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The Mediating Role of Voice and Accountability in the Relationship Between Internet Diffusion and Government Corruption in Latin America and Sub-Saharan Africa

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We examine relationships among Internet diffusion, voice and accountability, and government corruption based on data from 24 Latin American and 23 sub-Saharan African countries from 2006 to 2010. Our study suggests that greater levels of Internet diffusion are associated with greater levels of voice and accountability and that greater levels of voice and accountability are associated with lower levels of government corruption. Also, there seems to be an overall relationship between Internet diffusion and government corruption, which is primarily indirect and mediated by voice and accountability. Our study builds on modernization theory, and employs the method of robust path analysis, implemented through the software WarpPLS. Policy-makers in developing countries aiming at increasing voice and accountability at the national level, and thus the degree to which their citizens participate in the country's governance, should strongly consider initiatives that broaden Internet access in their countries.

Keywords: Latin America; sub-Saharan Africa; government corruption; voice and accountability; Internet diffusion

Introduction

The study of government corruption and its antecedents has been gaining increasing attention due to a number of reasons; one of the most important of these reasons is the increasingly vital role of globalization in defining the socio-economic conditions of both developed and developing countries (Rothstein, 2011). The levels of globalization seen today are in part due to the advent and widespread use of the Internet (Akpan, 2003; Darley, 2003; Qureshi, 2011). Interestingly, Internet use may also be associated with another factor that seems to strongly influence the socio-economic conditions of both developed and developing countries – government corruption. In this context, Internet use may act as a mitigating factor, reducing government corruption (Garcia-Murillo, 2010).

Government corruption, or the use of public office or power for personal gain, seems to be negatively associated with a country's socio-economic development; generally, less developed countries (e.g. Latin American and sub-Saharan African countries) have more government corruption than more developed countries (Treisman, 2007). Government corruption tends to lead to the misallocation of public resources, thereby creating a bias against efficient projects and practices (Macrae, 1982). It also tends to prevent or reduce the inflow of foreign investment (Kessing, Konrad, & Kotsogiannis, 2007), possibly perpetuating underdevelopment. Musa,

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Meso, and Mbarika (2005) provided a possible partial explanation for this situation, based on an examination of countries in sub-Saharan Africa. They argued that developing countries are more resistant to the introduction of technologies that can be used to fight corruption, such as Internet-based technologies, than developed countries.

The relatively low cost of Internet access has led to its growing use in government initiatives (Henriksen & Damsgaard, 2007). While these initiatives can themselves help to reduce government corruption (Shim & Eom, 2008, 2009), one of the most promising ways in which diffusion of Internet access (i.e. "Internet diffusion") can mitigate government corruption may be by increasing the extent to which a country's citizens are able to participate in the country's governance by examining several aspects of a country's political processes; including civil liberties, political rights, and a free media (Jakopin & Klein, 2011; Perez & Ben-David, 2012).

That is, Internet diffusion can mitigate government corruption (Garcia-Murillo, 2010) by increasing what is known as "voice and accountability"; the extent to which a country's citizens are able to participate in the country's governance (Kaufmann, Kraay, & Mastruzzi, 2009). This expectation is consistent with modernization theory; a broad theory of social change that attempts to identify those factors, often associated with technological diffusion, that result in positive and also negative social transformations (Apter, 1965; Scott, 1995).

We examine an important subset of the relationships hinted at above; specifically the relationships among Internet diffusion, voice and accountability, and government corruption. Following Darley (2003) and Musa et al. (2005), our focus is on developing countries in the sub-Saharan African region, as well as in a "matched" developing region of increasing importance in the world, namely Latin America. Central to our investigation are the predictions that one will find a negative overall relationship between Internet diffusion and government corruption (i.e. more Internet diffusion leading to less government corruption) in both Latin American and sub-Saharan African countries, and that this relationship will be indirect and mediated by voice and accountability.

Research background and hypotheses

Modernization theory is a broad theory of social change that attempts to identify those factors that lead to positive and negative social changes, among which technological diffusion plays a key role (Scott, 1995). Somewhat surprisingly, this theory has rarely been employed before in discussions about the impact of the Internet on social welfare at the national and global levels, with a few notable exceptions (Cooks & Isgro, 2005; Corrales & Westhoff, 2006; Sandywell, 2006). Sandywell (2006) builds on modernization theory to argue that the Internet is often perceived as a negative force behind social change, giving individuals the impression that they are losing control of the social environment around them. Cooks and Isgro (2005), on the other hand, build on modernization theory to argue that the Internet is an empowerment force for women in developing countries. Corrales and Westhoff (2006) use modernization theory as a basis for an empirical study that looked into the effect that democratic participation has on the impact of country wealth on Internet diffusion, a topic related to our own.

Within the context of national social change via political engagement, modernization theory explores the relationship between technological diffusion, democratic participation, and government effectiveness (Apter, 1965). In this context, modernization theory allows for the prediction that Internet diffusion will improve government effectiveness, in part through the reduction of government corruption and through various intermediate effects; a key intermediate effect being an increase in the extent to which a country's citizens are able to participate in the country's governance. This prediction is consistent with past empirical research, summarized in this section, and forms the basis on which our hypotheses are developed.

Jakopin and Klein (2011) found a significant bivariate association between Internet diffusion and voice and accountability; this association was primarily related to fixed, as opposed to mobile, Internet diffusion. They found no association between these two variables, however, in a multivariate analysis where voice and accountability was hypothesized to predict Internet diffusion. These results, when combined, suggest the existence of a possible association between Internet diffusion and voice and accountability where Internet diffusion is the predictor instead of the criterion. This expectation is generally consistent with qualitative studies conducted by Pirannejad (2011) in Iran and Perez and Ben-David (2012) in India, as well as with a survey-based study conducted by Cuillier and Piotrowski (2009). This expectation is formalized through hypothesis H1; which, like the other hypotheses guiding our investigation, is framed within the context of Latin American and sub-Saharan African countries.

H1: Greater levels of Internet diffusion in Latin American and Sub-Saharan African countries will be associated with greater levels of voice and accountability.

Sung (2012) conducted a longitudinal study of 204 countries, where the study was originally formulated to assess the role of women in government corruption. The study found no relationship between gender and government corruption, but did find a significant association between voice and accountability and government corruption, with voice and accountability appearing to be the predictor. This finding is consistent with the results of an earlier longitudinal study of 170 countries by Fredriksson, Neumayer, and Ujhelyi (2007). This possible causal link between voice and accountability and government corruption is also consistent with the results of a focused study in the country of Armenia conducted by Coxson (2009), as well as with the outcomes of an extensive review of the government corruption literature by Rothstein (2011). Hypothesis H2 formalizes this link in the context of our investigation.

H2: Greater levels of voice and accountability in Latin American and Sub-Saharan African countries will be associated with lower levels of government corruption.

An econometrics analysis conducted by Andrei, Stancu, Nedelcu, and Matei (2009) suggested that voice and accountability partially predicts government corruption, together with political pressure and quality of government employees' job-related relationships. Given the possible link between Internet diffusion and voice and accountability, this may be one of the underlying reasons for the overall link between Internet diffusion and government corruption suggested by a cross-sectional study of 170 countries conducted by Garcia-Murillo (2010). That is, Internet diffusion may exert its effect on government corruption primarily in an indirect way, by allowing a country's citizens to more actively participate in the country's governance.

A consistent finding in the research literature on the impacts of Internet-based communication technologies is that those technologies usually exert effects through key intermediate variables (Kock & DeLuca, 2007). This happens as individuals and groups adapt Internet-based communication technologies to carry out specific processes and achieve their goals (Kock, Lynn, Dow, & Akgün, 2006). Given this, the apparently strong causative association between Internet diffusion and voice and accountability (Jakopin & Klein, 2011) and the critical role that voice and accountability seems to play in the reduction of government corruption (Rothstein, 2011), a reasonable expectation can be hypothesized. The expectation is that Internet diffusion will affect government corruption primarily in an indirect way (Garcia-Murillo, 2010), via an intermediate effect on voice and accountability, which is formalized through hypothesis H3.

H3: The relationship between Internet diffusion and government corruption in Latin American and Sub-Saharan African countries will be indirect and mediated by voice and accountability.

The three hypotheses above provide a novel, important, and parsimonious framework for the examination of the associations among Internet diffusion, voice and accountability, and

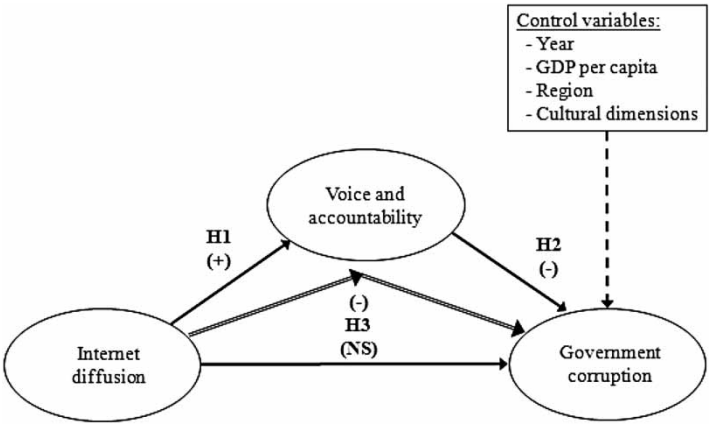

Figure 1. Model with hypotheses.
Notes: (+) or (−), significant positive or negative, respectively, association. NS , nonsignificant association.

government corruption in Latin American and sub-Saharan African countries. This framework may explain a number of previous findings and form a basis for future research. It can be expressed through a causal model, shown in Figure 1, which provides the basis for a test whereby quantitative data will be analyzed using the method of path analysis (Hair, Black, Babin, & Anderson, 2009; McDonald, 1996).

The model depicts hypotheses H1 and H2 employing the symbols "(+)" and "(−)" to refer to the positive and negative (or direct and inverse) relationships that are predicted through the hypotheses. Hypothesis H3 is depicted in a more complex way, through a double-lined arrow above the hypothesis and a single-lined arrow below it. The double-lined arrow represents the indirect relationship between Internet diffusion and government corruption, mediated by voice and accountability. This indirect relationship is hypothesized to be negative, hence the symbol "(−)." This indirect relationship is also hypothesized to capture the association between Internet diffusion and government corruption, or to fully mediate it (Preacher & Hayes, 2004), thus rendering the competing direct relationship represented by single-lined arrow nonsignificant, hence the symbol "(NS)."

Four control variables are also included in the model and listed within the rectangle symbol: year (2006–2010), GDP per capita, region (Latin America = 1 and sub-Saharan Africa = 0), and four cultural dimensions from Hofstede's (2001) framework for which country scores in these two regions were available. The choice of these control variables is explained in Appendix 1, where additional details about these variables can also be found.

Research method and descriptive statistics

Increasing access to the Internet and its effects in the sub-Saharan African region has been the focus of much research interest in recent years, particularly because of the Internet's potential to change and possibly reverse the historic technological underdevelopment of this region (Darley, 2003; Musa et al., 2005). This interest provided the motivation for our focus on developing countries in the sub-Saharan African region. However, we also wanted to incorporate into our investigation data from a "matched" developing region of increasing importance in the world, namely Latin America, for two main reasons. The first reason is that this would increase the size of our sample, and thus improve the reliability of our findings. The second reason is that

this would add to the generality of our findings, as we could include the variable "region" to our model, dummy coded as Latin America = 1 and sub-Saharan Africa = 0, as a control variable.

The data used in this study cover 47 countries, 24 of which in Latin America and 23 in sub-Saharan Africa; and spans five years, ranging from 2006 to 2010. This added up to a total sample size of $47 \times 5 = 235$ data points.

Internet diffusion was measured by the number of Internet users per 100 inhabitants in a country, obtained from the World Bank (http://www.worldbank.org). Voice and accountability was measured through the eponymous index, also from the World Bank. Government corruption was measured through the Corruption Perceptions Index published by Transparency International (http://www.transparency.org). The Corruption Perceptions Index scores were reversed, through multiplication by -1, so as to properly reflect the degree of corruption of countries; as opposed to reflecting the lack of corruption, as the original scores do, which could cause model interpretation problems.

The data were analyzed using the method of robust path analysis (Hair et al., 2009; McDonald, 1996; Siegel & Castellan, 1998). Robust path analysis was employed, instead of multiple regression or classic path analysis, for three main reasons. One of the reasons is that it allowed us to test the entire model, including the mediating effect, at once. The second reason is that all *P*-values were estimated through distribution-neutral nonparametric procedures. This was important, because several of the variables in the model, including voice and accountability and government corruption, were not normally distributed. The third reason for employing robust path analysis was that it allowed for the estimation of the *P*-value associated with the mediating effect directly, via resampling. This is a simpler, distribution-neutral, and more reliable approach than the classical approach proposed by Baron and Kenny (1986) and the more recent approach proposed by Preacher and Hayes (2004). Both of these approaches rely on the development of intermediate models and on various assumptions.

We used the multivariate statistical analysis software WarpPLS 3.0 (Kock, 2012), which allowed us to conduct a robust path analysis whereby *P*-values associated with various coefficients were calculated using a nonparametric resampling technique known as bootstrapping (Diaconis & Efron, 1983). Indirect coefficients of association were also calculated (Bollen & Stine, 1990) together with their respective *P*-values, as well as Cohen's (1988) *f*-squared effect sizes. Several moderating effects were also tested, where control variables that appeared to significantly influence other associations were included as moderators. Data validation was based on the calculation of Stone–Geisser *Q*-squared coefficients (Geisser, 1974; Stone, 1974), as well as block and full collinearity variance inflation factors (Kock & Lynn, 2012).

The sub-Saharan African countries included were Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Chad, Ethiopia, Kenya, Lesotho, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Nigeria, South Africa, Suriname, Tanzania, Uganda, Zambia, and Zimbabwe. The Latin American countries included were Argentina, Barbados, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Portugal, Trinidad and Tobago, Uruguay, and Venezuela.

Tables 1 and 2 show details about the variables: variable definitions and measurement approaches; correlations among variables; as well as means, standard deviations, maximum values, and minimum values for each variable. Appendix 5 provides additional details on the component measures that make up the Voice and Accountability Index and the Corruption Perceptions Index.

As can be seen, the three variables included in the model were strongly correlated; all correlations were significant at the $P < .001$ level. These call for collinearity tests, which were conducted and are described later. Even though strong correlations among variables are necessary

Table 1. Variable definitions and measurement.

Variable	Definition and measurement
Internet diffusion	The degree to which Internet access is available in a country. Measured through the number of Internet users per 100 inhabitants in a country obtained from the World Bank (http://www.worldbank.org)
Voice and accountability	The degree to which the citizens of a country are able to participate in the country's governance. Measured through the Voice and Accountability Index obtained from the World Bank (http://www.worldbank.org)
Government corruption	The degree to which public office or power is used for personal gain. Measured through the Corruption Perceptions Index published by Transparency International (http://www.transparency.org). The scores were reversed to properly reflect the degree of corruption of countries; the original scores reflect the lack of corruption

for and possibly suggestive of collinearity, they are not a guarantee of collinearity (Hair et al., 2009; Hamilton, 1987; Kock & Lynn, 2012). In the absence of collinearity, strong correlations among variables are indicative of significant associations.

Internet diffusion ranged from 0.313 to 74.248 Internet users per 100 inhabitants, with a mean of 15.849 and a standard deviation of 15.155. Voice and accountability scores ranged from −1.584 to 1.243, with a mean of −0.042 and a standard deviation of 0.671. Government corruption scores (reversed from the original scores) ranged from −7.800 to −1.600, with a mean of −3.377 and a standard deviation of 1.350. All variables were standardized prior to the path analysis (Kline, 1998; Maruyama, 1998; McDonald, 1996).

Model validation

Stone–Geisser Q-squared coefficients (Geisser, 1974; Stone, 1974) are given in Table 3 for each of the two endogenous variables in the path model. The Q-squared coefficient is a nonparametric measure, traditionally calculated via blindfolding, which is used for the assessment of the predictive validity (or relevance) associated with each variable block in a path model, through the endogenous variable that is the criterion variable in the block. Acceptable predictive validity in connection with an endogenous variable is suggested by a Q-squared coefficient greater than zero (Kock, 2012). Since this is the case for the two endogenous variables in the model, it can be concluded that the model presents acceptable predictive validity.

Block variance inflation factors were calculated for each variable with two or more predictors; that is, for each variable block in which two or more predictors point at an endogenous variable. There was only one such block in our model. The variance inflation factors are given in Table 4, where each variance inflation factor shown is associated with one of two predictors and relates to the link between that predictor and its criterion variable. In this context, a variance inflation factor is a measure of the degree of vertical collinearity (Kock & Lynn, 2012), or redundancy, among the variables that are hypothesized to affect another variable in a block. Variance inflation factors of 3.3 or lower suggest the existence of no vertical collinearity in a variable block (Cenfetelli & Bassellier, 2009; Kock & Lynn, 2012; Petter, Straub, & Rai, 2007). Since this is the case here, it can be concluded that the model is free from vertical collinearity.

Variance inflation factors were also calculated simultaneously for all variables, separately from the variance inflation factors calculated for two or more predictor variables in individual variable blocks. These variance inflation factors, reported in Table 5, were calculated based on a full collinearity test (Kock & Lynn, 2012). This test enables the identification of not

Table 2. Descriptive statistics for all years and separately for each year.

	Internet diffusion	Voice and accountability	Government corruption
All years			
Voice and accountability	(0.570)		
Government corruption	(−0.479)	(−0.790)	
Mean	*15.849*	*−0.042*	*−3.377*
Standard deviation	*15.155*	*0.671*	*1.350*
Maximum	*74.248*	*1.243*	*−1.600*
Minimum	*0.313*	*−1.584*	*−7.800*
Year: 2006			
Voice and accountability	(0.617)		
Government corruption	(−0.538)	(−0.740)	
Mean	*11.321*	*−0.011*	*−3.336*
Standard deviation	*11.811*	*0.664*	*1.298*
Maximum	*48.815*	*1.242*	*−2.000*
Minimum	*0.313*	*−1.559*	*−7.300*
Year: 2007			
Voice and accountability	(0.600)		
Government corruption	(−0.483)	(−0.786)	
Mean	*13.164*	*−0.011*	*−3.372*
Standard deviation	*13.086*	*0.672*	*1.334*
Maximum	*56.058*	*1.243*	*−1.800*
Minimum	*0.374*	*−1.584*	*−7.000*
Year: 2008			
Voice and accountability	(0.595)		
Government corruption	(−0.460)	(−0.808)	
Mean	*15.307*	*−0.042*	*−3.417*
Standard deviation	*14.356*	*0.673*	*1.375*
Maximum	*57.309*	*1.216*	*−1.600*
Minimum	*0.453*	*−1.567*	*−7.000*
Year: 2009			
Voice and accountability	(0.597)		
Government corruption	(−0.480)	(−0.801)	
Mean	*17.619*	*−0.068*	*−3.372*
Standard deviation	*16.115*	*0.686*	*1.365*
Maximum	*58.655*	*1.205*	*−1.600*
Minimum	*0.549*	*−1.523*	*−7.400*
Year: 2010			
Voice and accountability	(0.657)		
Government corruption	(−0.617)	(−0.819)	
Mean	*21.707*	*−0.076*	*−3.389*
Standard deviation	*18.508*	*0.685*	*1.446*
Maximum	*74.248*	*1.211*	*−1.700*
Minimum	*0.750*	*−1.488*	*−7.800*

Note: Correlation coefficients shown within parentheses; all significant at the $P < .001$ level.

Table 3. Stone–Geisser Q-squared coefficients.

Voice and accountability	Government corruption
0.324	0.689

Table 4. Block variance inflation factors.

	Internet diffusion	Voice and accountability
Government corruption	2.624	2.051

Table 5. Full collinearity variance inflation factors.

Internet diffusion	2.663
Voice and accountability	3.240
Government corruption	3.200
Year (2006–2010)	1.142
GDP per capita	2.684
Region (Latin America = 1 and sub-Saharan Africa = 0)	2.522
Cultural dimension 1: power distance	1.949
Cultural dimension 2: uncertainly avoidance	1.622
Cultural dimension 3: long-term/short-term orientation	1.654
Cultural dimension 4: individualism/collectivism	2.136

only vertical but also lateral collinearity, which is collinearity among predictor–criterion variable pairs. This test also allows for an assessment of collinearity involving all variables in a model, including control variables. The variance inflation factor threshold used here is the same as that used in the vertical collinearity test; that is, variance inflation factors of 3.3 or lower suggest the existence of no model-wide multicollinearity (Cenfetelli & Bassellier, 2009; Kock & Lynn, 2012; Petter et al., 2007). Since this is the case here for all variables, it can be concluded that results of our analysis have not been biased by model-wide multicollinearity.

In summary, based on the tests above, it can be concluded that in terms of the measures used the model presents acceptable predictive validity, is free from vertical collinearity, and is free from model-wide multicollinearity. These tests, particularly the tests addressing vertical and full collinearity, relied on conservative multivariate data analyses criteria (Hair et al., 2009; Kock & Lynn, 2012). Based on them, we can expect the results of the path analysis to be generally unbiased with respect to the data validation tests performed.

Data analysis results

The model with the main results is shown in Figure 2. The beta coefficients are standardized partial regression coefficients provided for each predictor–criterion variable pair. Beta coefficients noted with the symbol "***" are statistically significant at the $P < .001$ level. The beta coefficient noted with the symbol "NS" refers to a statistically nonsignificant association. *R*-squared coefficients are shown under criteria (aka endogenous) variables; they reflect the percentage of explained variance for those variables by their predictors in each variable block.

Greater levels of Internet diffusion in Latin American and sub-Saharan African countries were associated with greater levels of voice and accountability ($\beta = .570$, $P < .001$, $f^2 = .325$), supporting hypothesis H1. Greater levels of voice and accountability were associated with lower levels of government corruption ($\beta = -.610$, $P < .001$, $f^2 = .481$), supporting H2. As indicated by the f^2 coefficients (Cohen, 1988; Kock, 2012), the association between Internet diffusion and voice and accountability ($f^2 = .325$) had a medium effect size (i.e. $.150 \leq f^2 \leq .350$) and the association between voice and accountability and government corruption ($f^2 = .481$) had a large effect size (i.e. $f^2 > .350$).

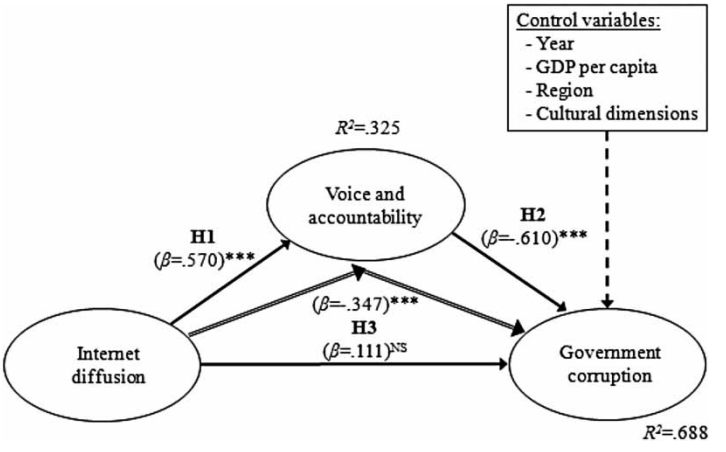

Figure 2. Model with results.
Notes: NS, nonsignificant association. $^{***}P < .001$.

The indirect association between Internet diffusion and government corruption was found to be significant ($\beta = -.347, P < .001, f^2 = .166$). The beta coefficient associated with this indirect association was calculated as the product of the two direct associations' beta coefficients, for the two path segments that make up the indirect association (Bollen & Stine, 1990; Kock, 2012). Moreover, the direct association between Internet diffusion and government corruption was found to be nonsignificant ($\beta = .111$, NS, $f^2 = .053$). Finally, the total association (aka total effect) between Internet diffusion and government corruption, which combines the direct and indirect associations, was found to be significant ($\beta = -.237, P < .01, f^2 = .113$).

Together, these three findings suggest that the relationship between Internet diffusion and government corruption in Latin American and sub-Saharan African countries was indirect and fully mediated by voice and accountability (Preacher & Hayes, 2004), supporting H3. As indicated by the f^2 coefficient for the indirect association ($f^2 = .166$), this indirect association had a medium effect size (i.e. $.150 \leq f^2 \leq .350$).

Since we controlled for the effects of several variables with respect to government corruption, we can say that the findings summarized above hold regardless of variations in those variables. The control variables in question are year (2006–2010), GDP per capita, region (Latin America = 1 and sub-Saharan Africa = 0), and cultural dimensions.

An exploratory nonlinear analysis was conducted to complement the above analysis, which assumed linear relationships among variables; the results of this exploratory nonlinear analysis are summarized in Appendix 3. To complement the mediating effect analysis above, both Baron and Kenny's (1986) and Preacher and Hayes's (2004) tests of mediation were conducted (see Appendix 4), confirming that voice and accountability fully mediates the relationship between Internet diffusion and government corruption (Baron & Kenny, 1986).

Discussion

Table 6 summarizes the support for the hypotheses based on the results. All three hypotheses were supported. Supporting hypothesis H1, the results suggested that greater levels of Internet diffusion in Latin American and sub-Saharan African countries were associated with greater levels of voice and accountability. Supporting H2, greater levels of voice and accountability were associated with lower levels of government corruption. Finally, supporting H3, the indirect

Table 6. Support for the hypotheses based on the results.

Hypothesis	Supported?
H1: Greater levels of Internet diffusion in Latin American and sub-Saharan African countries will be associated with greater levels of voice and accountability	Yes
H2: Greater levels of voice and accountability in Latin American and sub-Saharan African countries will be associated with lower levels of government corruption	Yes
H3: The relationship between Internet diffusion and government corruption in Latin American and sub-Saharan African countries will be indirect and mediated by voice and accountability	Yes

association between Internet diffusion and government corruption was found to be significant and the direct association between Internet diffusion and government corruption was found to be nonsignificant.

The beta coefficients shown earlier for each predictor–criterion variable pair reflect the multivariate-adjusted variation in the criterion variable, in number of standard deviations, associated with one standard deviation variation in each of its predictor variables. We can combine those beta coefficients with the descriptive statistics to get a better sense of the effects suggested by them.

The standard deviation of Internet diffusion was 15.155 users by 100 inhabitants of a country. Therefore, we can conclude that for each additional 15 Internet users per 100 inhabitants in a country there is approximately a 57% increase in voice and accountability, considering the average level of voice and accountability in the sample as the baseline. As can be seen in Figure 3, the variation in Internet diffusion spans about 5 standard deviations, going from approximately -1 to 4 standard deviations from the mean. The mean itself is indicated as zero on the horizontal axis.

We can conclude that a country where Internet diffusion is very high (74.248 Internet users by 100 inhabitants) is likely to present a level of voice and accountability that is approximately 278% higher (calculated as: $(74.248-0.313)/15.155 \times 0.57 \times 100$) than a country where Internet diffusion is very low (0.313 Internet users by 100 inhabitants).

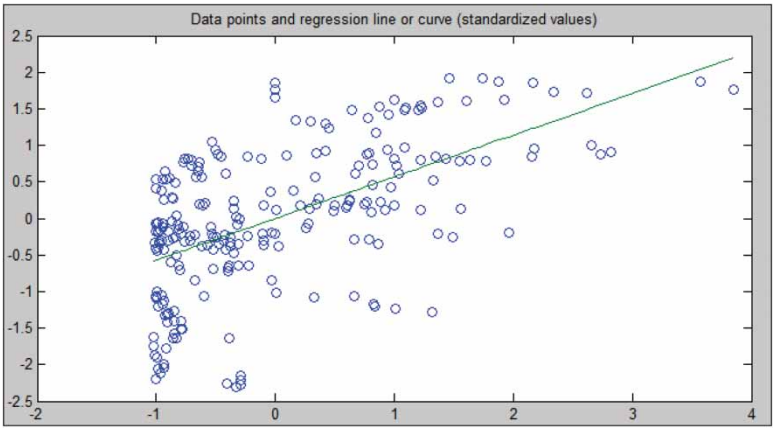

Figure 3. Voice and accountability vs. Internet diffusion.
Notes: Vertical (y) axis: Voice and accountability. Horizontal (x) axis: Internet diffusion. The values along the axes are standardized.

It is noteworthy that the association between voice and accountability and Internet diffusion becomes increasingly better defined as Internet diffusion increases. At low levels of Internet diffusion, there is greater variability in voice and accountability; which suggests that as Internet diffusion goes down other variables become more influential in terms of their possible associations with voice and accountability.

We can also conclude that for each additional 15 Internet users per 100 inhabitants in a country there is a 34.7% decrease in government corruption, mediated by an increase in voice and accountability, considering the average level of government corruption in the sample as the baseline. The relationship between voice and accountability and government corruption is shown in Figure 4.

While the plot of the indirect relationship (i.e. Internet diffusion → voice and accountability → government corruption) is not available, a similar extrapolation to that for voice and accountability can be made, with a slightly different mode of calculation. We can conclude that a country where Internet diffusion is very high (74.248 Internet users by 100 inhabitants) is likely to present a level of government corruption that is approximately 12.5% (calculated as: $(1-.347)^{(74.248-0.313)/15.155)} \times 100$) of the level in a country where Internet diffusion is very low (0.313 Internet users by 100 inhabitants).

Two relatively weak but practically relevant moderating effects were uncovered by an exploratory moderating effects analysis summarized in Appendix 2. The moderating variables in question are region and power distance; which moderated, in unrelated ways, the negative (or inverse) relationship between voice and accountability and government corruption.

In Latin America there were slightly less pronounced reductions in government corruption associated with increases in voice and accountability than in sub-Saharan Africa. One possible reason for this is that government corruption in Latin American countries may be more resistant to the possible effect of voice and accountability than in sub-Saharan African countries, perhaps due to cultural differences.

With respect to the moderating effect of power distance, in high power distance countries there were slightly less marked decreases in government corruption associated with increases in voice and accountability than in low power distance countries. This can be explained based on the greater information asymmetry that seems to be predominant in high power distance

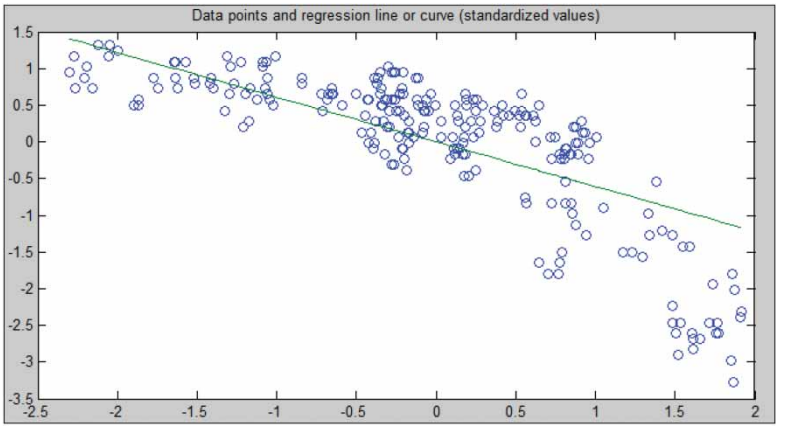

Figure 4. Government corruption vs. voice and accountability.
Notes: Vertical (*y*) axis: Government corruption. Horizontal (*x*) axis: Voice and accountability. The values along the axes are standardized.

countries (Hofstede, 2001; Kock, Del Aguila-Obra, & Padilla-Meléndez, 2009). In high power distance countries information related to voice and accountability may be available but not as promptly disseminated as in low power distance countries, which are likely to be inherently more democratic with respect to information sharing, leading to the moderating effect observed.

Limitations

Like all research studies, this study has limitations. While it is a step forward building on past research, it does not incorporate all possible effects of confounder variables. Two possible confounders are level of education and computer literacy. Both variables, education and computer literacy, have been shown to significantly influence Internet access; but not one's effectiveness in using, or taking advantage of, information obtained through Internet access (Thomas & Rutter, 2008; Valero-Aguilera et al., 2012). Since Internet access is not a criterion in the path model, the exclusion of level of education and computer literacy arguably does not invalidate our findings, as Internet access is captured through the variable Internet diffusion.

Nevertheless, it would be advisable to include level of education and computer literacy in future research models aimed at replicating and/or expanding on this study, particularly as: (a) moderators of the relationship between Internet diffusion and voice and accountability and (b) as control variables, since GDP per capita does not fully capture the variation in these variables. In either case, collinearity assessments should be conducted, as GDP per capita may be too highly correlated with level of education and computer literacy in a given data-set. For example, it is possible to find countries with higher levels of education and lower GDPs per capita than other countries, but for most countries levels of education and GDPs per capita should be strongly and positively correlated.

Our focus on developing countries in the sub-Saharan African region and on the "matched" developing region of Latin America, two regions with many developing countries, offered some advantages. It increased the size of our sample, and thus improved the reliability of our findings, and also added to the generality of our findings. Nevertheless, the relationships among Internet diffusion, voice and accountability, and government corruption in other developing regions in the world may be different from the ones found in this study. Future research aimed at replicating and extending this study should include other regions where developing countries predominate. For example, future research could include former socialist countries from Eastern Europe.

It would have been useful to conduct a full time-lagged analysis of the relationships among Internet diffusion, voice and accountability, and government corruption. For example, it is possible that Internet diffusion in 2006 has a stronger effect in voice and accountability in 2010 than in 2006. This type of analysis would be beyond the scope of this study, and probably add significantly to the length of this paper, and is thus recommended as future research.

Conclusion

Our study focused on the relationships among Internet diffusion, voice and accountability, and government corruption in Latin American and sub-Saharan African countries. The data used were obtained from the World Bank (http://www.worldbank.org), Transparency International (http://www.transparency.org), and Hofstede's (1983, 2001) cultural dimensions framework. It covers 47 countries, 24 of which in Latin America and 23 in sub-Saharan Africa; and spans five years, ranging from 2006 to 2010.

The data were analyzed using the method of robust path analysis, and its results suggest that Internet diffusion has strong direct and indirect relationships, respectively, with voice and accountability and government corruption. Voice and accountability seems to have a strong

direct relationship with government corruption; a relationship that appears to fully mediate the indirect relationship between Internet diffusion and government corruption.

According to our analyses, each additional increment of about 150 Internet users per 1000 people in a country (or 15 users per 100 people) was associated with a 57% increase in voice and accountability. A country with about 742 Internet users per 1000 people, at the high end of Internet diffusion in our data-set, is likely to present a level of voice and accountability that is approximately 278% higher than a country with about three Internet users per 1000 people, at the low end of Internet diffusion in our data-set.

Each additional increment of about 150 Internet users per 1000 people in a country was associated with a 34.7% decrease in government corruption, with this association being mediated by an increase in voice and accountability. A country with about 742 Internet users per 1000 people is likely to present a level of government corruption that is approximately 12.5% (a little over one-tenth) the level of a country with about three Internet users per 1000 people.

Policy-makers in developing countries aiming at increasing voice and accountability at the national level, and thus the degree to which their citizens participate in the country's governance, should strongly consider initiatives that broaden Internet access in their countries. It seems that the association between Internet diffusion and voice and accountability becomes increasingly more predictable (or better defined) as Internet diffusion increases, particularly above 300 users per 1000 people. Therefore, Latin American and sub-Saharan African countries interested in increasing voice and accountability through the manipulation of Internet diffusion, and thus ultimately decreasing government corruption, should aim at achieving levels above 300 users per 1000 people. Lower levels may lead to less predictable outcomes.

Our study is consistent with modernization theory, and well aligned with the theoretical perspective explored by Cooks and Isgro (2005) of Internet-enabled modernization being an empowerment force for the disenfranchised in developing countries. In the context of national social change via political engagement, modernization theory supports the prediction that Internet diffusion will improve government effectiveness via the reduction of government corruption. The theory also suggests the existence of important intermediate effects. One key intermediate effect predicted based on modernization theory is an increase in the extent to which a country's citizens are able to participate in the country's governance. This prediction was strongly supported by the results of our study.

One of the motivations for our study was the possible perpetuation of the vicious circle of underdevelopment and government corruption in developing countries, which Musa et al. (2005) argued was due to a certain resistance among developing countries against the introduction of technologies that can be used to fight corruption, such as Internet-based technologies. Our study suggests that this is not the case. It seems that Internet diffusion can significantly reduce government corruption in developing countries. But this effect is an indirect one, via voice and accountability, or the extent to which a country's citizens are able to participate in the country's governance.

If voice and accountability is suppressed, however, our study suggests that Internet diffusion may not have any effect on government corruption in developing countries. In other words, simply "throwing" advanced technologies at problems does not solve them, especially complex problems such as government corruption. On the other hand, although advanced technologies per se may not solve complex problems, they do facilitate the solution of those problems; for example, by facilitating a rise of voice and accountability, as suggested by our findings.

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Appendix 1. Control variables

The path model included the following control variables: year (2006–2010), GDP per capita, region (Latin America = 1 and sub-Saharan Africa = 0), and four cultural dimensions from Hofstede's (2001) framework – power distance, uncertainly avoidance, long-term/short-term orientation, and individualism/collectivism.

From a hypothesis-testing perspective, the meaning of including these control variables in the model is, essentially, the incorporation into the model of the expectation that the hypothesized effects should hold regardless of variations in the control variables. That is, the hypothesized effects are expected to hold regardless of year, GDP per capita, region, and cultural dimensions; when those variables are controlled for with respect to government corruption.

Our decision to include these control variables in the path model was motivated by an attempt to broaden the scope of the results, making them independent of factors that have traditionally been considered important from the perspective of the interface between national culture and proper functioning of government institutions (Hofstede, 1983, 2001; Musa et al., 2005).

Factors traditionally perceived as important are, in particular, GDP per capita (reflecting wealth), region (capturing elements not reflected in cultural dimensions), and cultural dimensions (Apter, 1965; Hofstede, 1983, 2001). Year was added to these variables because, as this study employs multi-year data, the level of development of countries might vary over the years, leading to a possible confounding effect on government corruption (Musa et al., 2005). If these control variables were not included in the path model, one could reasonably argue that their possible confounding effects could have rendered the association between voice and accountability and government corruption nonsignificant.

GDP per capita, measured in US dollars, ranged from 123 to 23,716, with a mean of 4211 and a standard deviation of 4579. Power distance scores ranged from 35 to 95, with a mean of 65.2 and a standard deviation of 13. Uncertainly, avoidance scores ranged from 13 to 104, with a mean of 66.1 and a standard deviation of 20.9. Long-term/short-term orientation scores ranged from 9 to 44, with a mean of 23.6 and a standard deviation of 8. Individualism/collectivism scores ranged from 6 to 65, with a mean of 28 and a standard deviation of 14.6.

Of the control variables, the following had significant associations with government corruption: GDP per capita ($\beta = -.298$, $P < .001$, $f^2 = .185$), region ($\beta = .280$, $P < .001$, $f^2 = .074$; i.e. more corruption in Latin America), cultural dimension 1: power distance ($\beta = .193$, $P < .001$, $f^2 = .053$), and cultural dimension 2: uncertainly avoidance ($\beta = -.175$, $P < .01$, $f^2 = .007$). Even though statistical significance for cultural dimension 2: uncertainly avoidance was achieved ($P < .01$), the corresponding effect size ($f^2 = .007$) was below the threshold of practical relevance (i.e. $f^2 < .020$) recommended by Cohen (1988).

Appendix 2. Exploratory moderating effects analyses

We also conducted additional moderating effects analyses where year (2006–2010), region (Latin America = 1 and sub-Saharan Africa = 0), and cultural dimension 1: power distance, were included as moderators of the significant main relationships in the model – i.e. those between Internet diffusion and voice and accountability, as well as between voice and accountability and government corruption.

Year (2006–2010) was found to weakly moderate the relationship between Internet diffusion and voice and accountability ($\beta = -.074$, $P < .05$, $f^2 = .008$), but not to moderate the relationship between voice and accountability and government corruption ($\beta = -.039$, NS, $f^2 = .002$). That is, in later years the positive relationship between Internet diffusion and voice and accountability became slightly less pronounced. It should be noted that even though statistical significance was achieved ($P < .05$), the effect size here ($f^2 = .008$) is below the threshold of practical relevance (i.e. $f^2 < .020$) recommended by Cohen (1988).

Region (Latin America = 1 and sub-Saharan Africa = 0) was found not to moderate the relationship between Internet diffusion and voice and accountability ($\beta = -.068$, NS, $f^2 = .015$), but to moderate the relationship between voice and accountability and government corruption ($\beta = -.264$, $P < .001$, $f^2 = .034$). That is, in Latin America there were less pronounced reductions in government corruption associated with increases in voice and accountability than in sub-Saharan Africa. Nevertheless, reductions in government corruption were significantly associated with increases in voice and accountability in both regions.

Cultural dimension 1: power distance was found not to moderate the relationship between Internet diffusion and voice and accountability ($\beta = -.015$, NS, $f^2 = .003$), but to moderate the relationship between voice and accountability and government corruption ($\beta = .191$, $P < .001$, $f^2 = .071$). That is, in high power distance countries there were slightly less marked decreases in government corruption associated with increases in voice and accountability than in low power distance countries. Nevertheless, reductions in government corruption were significantly associated with increases in voice and accountability across the range going from low to high power distance countries.

The two relatively weak but relevant (based on effect sizes) moderating effects above, of region and power distance on the relationship between voice and accountability and government corruption, were apparently unrelated. The reason for this conclusion is that the mean power distance scores for Latin American and sub-Saharan African countries were indistinguishable, and in fact nearly identical. For Latin American countries, the mean power distance score was 65.22 and for sub-Saharan African countries, it was 65.24.

A related moderating effects analysis was conducted whereby two sub-data-sets were obtained from the original data-set, each of which referred to one of the two regions. Our goal was to compare model coefficients generated for each region employing the procedure documented by Keil et al. (2000). Unfortunately, this data segmentation led to an unacceptable increase in multicollinearity, rendering the separate results for each region unreliable. This increase in multicollinearity is not surprising in path analyses where sample sizes are significantly reduced, as collinearity minimization algorithms such as partial least squares (PLS) regression can only operate on latent variables (Kock & Lynn, 2012).

One of the advantages of the moderating effects analyses conducted earlier, with the entire data-set instead of subsets with region-specific data, is that they did not lead to sample size reductions, as they did not rely on data segmentation. In the moderating effects analyses conducted earlier new variables were added as moderators; i.e. as variables that were hypothesized to affect the relationships among pairs of other variables. While the addition of moderating variables led to small increases in multicollinearity, the increases were much less pronounced than when data segmentation was employed, and resulted in full collinearity variance inflation factors below the thresholds indicative of multicollinearity discussed by Kock and Lynn (2012).

Appendix 3. Nonlinear analysis

An exploratory nonlinear analysis was conducted with WarpPLS 3.0 to investigate the possibility that the relationships among the variables in the path model conform to noncyclical nonlinear functions (Kock, 2012). If that were the case, it was also important to investigate the possibility that the overall signs of the path coefficients and their *P*-values changed significantly. The results of this exploratory nonlinear analysis, in terms of the path model coefficients, are shown in Figure A1.

Interestingly, not only did the use of a nonlinear algorithm (Warp2; see Kock, 2012) increase path coefficients' strengths (absolute β values) and variances explained (*R*-squared coefficients), but it also decreased multicollinearity slightly. Moreover, the signs of the path coefficients were the same as in the

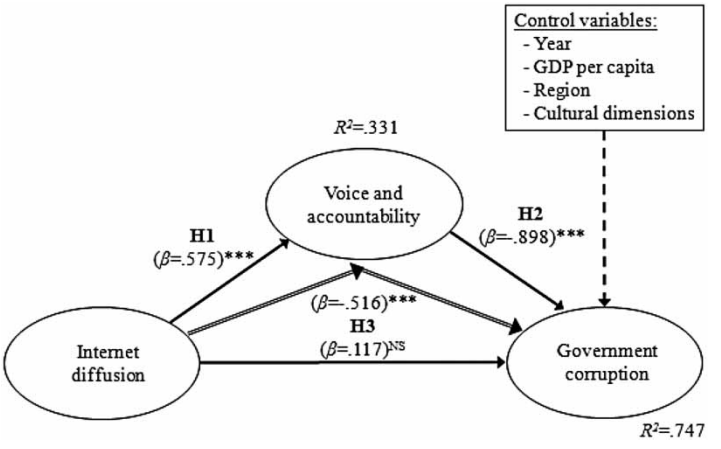

Figure A1. Model with nonlinear results.
Notes: NS, nonsignificant association. $^{***}P < .001$.

linear analysis and the *P*-values were significant at the same levels as well. That is, even though the actual *P*-values for most path coefficients were lower in the nonlinear analysis, the ones significant at the .001 level in the linear analysis were also significant at the .001 level in the nonlinear analysis.

The greatest path coefficient strength increases from linear to nonlinear were for the direct link between voice and accountability and government corruption (from −.610 to −.898) and for the indirect link between Internet diffusion and government corruption (from −.347 to −.516). There were also corresponding marked increases in effect size for these two links; from .481 to .793 for the direct link between voice and accountability and government corruption and from .166 to .248 for the indirect link between Internet diffusion and government corruption.

The path coefficient for the direct link between Internet diffusion and voice and accountability only increased slightly (from .570 to .575). So did the effect size for this link (from .325 to .331). Figure A2 shows the shape of the relationship between these two variables, from which one can surmise why the corresponding path coefficient varied only slightly; the relationship is only weakly nonlinear.

Figure A3 shows the shape of the relationship between voice and accountability and government corruption. The relationship appears to follow a clear and strong nonlinear pattern, which is consistent with the

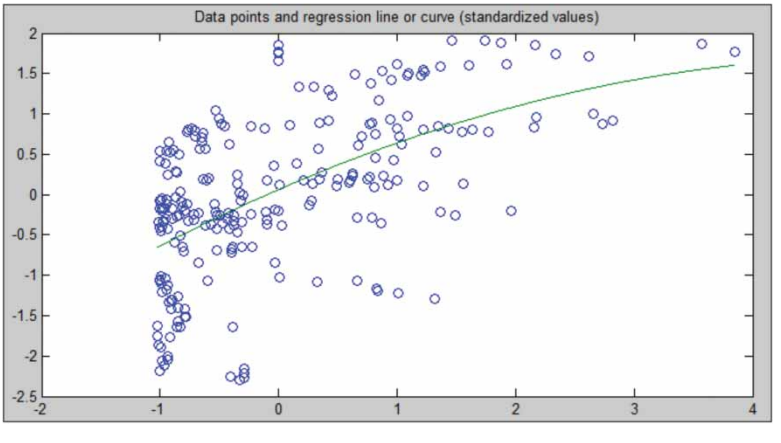

Figure A2. Voice and accountability vs. Internet diffusion (nonlinear).
Notes: Vertical (*y*) axis: Voice and accountability. Horizontal (*x*) axis: Internet diffusion. The values along the axes are standardized.

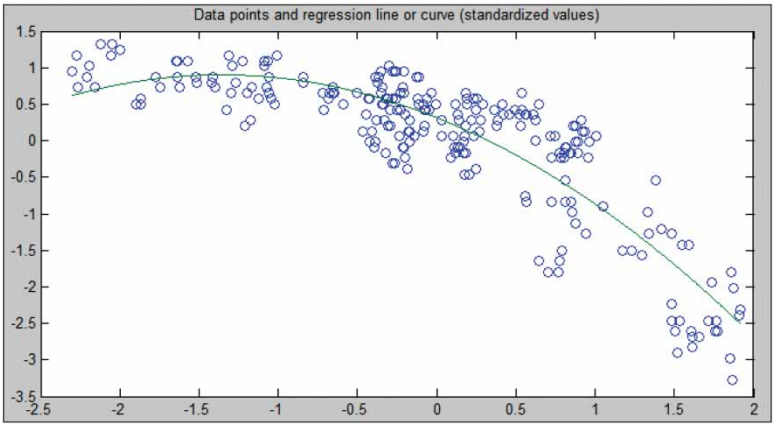

Figure A3. Government corruption vs. voice and accountability (nonlinear).
Notes: Vertical (*y*) axis: government corruption. Horizontal (*x*) axis: voice and accountability. The values along the axes are standardized.

large path coefficient strength increase for the link between these two variables as the analysis moved from linear to nonlinear.

As previously noted, the use of a nonlinear algorithm increased path coefficients' strengths without changing their signs, increased variances explained, and decreased multicollinearity. Given these outcomes, it is reasonable to assume that the nonlinear functions better reflect the underlying relationships among variables.

If this assumption is correct, the main difference in the interpretation of the findings would be that the association between voice and accountability and government corruption is somewhat flat for low levels of voice and accountability and strongly negative for high levels of voice and accountability.

Appendix 4. Additional mediating effect analyses

Earlier we reported that the indirect association between Internet diffusion and government corruption, mediated by voice and accountability, was found to be significant ($\beta = -.347$, $P < .001$, $f^2 = .166$). The beta coefficient associated with this indirect association was calculated as the product of the two direct associations' path coefficients and the *P*-value was calculated directly via resampling; these were done automatically by WarpPLS 3.0. Moreover, the direct association between Internet diffusion and government corruption, when the effect of voice and accountability was controlled for, was found to be nonsignificant ($\beta = .111$, NS, $f^2 = .053$). As can be seen in the reduced model shown in Figure A4, the direct association between Internet diffusion and government corruption, when the effect of voice and accountability was *not* controlled for, was significant ($\beta = -.434$, $P < .001$, $f^2 = .208$).

Combined, the above results suggest that voice and accountability fully mediates the relationship between Internet diffusion and government corruption, following the classical framework for assessment of mediating effects discussed by Baron and Kenny (1986). According to this classical framework, full mediation occurs when: (a) the direct association in the reduced model, *without* the mediating variable, is significant; (b) the direct association in the full model, *with* the mediating variable, is nonsignificant; and (c) both constituent paths making up the indirect relationship are significant (Baron & Kenny, 1986). A more recent approach, discussed by Preacher and Hayes (2004), also requires that the product of the paths making up the indirect relationship be itself significant for full mediation to occur.

The results of the automated indirect effect test were confirmed by an additional test using the formulas discussed by Preacher and Hayes (2004), which build on the product of the path coefficients, and standard errors (used in the calculation of Sobel's standard error), for the two paths that make up the indirect effect of Internet diffusion on government corruption via voice and accountability. This manual and somewhat cumbersome test yielded the same results ($\beta = -.347$, $P < .001$) as the automated test conducted by WarpPLS, but without a corresponding effect size.

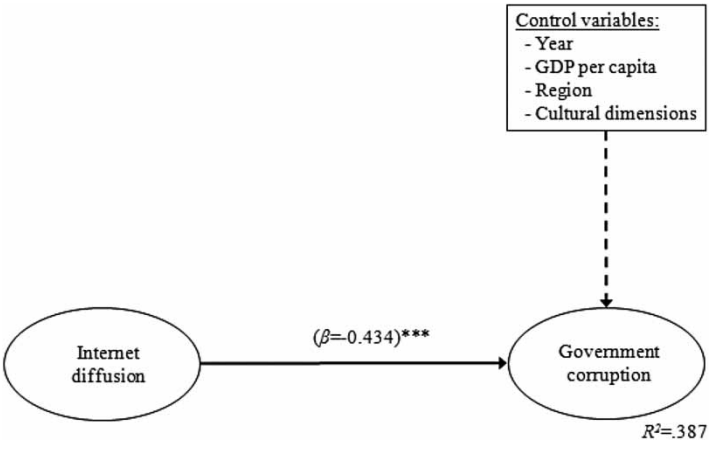

Figure A4. Reduced model for mediating effect analysis.
Note: $^{***}P < .001$.

One additional interesting phenomenon associated with this mediating effect is Simpson's paradox (Wagner, 1982). The inclusion of the mediating variable, voice and accountability, led to the bivariate correlation and the path coefficient for the direct link between Internet diffusion and government corruption to assume different signs. This characterizes Simpson's paradox, suggesting that the direct (and nonsignificant) link should perhaps be considered for removal from the model, and thus reinforcing the conclusion that full mediation is taking place (Pearl, 2009).

Appendix 5. Voice and accountability and corruption perceptions

The Voice and Accountability Index, obtained from the World Bank, is an aggregate of 20 different governmental and public (GOV), nongovernmental (NGO), commercial business information providers (CBIP), and surveys of households and firms (SURVEY) component data sources (see Table A1). Each component data source is combined, leading to the Voice and Accountability Index, using a complex statistical method called as the unobserved components model. This model requires each component data source to be rescaled and normalized to create the Voice and Accountability Index.

Table A1. Voice and accountability index data types and sources.

Source	Type
African Electoral Index (IRP)	NGO
Afro-barometer (AFR)	GOV
Bertelsmann Transformation Index (BTI)	NGO
Cingranelli Richards Human Rights Database and Political Terror Scale (HUM)	GOV
Economist Intelligence Unit Risk-wire and Democracy Index (EIU)	CBIP
Freedom House (FRH)	NGO
Freedom House Countries at the Crossroads (CCR)	NGO
Gallup World Poll (GWP)	SURVEY
Global Insight Business Conditions and Risk Indicators (WMO)	CBIP
Global Integrity Index (GII)	NGO
IFAD Rural Sector Performance Assessments (IFD)	GOV
Institute for Management and Development World Competitiveness Yearbook	SURVEY
Institutional Profiles Database (IPD)	GOV
International Budget Project Open Budget Index	NGO
Latinobarómetro	SURVEY

(*Continued*)

Appendix 5. Continued

Source	Type
International Research and Exchanges Board Media Sustainability Index	NGO
Political Risk Services International Country Risk Guide (PRS)	CBIP
Reporters Without Borders Press Freedom Index (RSF)	NGO
Vanderbilt University Americas Barometer	SURVEY
World Economic Forum Global Competitiveness Report (GCS)	SURVEY

Notes: "Type" refers to the nature of the data source. Data sources for the Voice and Accountability Index are: government and public sector (GOV), nongovernmental organizations (NGO), commercial business information providers (CBIP), and surveys of households and firms (SURVEY).

The Corruption Perceptions Index, obtained from Transparency International, is an aggregate measure that builds on 17 different surveys and polls from 10 independent organizations: Freedom House (FH); Gallup International (GI); Economist Intelligence Unit (EIU); Institute of Management Development (IMD); International Working Group (developing the Crime Victim Survey); Political and Economic Risk Consultancy (PERC); Political Risk Service (PRS); The Wall Street Journal – Central European Economic Review (CEER); World Bank and University of Basel (WB/UB); and World Economic Forum (WEF).

Both the Voice and Accountability Index and the Corruption Perceptions Index are calculated through multistep processes. For example, with respect to the Corruption Perceptions Index, initially opinion surveys from business representations are averaged by country. Next, the data from the 17 data sources are normalized using matching percentiles and country ranks, and then rescaled and re-normalized. These multistep processes aim at reducing measurement error while proving comprehensive measures of voice and accountability and corruption perceptions in different countries.