}$$

This second model addresses the question: Do the countries that increased their internet usage since 2003 the most have lower corruption levels? Here all the variables except the dependent variables, consider the change in their values since 2003. I have chosen this year to maximize the number of countries in my sample. Nonetheless, the results vary little and are robust to using different base years. I also estimated models specifying the dependent variables as the independent variables. I did not find any significant results with these specifications though. However, these results are not shown in this version of the paper but will be further discussed later on.

My final specification is a dynamic panel equation:

$$Corruption_{i,t} = \alpha + \chi Corruption_{i,t-1} + \tau Corruption_{i,t-2} + \beta InternetUsage_{i,t} + \pi X_{i,t} + \varepsilon_{i,t} \tag{5}$$

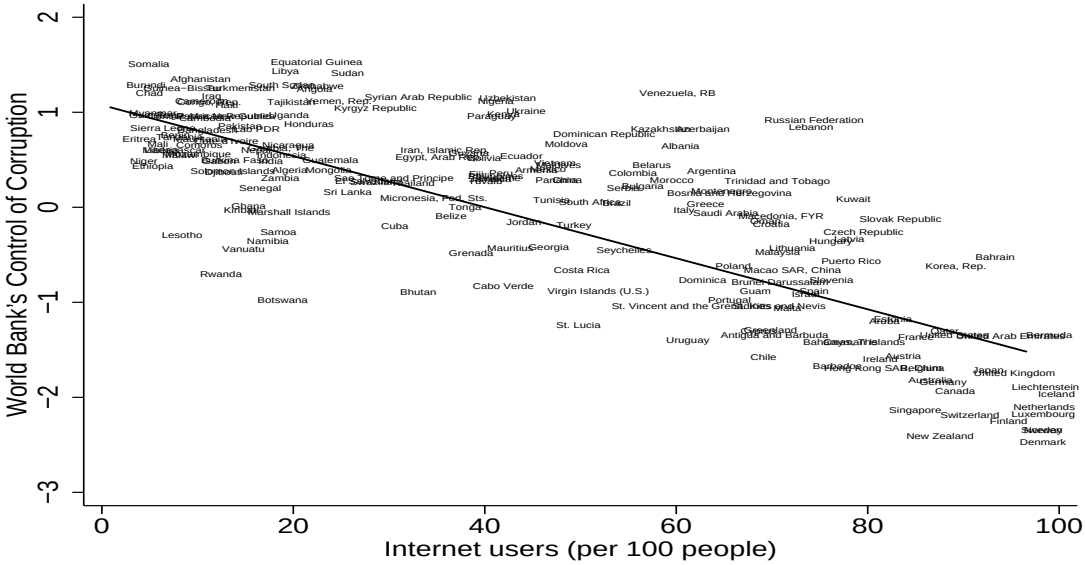
Along with this dynamic panel specification, I estimate its instrumental variable counterpart, the Arellano-Bond dynamic panel estimator. I also present estimates with a regular panel with and without fixed effects and discuss them in the result section. However, since corruption is an institutionalized social and political phenomenon as previosuly discussed, it is reasonable to assume that recent lags of it have significant explanatory power. This is indeed the case in this data set, and all the statistical tests point out that this particular specification is the best suited to explain the phenomen of interest. Thus, the dynamic panel estimations along with their IV counterparts are assumed to be the best suitable specifications for the pannel data in this research.

Results

Effect of Internet Usage on Corruption

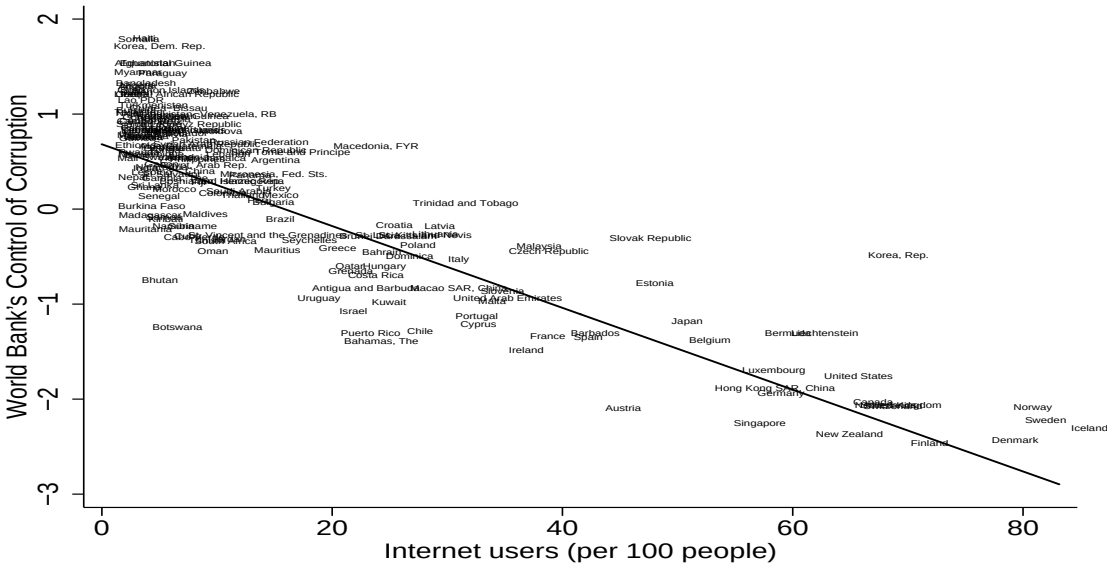
Below in figure 1, I show for 2013 that there is indeed a negative relationship between internet usage and corruption levels. For this figure, I used the data of the World Bank's control of corruption indicator since it is the one with most observations. I used this particular year because it is the most recent year where for which I have data for all my independent variables, and thus, I can control for all the relevant variables as specified in literature. However, this relationship can be found for any of the other five indicators and for any year where there is available data.

Figure 1: Relationship between Internet usage and corruption in 2013



Nonetheless, something that is not appreciated in Figure 1 is how this relationship has evolved over time. In Figure 2 I show the exact same relationship but in 2003. Comparing both figures, it can clearly be seen that there has been a significant change in the relationship over time. In 2003, in 128 out of 190 countries - 67.36% - less than 20% of their population used the internet over the year. Furthermore, for 101 countries - 53.15 % - less than 20% of their population used the internet over the year and the country had corruption levels above the average value. For 2013, these percentages are 31% and 27.91% respectively. By the same token, this relationship has weakened in ten years. Thus, regardless of the initial level of corruption, countries have increased their internet usage. To complement this point, the distribution of countries according to their corruption level has not varied much in average over time. While in 2003, 58.94% of countries had above average corruption scores, for 2013 this was 57.86%. The total sample only increased in 7 countries during this period, so it is highly unlikely that new observations helped maintain this result. What seems to be the case is that countries that started with lower corruption levels, increased their internet usage the most, but they never ceased to be relatively non-corrupt countries.

Figure 2: Relationship between Internet usage and corruption in 2003



To further inquire into this possibility, I estimated OLS regression cross country models for every year and dependent variable [5], where I control for other variables that might be determining this relationship. The result of each of these models are plotted in Figure 3 below. For all my estimations, regardless of year and dependent variable, my estimates yield negative and significant coefficients at the 1% and 5% significance levels for the internet usage variable. For a more intuitive interpretation of the graph and results, I show the absolute value of the coefficients of the internet value for each regression [6].

Figure 3: Absolute value of the effect of internet usage on corruption

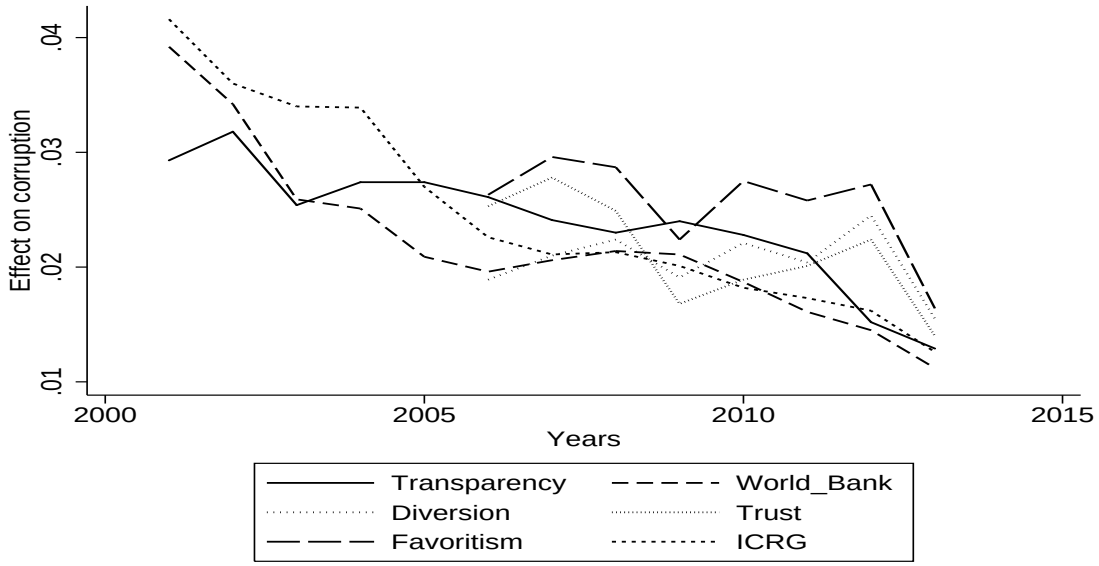


Figure 3 reinforces the findings from figures 1 and 2, as it shows that after controlling for all the relevant determinants of corruption, the negative relationship between internet usage and corruption holds and it

[5] See equation 1 in the previous section

[6] In order to save space in the document, I have not included the complete regression results in this version of the paper, but they are available upon request.

diminishes over time. To give some practical interpretation, the -0.025 coefficient for the World Bank indicator means that a one percent increase in internet usage diminishes the corruption level of a country in 2.5% of a standard deviation of the corruption indicator. At first, this might seem like a small effect, but one has to consider that the internet usage variable has a large standard deviation relative to its mean. Consider two countries, one close to the mean of internet usage and another one standard deviation above: Uruguay and France. If Uruguay had France's internet usage while leaving everything else the same, it would be as corrupt as Ireland in 2003. Which means passing from rank 36 to 18. Similarly, in 2013, if Georgia had the internet usage of Spain it would be as corrupt as Slovenia. Which means, passing from rank 64 to 49.

Furthermore, for each year and dependent variable, the coefficients of all the other control variables are very significant for most years and specifications. Income, Government Size and Freedom of Press have a negative effect on corruption, while the amount of resource rents, years of schooling and the level of democracy have positive effects. The effect of the years of schooling and democracy levels might be startling at first. But one has to bear in mind that this is their effect once it is being controled by other variables. Indeed, if one analyzes these variables on their one with each corruption indicator, one would find a robust negative relationship.

As for my instrumental variable estimations, these are shown for each year in Table 5 in the appendix. For this specification, both of my proposed instruments are valid for almost every year and dependent variable, and the internet usage coefficients still have the expected sign and are significant. Furthermore, the first stage coefficients for my instruments have a positive and significant sign for every model. Said results give support to the "*good neighbor effect*"that I proposed as the justification of my instrumental variables previously.

In addition, to further strenghten the exogeneity claim of my instruments, I also estimated each model where I lag each independent variable, including the instrumental variable. When put like this, this basic specification now indicates if previous periods or levels in internet usage have a current effect on corruption. But more importantly, it is harder to argue that there is endogeneity from present corruption to past internet usage. Thus giving support to the exogeneity claim of the instruments. After estimating this, the results hold. Both instruments remain valid, but the average internet usage of the neighbors loses robustness across dependent variables. In the appendix, I show the estimates for the lagged specification and while using the average rule of law score of the neighbors [7] . Something that stands out with the instrumental variable results, is that there no longer is a decreasing trend of the effect of internet usage on corruption over time. This change in trends relative to the previous models, can be attributed to the effect of the instrumental variable. Therefore, the effect that the institutions of the "*Good neighbors*"does not wear off over time. Which implies, that even if countries increase their internet usage out of an inertial technological process, internet usage still has influence on the corruption levels of a country through the institutional effects of each countries neighbors.

Again, to provide practical meaning to my results using the world bank corruption indicator and the same countries as in the previous example, in 2003, if Uruguay had France's internet usage while leaving everything else the same, it would be as corrupt as Chile. Meaning, passing from ranking 36 to 28. And, in 2013, if Georgia had the internet usage of Spain, it would be as corrupt as Cyprus. Which means passing from rank 64 to 31.

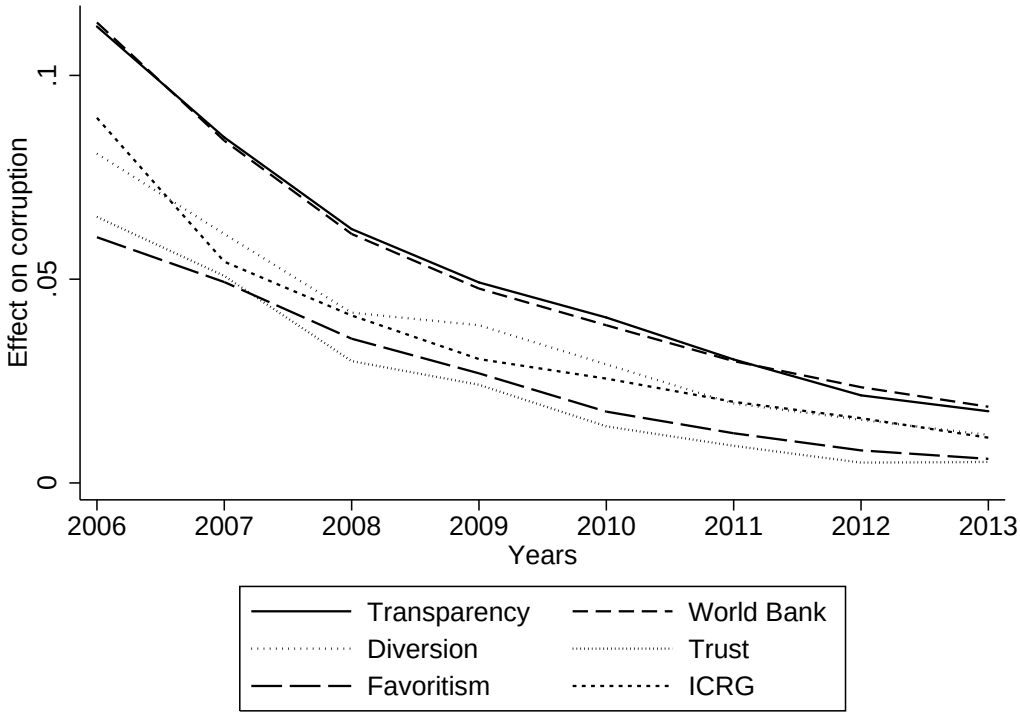
Effect of Change in Internet Usage on Corruption

Now, turning to equation 3, in figure 4 I show the coefficients of change in internet usage since 2003 for each dependent variable plotted for every year since 2006. Again, most coefficients are very signifficant for every year and dependent variable used. All the coefficients are negative, implying that the more a country changed its internet usage since 2003, it is a less corrupt country. After controlling for the changes in other relevant dependent variables during the same period, I find that the effect of internet change since 2003 is

[7] In order to save space, I only present these results to save space in the document and focus on certain results.But any other result or statistics are available upon request.

decreasing over time. This holds true even when calculating the net effects, given that the change in internet usage is increasing over time.

Figure 4: Absolute value of the effect of the change in internet usage on corruption



As for a practical intepretation of the results, consider the world bank corruption indicator again. For 2006, the mean change in internet usage since 2003 was 4.38, while its standard deviation was 4.80. Consider a country near the average change since 2006, like Mexico, and one that is one standard deviation above the mean, like Malta. The results show that if by 2006 Mexico had its internet usage like Malta, it would be as corrupt as Belgium. This is, passing from the rank 95 to the 29. For 2013, consider Jamaica as the average change and Antigua and Barbuda the country one standard deviation above the mean change. Had Jamaica changed its internet usage since 2003 like Antigua and Barbuda, in 2013 it would be corrupt as Estonia. This is, a change from the rank 106 to rank 36.

Regarding the instrumental variable estimations. I find that both my instruments are good instruments and also yield the expected result in the second stage of the estimations. As in the previous subsection, I have also lagged one period on all the independent variables of my models in order to stenghten the exogeneity claim of my instruments. By doing this, my instruments remain valid but the average rule of law score losses robustness. In table 6 in the appendix, I show my estimates using as instrument the average value of the internet usage of the neighbor countries. Where again, not only it is confirmed that there is a declining trend over time -even after considering the increasing change in internet usage over time- but also that all my estimates yield the expected sign.

As for the practical implications, for 2006 if Mexico has changed its internet usage like Malta, it would have been as corrupt as France by 2006. This is a change from rank 95 to 18. By the same token, in 2013, had Jamaica changed its internet usage since 2003 like Antigua and Bermuda, by 2013 it would have been as nearly corrupt as the United States. Passing from rank 106 to 30. Thus, just as in the previous results. The instrumental variable estimates yield effects with larger magnitudes than the regular least squares estimates. This keeps supporting the idea that the institutions in a country can be affected by other countries institutions.

Besides equations (3) and (4), I also estimated models for each year where the dependent variable was the change in corruption since 2003. I did not find any significant robust effects with these specifications, either with regular OLS or IV estimates. In other words, I could not find evidence that the change in internet usage changes the corruption levels in a country. As disappointing as these results might sound, some methodological caveats must be considered before jumping into any conclusions about this. Firstly, the corruption indicators used in this research are bounded from below, which can be an issue when trying to explain the change in corruption levels of a country over time. Consider a hypothetical case of a country that has always been one of the least corrupt countries in the globe by any definition. Even if this country becomes less corrupt over time, it can not get less than a certain corruption score. While it is true that relatively speaking, the indicators will still reflect how corrupt this country is in comparison to others, the final scores of this indicators may fail to reflect the true change in absolute corruption. Secondly, statistically speaking the overall adjustment of these specifications are simply awful. As a group, the change in internet usage along with the change of the other independent variables miserably fail to explain the change in corruption over time.

Therefore, it can not be claimed for sure that internet usage does not change corruption levels. It could very well be the case that corruption changes at a very different pace than the other variables or that other variables omitted in the regressions explain changes in corruption over time. To the best of my knowledge, there is no empirical literature up to this date that points out a group of variables that explain the change in corruption in short periods of time. Hence, this remains as a moot point and it is not directly addressed in this research.

Panel Estimations

Below in table 3, I present my panel estimates. On each panel of the table I have used the same dependent variables but with different model specifications. Panel A shows the basic panel estimates, where I regress each dependent variable of interest on all the control variables previously mentioned in the document. I find that for each dependent variable, there is indeed a very strong, significant and negative relationship between internet usage and corruption. In panel B of the table, I specify my models as dynamic panels, where I include two lags of each dependent variable. The results remain negative and significant for four of the six dependent variables. Furthermore, the general adjustment of the model considerably increased in comparison to the non-dynamic panel estimation. This suggests that a dynamic panel specification is a better model to explain corruption variables in general instead of regular panel specifications. Then again, this makes sense considering the long lasting effects of corruption and how it is a phenomenon that becomes institutionalized in a country.

Panel C shows my estimates of the basic panel specifications with country fixed effects and without any lags of the dependent variables. For these estimates, only 2 of my 6 dependent variables remain significant. However, in comparison to the models in Panel B, the fixed effects panel estimates have a marginally lower explanatory power. Thus suggesting that dynamic panel specifications are better at explaining the phenomenon of interest at hand. Furthermore, it also shows the strong autocorrelation component in the dependent variables, this further strenghtens the claim that a dynamic panel is a more suitable specification than a fixed effect model. Lastly, in panel D, I show the first difference estimates, where thanks to the first difference operator, fixed effects are eliminated. Under this specification, three of my six dependent variables are significant. However, the explanatory power of this model is limited in comparison to the previous models shown in the table. Besides indicating that this is not the best econometric approach to identify the model, the small adjusted R squared suggests that the dependent variables discussed in the literature as determinants of corruption are not good at explaining changes in corruption over time. This goes along the lines of and complements the results of the cross country models where the dependent and independent variables are changes since 2003[8].

Given the previous discussion of the results in Table 3, now I proceed to show my instrumental variable estimates for the dynamic panel models. I have defined my instrumental variables and the lags of the dependent variables as the exogenous variables for the Arellano-Bond estimations, whereas the rest of the controls and dependent variables are considered endogenous. This distinction makes sense given the

[8]Not shown in the document but briefly discussed in a previous section.

Table 3: Panel Estimates

Variables	Transparency	World Bank	ICRG	Trust	Favoritism	Diversion
			Panel A: Regular Panel			
Internet	-0.0130***	-0.0114***	-0.0118***	-0.0174***	-0.0175***	-0.0111***
	(0.00181)	(0.00174)	(0.00236)	(0.00491)	(0.00456)	(0.00387)
Observations	1,508	1,670	1,508	861	861	861
Adj R2	0.790	0.807	0.572	0.472	0.455	0.578
			Panel B: Regular Panel with two lags of dependent variables			
Internet	-0.000940***	-0.000428*	-0.00247***	-0.000517	-0.00129	-0.00148**
	(0.000255)	(0.000247)	(0.000467)	(0.000687)	(0.000904)	(0.000722)
Observations	1,268	1,428	1,290	633	633	633
Adj R2	0.983	0.978	0.931	0.955	0.942	0.969
			Panel C: Regular Panel with country fixed effects			
Internet	-0.000403	0.00118	-0.00319	-0.00871***	-0.00846*	-0.00183
	(0.00161)	(0.00145)	(0.00325)	(0.00330)	(0.00462)	(0.00345)
Observations	1,508	1,670	1,508	861	861	861
Adj R2	0.969	0.973	0.868	0.928	0.911	0.945
			Panel D: First Differences Panel			
Internet	-0.00132	-0.0834***	0.000385	-0.00576**	-0.00723*	-0.00212
	(0.00132)	(0.0118)	(0.00227)	(0.00238)	(0.00411)	(0.00222)
Observations	1,376	1,535	1,387	743	743	743
Adj R2	0.003	0.090	-0.000	0.040	0.020	0.028

[a] Robust Standard Errors, Clustered by Country are shown in parentheses.
[b] *** Significant at 1%, ** Significant at 5%, * Significant at 10%.

discussion in the literature review section, where it is widely acknowledged that one can make a case where any of the controls could be endogenous to the current corruption levels of a country. Furthermore, the statistical tests for instrument validity do not reject the null hypothesis that these specifications generate a valid set of instruments for these specifications [9] .

In panels A and C in table 4, I show the Arellano-Bond estimations where I do not include the lags of the dependent variable. The estimations show that a negative robust relationship exists for all the dependent variables used in this research. However, the estimations show that one can not reject the null hypothesis of autocorrelation in the models. Ergo, the models are potentally biased and thus the inclusion of lags of the dependent variables in the models can help correct this. Therefore, in panel B and D I include in my estimations the first and second lag in my models. Statiscally speaking, the models no longer suggest autocorrelation problems in their specifications and the group of instruments remain valid. I find that my prefered three dependent variables show the expected sign for all the models, while they are all significant in the models where I use the neighbor's rule of law score. In addition, the magnitude of the effects diminish considerably once the lags of the dependent variables are taken into account in comparison with the models without the lagged dependent variables. I have also changed the model specifications of the Arellano-Bond estimator, more specifically, the number of lags to consider as instruments and what variables to consider as exogenous and endogenous. The main results remain significant to these changes [10].

Overall, the results give support to the hypotheses that higher internet usage leads to less corruption. In comparison to the results discussed in the previous sections, the ones yielded by the dynamic panels are much smaller in magnitude. However, this is not surprising given that as previously shown, the negative relationship between internet usage and corruption weakens over time. Bear in mind that the panel coefficients give an estimate of the average effect over time of one variable over another. Since the internet usage of a country can only grow so much -bounded by 100%- and it becomes increasingly harder to increase the internet usage in a country over time, the expected effect of internet usage on corruption will be decreasing over time. Nevertheless, in spite of the elusiveness of this effect, the results still show the expected signs and are significant.

[9] These statistical tests are not shown in this version of the paper in order to save space, but are available upon request
[10] These other results are available upon request

Table 4: Dynamic Panel IV Estimates

Variables	Transparency	World Bank	ICRG	Trust	Favoritism	Diversion
Instrumental Variable: Average of Neighbors Rule of Law						
Panel A: No Lags in the original models						
Internet	-0.0107***	-0.00960***	-0.00829***	-0.0224***	-0.0197***	-0.0136***
	(0.00151)	(0.00171)	(0.00220)	(0.00431)	(0.00438)	(0.00376)
Observations	1,497	1,656	1,496	861	861	861
Countries	125	127	115	116	116	116
Panel B: Models include two lags of the dependent variables						
Internet	-0.00121***	-0.000555*	-0.00329***	0.000146	-0.000312	-0.00148
	(0.000330)	(0.000336)	(0.000649)	(0.00115)	(0.00129)	(0.00108)
Observations	1,261	1,418	1,280	633	633	633
Countries	124	127	115	111	111	111
Instrumental Variable: Average of Neighbors Internet Usage						
Panel C: No Lags in the original models						
Internet	-0.0110***	-0.0102***	-0.00810***	-0.0205***	-0.0179***	-0.0119***
	(0.00152)	(0.00160)	(0.00218)	(0.00443)	(0.00425)	(0.00365)
Observations	1,482	1,631	1,471	861	861	861
Countries	125	127	115	116	116	116
Panel D: Models include two lags of the dependent variables						
Internet	-0.00113***	-0.000530	-0.00318***	0.000159	-0.000277	-0.00125
	(0.000335)	(0.000339)	(0.000613)	(0.00113)	(0.00128)	(0.00107)
Observations	1,255	1,402	1,264	633	633	633
Countries	124	127	115	111	111	111

[a] Robust Standard Errors, Clustered by Country are shown in parentheses.
[b] *** Significant at 1%, ** Significant at 5%, * Significant at 10%.

Conclusions and Final Remarks

Does internet usage reduce corruption? So far, the existing literature provides tempting evidence to suggest that it does. Although, more often than not, studies that tackle this question fail to check for robustness with other variables and do not consider the existence of endogeneity in their estimations. By contrast, I used this paper to retake this question while, considering multiple measurements of corruption and the necessity to control for potential endogeneity.

I find that more internet usage does imply lower corruption in a country. Also, I find that the countries that changed their internet usage over time are less corrupt than countries that did not change their internet usage much. These results are robust to various econometric specifications and the inclusion of control variables. Nonetheless, this phenomenon could be attributed to an omitted variable, most likely good institutions. To tackle this issue along with the reverse causality concerns, I also carried out instrumental variable estimates. Said estimates not only yielded robust and consistent results with the original estimations, but also give support to the idea that countries connected through internet cables influence one another.

These results have important public policy implications. They suggest that the availability of information and the quality of institutions can be transmitted or at least influence political outcomes in other countries, via their internet connectivity through submarine cables or across geographical borders. This is what I call the "*good neighbor hypothesis*", i.e. a country becomes less corrupt the more connected it is to clean countries . This result is of much importance in an increasingly interconnected world via internet, social media and telecommunications. It implies that internet usage and its content trascends the realm of simple exchanges of information, and that the simple fact of using more internet can make a society better off in terms of how corrupt it is.

Unfortunately, I did not find evidence to support the claim that changes in the internet usage imply changes in the corruption levels of a country. However, it would also be wrong to claim otherwise, given the many methodological caveats discussed in the paper. In particular, the corruption measurements are by definition bounded, which do not allow to properly assess changes in absolute values of corruption over time. Also, the statistical adjustment of the models that attempted to explain these changes was unsuccessful, meaning that the econometric specifications do not constitute credible statistical evidence. This is a question that remains unanswered in this paper and should be addressed in future research

regarding corruption determinants.

Altogether, my results are optimistic in relation to the role of internet in political accountability. However, there are many questions that my analysis does not address. For instance: the difference in effects between poor and rich countries, the difference in effects between countries on different continents, or the effect of internet usage on other political, social or institutional variables. More detailed analysis considering these differences is an important area for future study.

References

Acemoglu, D., Johnson, S., Robinson, J., & Yared, P. (2008). "Income and democracy. "American Economic Review, Vol. 98, No. 3, pp. 808-842

Acemoglu, Daron, Tarek Hassan, and Ahmed Tahoun (2015) "The Power of the Street: Evidence from Egypts Arab Spring,"working paper.

Ahrend, R. 2002. "Press freedom, human capital and corruption ". DELTA Working Paper, vol. 2002-11.

Andersen TB, Bentzen J, Dalgaard C-J, Selaya P (2011).Does the Internet Reduce Corruption? Evidence From U.S. States and Across Countries. World Bank Economic Review. 2011;25 (3) :387-417

Barnebeck, Thomas. 2009. "E-government as an anti-corruption strategy ". Information Economics and Policy 21(2009) 201-210

Barro, Robert and Jong-Wha Lee. 2010. "A New Data Set of Educational Attainment in the World, 1950-2010 ". Journal of Development Economics, vol 104, pp.184-198.

Becker, G. 1968. "Crime and punishment: An economic approach ". Journal of Political Economy, 76, 169217.

Bologna, Jamie (2014) Is the Internet an effective mechanism for reducing corruption experience? Evidence from a cross-section of countries, Applied Economics Letters, 21:10, 687-691

Brollo, Fernanda ; Nannicini, Tommaso; Perotti, Roberto and Tabellini, Guido. (2010). "The political Resource Course ". NBER Working Paper 15705.

Brunetti, Aymo and Weder, Beatrice. 2003. "A free press is bad news for corruption ". Journal of Public Economics 87 (2003) 1801-1824

Bulte, Erwin and Damania, Richard. 2008. "Resources for Sale: Corruption, Democracy and the Natural Resource Curse ". The B.E. Journal of Economic Analysis & Policy. Volume 8, Issue 1 (2008)

Chi Lio, Mon; Chun Liu ,Meng and Ou, Yi-Pey.2011. "Can the internet reduce corruption? A cross-country study based on dynamic panel data models ". Government Information Quarterly 28 (2011) 4753

Chinn, Menzie and Fairlie, Robert. 2004. "The determinants of the Global Digital Divide: A cross-country analysis of computer and internet penetration ". NBER Working paper 10686

Chong, Alberto, De la O, Ana, Karlan, Dean and Wantchekon, Leonard (2014) Does Corruption Information Inspire the Fight or Quash the Hope? A Field Experiment in Mexico on Voter Turnout, Choice, and Party Identification. The Journal of Politics, volume 77, number 1. Published online December 22, 2014.

Chowdhury, Shyamal. 2004. "The effect of democracy and press freedom on corruption: an empirical test ". Economics Letters 85 (2004) 93-101

Czernich, Nina, Oliver Falck, Tobias Kretschmer, and Ludger Woessmann. "Broadband infrastructure and economic growth "The Economic Journal121, no. 552 (2011): 505-532.

Djankov, Simeon; La Porta, Rafael; Lopez-de-Silanes, Florencio and Shleifer, Andrei. 2009. "Disclosure by politicians ". NBER Working paper 14703

Elbahnasawy, Nasr and Revier, Charles. 2012. "The determinants of Corruption: Cross-Country-Panel-Data Analysis ". The Developing Economies 50, no 4 (December 2012) 311-333 18

Enikolopov, Ruben and Petrova, Maria and Sonin, Konstantin, Social Media and Corruption (February 22, 2016). Available at SSRN:http://ssrn.com/abstract=2153378orhttp://dx.doi.org/10.2139/ssrn.2153378

Evrensel, Ayse. 2010. "Institutional and economic determinants of corruption: a cross-section analysis ". Applied Economic Letters 17 (2010), 551-554

Falck, Oliver, Robert Gold, and Stephan Heblich. "E-lections: Voting behavior and the internet "The American Economic Review104, no. 7 (2014): 2238-2265.

Forman, Chris; Goldfarb, Avi and Greenstein, Shane. 2005. "Geographic location and the diffusion of Internet technology ". Electronic Commerce Research and Applications 4 (2005) 1-13

Francois, J. F., & Manchin, M. (2007). "Institutions, infrastructure and trade. "

Freille, Sebastian; Haque, Emranul and Kneller, Richard. 2007. "A contribution to the empirics of press freedom and corruption ". European Journal of Political Economy 23 (2007) 838-862

Furlong, Kathryn & Nils Petter Gleditsch, 2003. The Boundary Dataset,Conflict Management and Peace Science29(1): 93117 Garca-Murillo, Martha. 2012. "The Effect of Internet Access on Government Corruption ". Available at SRN http://ssrn.com/abstract=2008249 or http://dx.doi.org/10.2139/ssrn.2008249

Goel, Rajeev and Nelson, Michael. 2010. "Causes of corruption: History, geography and government ". Journal of Policy Modeling 32 (2010) 433447

Goel, Rajeev; Nelson, Michael and Naretta, Michael. 2012. The internet as an indicator or corruption awareness. Euroan Journal of Political Economy 28 (2012) 64-75

Hochman, Gal, Chrysostomos Tabakis, and David Zilberman. 2013. "The impact of international trade on institutions and infrastructure. "Journal of Comparative Economics 41, no. 1: 126-140.

Hung Mo, Pak. 2001. "Corruption and Economic Growth ". Journal of Comparative Economics 29, 6679 (2001)

International Telecommunications Unions. 2014. "World Telecomunications/ICT Indicators Database ". Available at: http://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx

Kar, Dev and Spanjers, Joseph. 2015. "Illicit Financial Flows from Developing Countries: 2004-2013". Global Financial Integrity

Kaufmann, Daniel and Kraav, Aart (2015) "World Governance Indicators". World Bank

Kim, Myeong Hwan, Dongsoo Kim, and Yongseung Han. 2008. "The impact of international institutions on bilateral trade: Economic and political."Global Economy Journal 8, no. 4.

Klein, Philip. 2014. "A cryptography primer ". First Edition, Cambridge University Press, New York. 2014

Kolstad, Ivar and Wiig, Arne. 2009. "Is transparency the key to reducing corruption in resource rich countries? ". World Development Vol.37, No 3 (2009) 521-532

Krenz, A. 2016. "Do political institutions influence international trade? Measurement of institutions and the Long-Run effects ". Center for European, Governance and Economic Development Research Discussion Papers Number.

Kyu-Nahm Jun , Feng Wang & Dapeng Wang (2014) E-Government Use and Perceived Government Transparency and Service Capacity, Public Performance & Management Review, 38:1, 125-151

Lalountas, Dionisios; Manolas, Geroge and Vavouras, Ioannis. 2011. “Corruption, globalization and development: How are these three phenomena related? ”. Journal of Policy Modeling 33 (2011) 636-648

Leite, C and Weidmann, J. 1999. “Does mother nature corrupt? Natural resources, corruption, and economic growth ”. Natural Resources, Corruption, and Economic Growth (June 1999). IMF Working Paper, (99/85).

Loshin, Peter. 1998.“Personal encryption clearly explained ”. Academic Press Limited, United Kingdom, 1998.

Mauro, Paolo. 1995. “Corruption and Growth ”. The Quarterly Journal of Economics, Vol. 110, No. 3 (Aug., 1995), pp. 681-712

Mauro, Paolo. 2002. “The persistence of Corruption and slow economic growth ”. IMF Working paper.

Mayer, T. & Zignago, S. (2011) Notes on CEPIIs distances measures : the GeoDist Database CEPII Working Paper 2011-25

Miner, Luke. “The unintended consequences of Internet diffusion: Evidence from Malaysia ”Journal of Public Economics132 (2015): 66-78.

Olken, Benjamin and Rohini, Pande. 2011. “Corruption in Developing Countries ”. NBER Working Paper 17398

Pande, Rohini. 2007. “Understanding Political Corruption in Low income countries ”. CID Working Paper No.145

Pande, Rohini. 2011. “Can Informed Voters Enforce Better Governance? Experiments in Low Income Democracies ”. Annual Review of Economics 3, no. 1: 215-237.

Pendergast, Shannon; Van Kooten, Cornelis and Clarke, Judith. 2008. “Corruption and the curse of Natural resources ”. Department of Economics, University of Victoria (2008)

Polity IV Project. 2013. “Polity IV: Regime Authority Characteristics and Transitions Datasets ”. Available at: http://www.systemicpeace.org/inscrdata.html

Qin, Bei, David Strmberg, and Yanhui Wu (2016) “The Political Economy of Social Media in China,”Working Paper.

Reporters Without Borders. 2014. “World Press Freedom Index ”. Available at: http://en.rsf.org/

Sachs, Jeffrey and Warner, Andrew. 1995. “Natural Resource Abundance and Economic Growth ”. NBER Working Paper 5398

Serra, Daniela. 2006. “Empirical Determinants of Corruption: A Sensitivity Analysis ”. Public Choice, Vol. 126, No. 1/2 (Jan., 2006), pp. 225-256

Stapenhurst, R. 2000. “The Media’s Role in Curbing Corruption ”. World Bank Institute,Washington DC.

Submarine Cable Map. Available at www.submarincecablemap.com

Transparency International (2016). “Corruptions Perceptions Index 2015 ”

Treisman, Daniel. 2000. “The causes of corruption: a cross-national study ”. Journal of Public Economics 76 (2000) 399457

Treisman, Daniel. 2007. “What have we learned about the causes of corruption from ten years of cross-national empirical research? ”. Annual Review of Political Science 10 (2007) 211-244

World Bank . 2015. “Development Indicators ”. Available at: http://data.worldbank.org/indicator

Appendix

Table 5: IV Effect of Internet Usage on Corruption. Instrument: Neighbors' Rule of Law

Variables	Transparency	World Bank	ICRG	Trust	Favoritism	Diversion
	Year of Dependent Variables: 2006					
Internet 2005	-0.0242***	-0.0212*	-0.0309**	-0.0255**	-0.0344**	-0.0165
	(0.00845)	(0.0113)	(0.0132)	(0.0127)	(0.0157)	(0.0111)
Rule of Law 2005	10.02***	7.153**	11.21***	11.85***	11.85***	11.85***
	(2.982)	(3.578)	(3.079)	(3.118)	(3.118)	(3.118)
Observations	117	117	105	99	99	99
	Year of Dependent Variables: 2007					
Internet 2006	-0.0241***	-0.0244***	-0.0420***	-0.0278***	-0.0358***	-0.0213**
	(0.00675)	(0.00892)	(0.0111)	(0.0102)	(0.0111)	(0.00901)
Rule of Law 2006	12.22***	9.032**	14.20***	13.22***	13.22***	13.22***
	(2.664)	(3.493)	(2.653)	(2.784)	(2.784)	(2.784)
Observations	116	117	106	103	103	103
	Year of Dependent Variables: 2008					
Internet 2007	-0.0254***	-0.0240**	-0.0440***	-0.0293**	-0.0366***	-0.0269***
	(0.00762)	(0.0102)	(0.0126)	(0.0115)	(0.0115)	(0.0104)
Rule of Law 2007	11.92***	8.585**	13.35***	13.01***	13.01***	13.01***
	(2.600)	(3.446)	(2.638)	(2.632)	(2.632)	(2.632)
Observations	119	120	108	108	108	108
	Year of Dependent Variables: 2009					
Internet 2008	-0.0300***	-0.0257**	-0.0441***	-0.0324**	-0.0394***	-0.0321***
	(0.00875)	(0.0126)	(0.0133)	(0.0141)	(0.0145)	(0.0120)
Rule of Law 2008	11.04***	7.645**	12.30***	12.17***	12.17***	12.17***
	(2.644)	(3.473)	(2.659)	(2.657)	(2.657)	(2.657)
Observations	118	119	107	108	108	108
	Year of Dependent Variables: 2010					
Internet 2009	-0.0285***	-0.0240**	-0.0358***	-0.0335**	-0.0440***	-0.0357***
	(0.0107)	(0.0108)	(0.0129)	(0.0160)	(0.0165)	(0.0136)
Rule of Law 2009	10.92***	10.32***	11.76***	11.57***	11.57***	11.57***
	(2.850)	(2.810)	(2.921)	(2.821)	(2.821)	(2.821)
Observations	118	118	107	111	111	111
	Year of Dependent Variables: 2011					
Internet 2010	-0.0330**	-0.0262**	-0.0420**	-0.0355*	-0.0473**	-0.0427**
	(0.0137)	(0.0131)	(0.0170)	(0.0196)	(0.0205)	(0.0179)
Rule of Law 2010	9.367***	8.719***	9.929***	10.09***	10.09***	10.09***
	(2.784)	(2.719)	(2.895)	(2.746)	(2.746)	(2.746)
Observations	120	120	109	112	112	112
	Year of Dependent Variables: 2012					
Internet 2011	-0.0231	-0.0320	-0.0552***	-0.0340	-0.0452*	-0.0436*
	(0.0146)	(0.0222)	(0.0214)	(0.0246)	(0.0249)	(0.0224)
Rule of Law 2011	7.922***	4.777	8.613***	8.232***	8.232***	8.232***
	(2.727)	(3.164)	(2.912)	(2.647)	(2.647)	(2.647)
Observations	118	119	107	111	111	111
	Year of Dependent Variables: 2013					
Internet 2012	-0.0256**	-0.0284*	-0.0486***	-0.0502**	-0.0611**	-0.0526**
	(0.0117)	(0.0154)	(0.0167)	(0.0251)	(0.0247)	(0.0228)
Rule of Law 2012	9.095***	6.264**	10.06***	8.188***	8.188***	8.188***
	(2.708)	(3.004)	(2.822)	(2.540)	(2.540)	(2.540)
Observations	117	118	107	111	111	111

[a] Robust Standard Errors are shown in parentheses.
[b] Internet shows the second stage instrumental variable coefficient and Rule of law shows the first stage instrumental variable coefficient.
[c] *** Significant at 1%, ** Significant at 5%, * Significant at 10%.

Table 6: IV Effect of Internet Change on Corruption. Instrument: Neighbors' change in internet usage Level

Variables	Transparency	World Bank	ICRG	Trust	Favoritism	Diversion
Year of Dependent Variables: 2006						
Internet Change 2005	-0.189***	-0.182***	-0.173***	-0.0988**	-0.0893*	-0.137***
	(0.0422)	(0.0430)	(0.0486)	(0.0469)	(0.0523)	(0.0438)
Neighbors' change 2005	0.573***	0.571***	0.528**	0.536**	0.536**	0.536**
	(0.192)	(0.193)	(0.202)	(0.206)	(0.206)	(0.206)
Observations	110	110	98	94	94	94
Year of Dependent Variables: 2007						
Internet Change 2006	-0.139***	-0.133***	-0.127***	-0.0535	-0.0536	-0.0906***
	(0.0279)	(0.0281)	(0.0372)	(0.0364)	(0.0355)	(0.0320)
Neighbors' change 2006	0.653***	0.648***	0.587***	0.577***	0.577***	0.577***
	(0.159)	(0.160)	(0.172)	(0.165)	(0.165)	(0.165)
Observations	109	109	98	97	97	97
Year of Dependent Variables: 2008						
Internet Change 2007	-0.118***	-0.110***	-0.108***	-0.0414	-0.0521*	-0.0789***
	(0.0232)	(0.0234)	(0.0279)	(0.0289)	(0.0273)	(0.0274)
Neighbors' change 2007	0.681***	0.679***	0.629***	0.580***	0.580***	0.580***
	(0.137)	(0.137)	(0.148)	(0.148)	(0.148)	(0.148)
Observations	112	112	100	100	100	100
Year of Dependent Variables: 2009						
Internet Change 2008	-0.0814***	-0.0754***	-0.0703***	-0.0280	-0.0355**	-0.0571***
	(0.0142)	(0.0149)	(0.0180)	(0.0179)	(0.0176)	(0.0174)
Neighbors' change 2008	0.858***	0.859***	0.811***	0.797***	0.797***	0.797***
	(0.107)	(0.108)	(0.122)	(0.122)	(0.122)	(0.122)
Observations	111	111	99	100	100	100
Year of Dependent Variables: 2010						
Internet Change 2009	-0.0515***	-0.0466***	-0.0450***	0.00468	-0.00539	-0.0225
	(0.0101)	(0.0106)	(0.0114)	(0.0152)	(0.0148)	(0.0144)
Neighbors' change 2009	0.944***	0.947***	0.929***	0.878***	0.878***	0.878***
	(0.103)	(0.104)	(0.116)	(0.108)	(0.108)	(0.108)
Observations	111	110	99	103	103	103
Year of Dependent Variables: 2011						
Internet Change 2010	-0.0454***	-0.0454***	-0.0417***	0.00902	-0.00365	-0.0210
	(0.00965)	(0.00991)	(0.00986)	(0.0157)	(0.0147)	(0.0140)
Neighbors' change 2010	0.941***	0.941***	0.931***	0.862***	0.862***	0.862***
	(0.105)	(0.107)	(0.118)	(0.121)	(0.121)	(0.121)
Observations	111	110	99	103	103	103
Year of Dependent Variables: 2012						
Internet Change 2011	-0.0422***	-0.0480***	-0.0458***	0.0151	0.00118	-0.0177
	(0.00942)	(0.0105)	(0.0111)	(0.0157)	(0.0150)	(0.0132)
Neighbors' change 2011	0.899***	0.908***	0.871***	0.813***	0.813***	0.813***
	(0.103)	(0.104)	(0.123)	(0.114)	(0.114)	(0.114)
Observations	109	109	97	103	103	103
Year of Dependent Variables: 2013						
Internet Change 2012	-0.0308***	-0.0360***	-0.0317**	0.00685	-0.00288	-0.0140
	(0.0118)	(0.0131)	(0.0134)	(0.0190)	(0.0181)	(0.0168)
Neighbors' change 2012	0.716***	0.718***	0.732***	0.651***	0.651***	0.651***
	(0.179)	(0.178)	(0.221)	(0.186)	(0.186)	(0.186)
Observations	107	107	96	102	102	102

[a] Robust Standard Errors are shown in parentheses.

[b] Internet Change shows the second stage instrumental variable result while Neighbors' change shows the first stage coefficient.

[c] *** Significant at 1%, ** Significant at 5%, * Significant at 10%.