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A New Cross-National Measure of Corruption

Laarni Escresa
Lucio Picci

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Abstract

A new measure of cross-national corruption is constructed based on the geographic distribution of public officials involved in cross-border corruption cases. A comparison is made between the Public Administration Corruption Index (PACI) and perception-based measures, considers the extent to which differences between them are driven by systematic factors, and concludes that they are not. As more data on cases of cross-border bribery incidents become available, the PACI will provide an increasingly valid cross-national measure of corruption.

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The authors may be contacted at laarni.escresa@eui.eu and lucio.picci@unibo.it.

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Laarni Escresa and Lucio Picci

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Laarni Escresa is an assistant professor at the School of Economics, University of the Philippines; her email is laarni.escresa@eui.eu. Lucio Picci (corresponding author) is a professor at the Department of Economics, University of Bologna, Strada Maggiore 45, I-40125 Bologna, Italy; his email is lucio.picci@unibo.it. They would like to thank, for their comments on a previous version of this paper, Rajeev Goel, Miriam Golden, Johann Graf Lambsdorff, Jerg Gutmann, Robert Klitgaard, Nicholas McLean, Angela Reitmaier, Susan Rose-Ackerman, participants to a workshop at the Inter-American Development Bank in Washington, DC, to the European Political Science Association 4th Annual Conference in Edinburgh, and to the 10th Annual Conference of the Italian Society of Law and Economics in Rome and three anonymous referees. Laarni Escresa acknowledges research funding from the Deutsche Forschungsgemeinschaft (German Research Foundation). Lucio Picci acknowledges the financial support of the Fondazione Cassa dei Risparmi di Forli. All Website contents were accessed on June 8, 2015.

This research presents a new measure of corruption, the Public Administration Corruption Index (PACI), formulated using data on cross-border corruption cases. The proposal is motivated by the need to find viable alternatives to currently available cross-national measures of corruption, which, despite their shortcomings, have been and are being extensively used in academia,[1] within policy circles, and in public debates at large.

There are two types of cross-national measures of corruption currently available. The most widely used type is perception-based, such as the Transparency International Corruption Perceptions Index (TI-CPI; Saisana and Saltelli 2012; Transparency International 2012) and the World Bank Control of Corruption Indicator (WB-CCI; Kaufmann, Kraay, and Mastruzzi 2009). The shortcomings of the cited type, however, are well known. For one, perceptions may have weak correlations with actual experiences of corruption (Seligson 2006; Olken 2009; Razafindrakoto and Roubaud 2010). Moreover, often the precise definition of corruption being assessed is not precisely defined. The second type of cross-national measure, meanwhile, is based on surveys assessing first-hand experiences of corruption.[2] Surveys, however, are often costly endeavours, and their results are affected by respondents' reticence in answering questions related to their participation in corrupt activities.[3]

Proposing to use judicial statistics to develop a cross-national measure of corruption may appear ungainly. Even setting aside differences in legal definitions across jurisdictions, the fraction of observed corrupt transactions relative to their actual number is unknown and varies widely across countries. These differences could be so important that they could even imply a *negative*

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[1] On the use of perception-based measures to inquire into the nature, causes and consequences of corruption, see Lambsdorff (2006 and 2007), Treisman (2007), and Rose-Ackerman (1999).

[2] A well-known example is Transparency International's "Global Corruption Barometer" (TI-GCB). See http://www.transparency.org/research/gcb/overview.

[3] See for instance Treisman (2007), Clausen et al. (2011), and Kraay and Murell (2013). Other types of measures of corruption have been proposed, but so far not at the cross-national level. See for example Golden and Picci (2005).

correlation between actual and observed corrupt transactions. After all, where corruption is endemic, the judiciary may also be corrupt or vulnerable to threats (Van Aaken et al. 2010).[4]

However, judicial statistics on *cross-border corruption*, which refers to corrupt transactions between firms headquartered in a particular country (hence, the "headquarters country") and public officials elsewhere (the "foreign country") permit the computation of a valid cross-national corruption index. A valid index in the lexicon of this article means one that increases along with the probability that a transaction is corrupt. The intuition behind such index is simple. To illustrate, the instances of corruption involving US firms caught bribing public officials abroad are not informative of the level of corruption *in the United States*; however, the *distribution* of these cases, with respect to the nationalities of the foreign public officials involved, reveals the relative level of corruption *abroad*. For example, if half of all the cases concerning US firms are seen to involve Chinese public officials, enough evidence would be provided that public sector corruption *in China* is relatively high. Obviously, such a conclusion should take into account the extent of the subject countries' bilateral transactions (the US interacts more often with China than, say, Denmark). As a suitable proxy for the number of bilateral transactions that could be vulnerable to corruption, export figures from the headquarters to the foreign country are used. In other words, the proposed measure uses information on the spatial distribution of cases enforced in a given country to evaluate levels of corruption *in all other* countries. Moreover, it considers cases arising not only from a single jurisdiction, but from all relevant ones.[5]

The necessary data are derived from reports of cross-border corruption ensuing from the criminalization of foreign bribery in several jurisdictions. With the passage of the Foreign Corrupt Practices Act (FCPA) of 1977, the United States became the first country to criminalize foreign

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[4] Judicial statistics have been used to measure corruption in studies at the sub-national level, where the assumption of spatially homogenous enforcement is plausible. See for instance, Glaeser and Saks (2006), Goel and Nelson (2011), Fisman and Gatti (2002), Alt and Lassen (2012), for the US; Chang et al. (2010), and Golden and Picci (2008).

[5] This paper is arguably the first to propose an index of corruption based on cross-border incidents of corruption. McLean (2012) contemplates the possibility of computing such an index; see in particular his Figure 1

bribery. On 15 February 1999, the Organisation for Economic Cooperation and Development (OECD) Anti-Bribery Convention came into force, requiring signatory countries to legislate measures intended to combat foreign bribery in their own jurisdictions. To date, 41 countries have signed the Convention, and hundreds of cases of foreign bribery have been investigated worldwide.[6]

The number of observed cases, however, is not sufficient for the computation of a reliable *annual* measure. In light of this, this paper consolidated data culled from corruption cases reported over a 15-year period or from 1998 to 2012. However, as more and more countries sign the OECD Anti-Bribery Convention, and as more cases of cross-border corruption are exposed, there will arise the possibility of computing the PACI for shorter periods of time. Increased data availability would also enable the computation of more granular measures, which pertain to specific sectors of the economy or particular segments of public administrations.

The PACI is described in the next section. Section II introduces the dataset and presents the computation of the index. Section III shows that the PACI is highly correlated with existing perception-based measures of corruption and considers the determinants of the observed differences. Section IV discusses available evidence regarding the assumptions that ensure the validity of the index, which are described in detail in Appendix A. Section V concludes**.**

I. The Public Administration Corruption Index

To illustrate the mechanics of the PACI, it is necessary at the outset to distinguish cases of cross-border corruption (involving firms from the headquarters country *i* bribing public officials in the foreign country *j*) based on where they were *enforced first,* that is, the country whose judiciary was the first to take action on a particular corruption case. The vast majority of cross-

[6] See Carr and Outhwaite (2008) and http://www.oecd.org/daf/anti-bribery/oecdantibriberyconvention.htm.

border corruption cases were first enforced in headquarters countries, comprised mostly of developed nations. This is expected, because the FCPA and the OECD Anti-Bribery Convention were envisioned precisely to address the lax policing of corruption in many foreign countries where multinational firms operate. It is also possible that corruption cases are first enforced in a third country, mainly because of broad interpretations of the extent of the jurisdiction of the United States, which covers companies registered in its Securities and Exchange Commission (SEC) and, generally, entities carrying out their businesses in the United States.[7]

The intuition behind the PACI is best described by means of a simple example, illustrated in Table 1. The available data (to be presented in detail in Section III) indicate the presence of 315 cases of cross-border alleged corruption, first enforced in the United States and involving firms headquartered in the same country. If the public officials of all countries trading with the United States were equally corrupt, the 315 cases could be expected to be distributed according to the number of bilateral transactions, which can be proxied by bilateral trade flows. Exports to China represented 9.29 percent of total US exports, implying an expected number of 29.26 cases (Table 1). However, the number of actual observed occurrences of corruption is 65, or 20.63 percent of the total. Thus, the number of cross-border corruption cases involving Chinese public officials was 2.22 times more than what could be expected if the total number of cases first enforced in the United States, and involving firms headquartered there, were distributed geographically according to the countries' shares in US exports (see the last column of Table 1). This provides evidence that the level of corruption exhibited by public officials in China is higher than the average level demonstrated by the public officials of all trade partners of the United States.

[7] After a case is first enforced in the headquarters country or in a third-country jurisdiction it may also fall under the radar of the foreign country's judiciary.

Table 1. An Illustrative Example

HQ	FO	(1) Cases, first pursued in HQ	(2) Cases, as percent of total no. cases first pursued in HQ	(3) Exports HQ→ FO as percent of total exports of HQ	Ratio Col. (2) / Col. (3)
USA	China	65	20.63%	9.29%	2.22
USA	Austria	1	0.32%	0.31%	1.02
Germany	China	4	7.14%	3.96%	1.96
Germany	Austria	3	5.36%	5.62%	0.95

*Notes:*Cases reported are those first pursued in the headquarters country (HQ), 1998–2012. FO: Foreign country. The total number of cases first pursued in the United States is 315, while the total number of cases first pursued in Germany is 56. Data sources are reported in Appendix B.

In comparison, Austria was pegged as the destination of 0.31 percent of total US exports (Table 1). It registered one reported case of bilateral corruption, corresponding to 0.32 percent of the total. Based on these figures, the level of corruption demonstrated by Austrian public officials is shown to be close to the average level, with the ratio tallied at 1.02.

Similarly, occurrences of corruption from the point of view of other countries may be considered. Germany, for instance, could be designated as the headquarters country. The available data indicate that there were four cases involving Chinese public officials, out of a total of 56 documented cases of corruption involving firms headquartered in Germany (and first enforced in the same country). The tally would also lead to the conclusion that China's public officials are more corrupt than the average trade partners of Germany. Meanwhile, Austria registered fewer cases of cross-border corruption despite having a larger share of German exports (see the last column of Table 1).

The PACI is based not only on one or two "points of observation", but it aggregates cases involving firms headquartered in any country. This reasoning does not need any assumption with

respect to the probability that cases in a given country would be enforced. Notably, that there were 315 cases of corruption involving firms headquartered in the United States and only 56 in Germany (with enforcement occurring first in the respective countries) has no implications with respect to levels of corruption in the United States or in Germany. It is the *distribution* of these cases (regardless of how many there are) *abroad* which conveys information that could help determine the level of corruption in the countries where the bribery of foreign officials takes place.

The PACI

The incidents of corruption involving firms in *i* that implicate public officials in *j* and first enforced in the headquarters' country *i* is indicated by $cases\_obs\_HQ_{i,j}$. The $PACI_z$ compares the total number of those cases with the expected number of corrupt transactions that would be observed if their spatial distribution reflected bilateral trade shares between the headquarters countries and *z*:

$$PACI_z = \frac{\sum_{i=1}^{N} cases\_obs\_HQ_{i,z}}{\sum_{i=1}^{N} E(cases\_obs\_HQ_{i,z})} \cdot 100 \text{, with } i \neq z. \qquad (1)$$

The numerator, $\sum cases\_obs\_HQ_{i,z}$, is the total number of observed corrupt exchanges between officials from country *z* and firms from all other headquarters countries, first enforced in those countries. The denominator is the total number of similar cases which could be observed if cases of corruption were distributed according to the ratio of exports of country *i* to *z* (X_{iz}) with respect to the total amount of country *i* exports to the rest of the world:

$$\sum_{i=1}^{N} E(cases\_obs\_HQ_{i,z}) = \sum_{i=1}^{N} \frac{X_{iz}}{\sum_{j=1}^{N} X_{ij}} \cdot \sum_{j=1}^{N} cases\_obs\_HQ_{i,j} \; . \qquad (2)$$

The denominator may be interpreted as the total number of cross-border corruption cases involving country *z* public officials, first enforced elsewhere, that could be observed if the level of corruption of public officials were the same in all countries. If the actual and expected values are equal, then the PACI equals 100. The lowest value that the index may take is zero, which obtains when no corruption case (first enforced in all headquarters countries) is registered in country *z*.

The composite PACI

The $PACI_z^{ALL}$ or "composite PACI" follows the same logic of the simple $PACI_z$. However, it accounts for cases that were first enforced not only in all headquarters countries but also in other countries except *z*. Cases that are first enforced in a third country *w*, meanwhile, are denominated as $cases\_obs\_OTH_{i,j}^{w}$ (where $i,j \neq w$). The index is then shown as:

$$PACI_z^{ALL} = \frac{\sum_{i=1}^{N} cases\_obs\_HQ_{i,z} + \sum_{w=1}^{D}\sum_{i=1}^{N} cases\_obs\_OTH_{i,z}^{w}}{\sum_{i=1}^{N} E(cases\_obs\_HQ_{i,z}) + \sum_{w=1}^{D}\sum_{i=1}^{N} E(cases\_obs\_OTH_{i,z}^{w})} \cdot 100 \qquad (3)$$

with $i \neq j$, $w \neq i,j$, D is the number of third countries that first enforced cases, and for the denominator the following holds:

$$\sum_{w=1}^{D}\sum_{i=1}^{N} E(cases\_obs\_OTH_{z,i}^{w}) = \sum_{w=1}^{D}\sum_{i=1}^{N} \frac{X_{iz}}{\sum_{j=1}^{N} X_{ij}} \sum_{j=1}^{N} cases\_obs\_OTH_{i,j}^{w}$$

The interpretation of the $PACI_z^{ALL}$ is conceptually the same as that of the $PACI_z$ (Eq. 1), but it considers all available cases of observed cross-border corruption, first enforced either in the

country where firms are headquartered or within the jurisdictions of third countries. This is the version of the index computed in this article.

Conditional probability of observing zero cases

It is also important to demonstrate the varying precision with which the PACI measures corruption, which is influenced by the total number of transactions between countries as represented by bilateral trade flows. To fix ideas, consider the case of a foreign country that has no reported incident of cross-border corruption. Such a situation could be interpreted as a signal that corruption in the said foreign country is relatively low, but not necessarily equal to zero. The strength of such a signal depends on the number of cross-border transactions, proxied by imports. To express this concept, the "probability of observing zero cases, conditional on the probability of corruption being equal in all foreign countries" is introduced:

$$\Pr\_zero\_cases_z^{PACI} = \Pr(\sum_{i=1}^{N} cases\_obs\_HQ_{i,z} = 0 \mid \Pr\_corr\_FO_z = c)$$

where $\Pr\_corr\_FO_z$ is the underlying probability that a public official accepts a bribe (see Appendix A) and c is a constant. The measure expresses the probability that no case involving country z public officials (first enforced in the headquarters country) is observed when the true country z probability that a cross-border transaction involving its public officials is corrupt is the same everywhere in the world. $\Pr\_zero\_cases_z^{PACI}$ may be computed as the product of individual probabilities:

$$\Pr\_zero\_cases_z^{PACI} = \prod_{i=1}^{N} (\Pr\_cases\_obs\_HQ_{i,z} = 0 \mid \Pr\_corr\_FO_z = c)$$

Each one of these probabilities, referring to a rare event, is described by a Poisson distribution and may be easily computed by making the condition $\Pr\_corr\_FO_z = c$ correspond to an ideal situation where occurrences of corruption are distributed according to trade shares.

High values of $\Pr\_zero\_cases_z^{PACI}$ indicate that the country in question has relatively few cross-border transactions – that is, information is relatively scarce.

II. Computing the PACI

Information on cases of cross-border corruption from 1977 until the end of 2012 were collected using various sources (See Appendix B). However, only cases reported in 1998 onwards were used, approximately coinciding with the effectivity of the OECD Anti-Bribery Convention. Out of a total of 979 cases detailed in this study, 796 cases were first enforced either in the headquarters country (569), in the United States acting as a third country jurisdiction (177), or in other third country jurisdictions (50). The remaining 183 cases that were first enforced in foreign countries were not considered for the purpose of computing the PACI.

Each case was coded according to the observed outcome. They were classified "positive" if the accused party was either found guilty or, while not admitting guilt, conceded to the payment of a fine (as in the case of a "consent to a cease-and-desist order" in the US);[8] "not positive" if the case was eventually dropped and no action was taken; or "ongoing" if no available evidence was found to determine whether the case is "positive" or "not positive." The term *public official* is used in a broad sense, encompassing both bureaucrats and politicians.

Table 2 indicates that out of 796 cases that may be used to compute the PACI, 444 are classified as positive, 272 as ongoing, while the rest have either been dropped or have resulted in an acquittal. Firms are shown to be headquartered in 40 countries, comprised mostly of industrialized nations. Among them, the United States takes the lion's share in the number of cases enforced, reflecting both its early adoption of the FCPA and the proactive stance adopted by its

[8] It should be emphasized that coding the outcome of a case as positive does not imply conviction or guilt on the part of the accused.

Department of Justice (DOJ) and SEC after its ratification of the OECD Anti-Bribery Convention. Germany, Britain, and France follow in the list.

Table 2. Total Number of Cases by Headquarters' Country, 1998–2012

Country of firm's headquarter	Total Cases	Positive Cases	Ongoing Cases
United States	331	227	82
Germany	86	50	36
United Kingdom	54	25	24
France	47	27	18
Switzerland	46	40	6
Italy	27	5	16
Spain	22	0	8
Australia	19	5	14
Canada	19	4	8
Japan	17	11	5
Netherlands	15	8	5
Sweden	15	1	12
Korea	14	14	0
Portugal	13	0	7
Norway	9	5	3
China	8	7	1
Argentina	6	1	2
Austria	6	2	4
Brazil	6	0	5
Finland	5	4	1
Bermuda	4	0	0
Chile	3	0	2
Denmark	3	0	3
Israel	3	2	1
Belgium	2	0	2
Hungary	2	1	1
Angola	1	0	0
Bangladesh	1	1	0
Czech Republic	1	0	0
Ghana	1	1	0
Ireland	1	0	1
India	1	1	0
Luxembourg	1	1	0
New Zealand	1	0	1
Poland	1	0	1
Russia	1	0	0
Slovak Republic	1	0	1
Turkey	1	0	1
British Virgin Islands	1	1	0
South Africa	1	0	1
Total	796	444	272

Notes: Cases are those first enforced in the headquarters country or in any third-country jurisdiction. The "headquarters country" is where the firm which allegedly bribed public officials abroad is headquartered. Positive Cases refer to cases that were concluded with a judgment in favor of the prosecution or a settlement. Ongoing cases are those that are still pending.

Table 3. Total Number of Cases by Country where Alleged Corruption Takes Place, 1998–2012

Foreign country	Total Cases	Positive Cases	Ongoing Cases
China	88	49	34
Nigeria	42	32	6
India	29	12	14
Russia	28	15	10
Indonesia	24	18	5
Libya	24	6	16
Brazil	22	7	11
Kazakhstan	22	8	9
Angola	19	9	8
Egypt	17	14	3
Argentina	16	9	7
Philippines	15	9	5
Greece	14	9	4
Mexico	14	10	4
Thailand	14	11	3
Saudi Arabia	12	7	4
United States	12	12	0
Vietnam	12	11	1
Venezuela	11	7	3
Algeria	10	3	6
Poland	10	6	2
Turkey	10	6	1
United Arab Emirates	9	5	4
Iraq	9	3	6
Ghana	8	2	3
Iran	8	4	2
Korea	8	3	5
Malaysia	8	5	1
Romania	8	3	3
Bangladesh	7	5	2
Bulgaria	7	4	1
Czech Republic	7	2	4
Hungary	7	3	3
Liberia	7	4	1
Serbia	7	4	2
Congo, Republic of	6	4	2
Costa Rica	6	3	3
Croatia	6	3	2
Italy	6	2	3
Kenya	6	4	2
Panama	6	2	3
Uganda	6	3	2
Uzbekistan	6	4	2
South Africa	6	2	3
Austria	5	2	2
Peru	5	1	3
Pakistan	5	4	1
Syria	5	3	2
Bahrain	4	4	0
France	4	4	0
Equatorial Guinea	4	2	1
Haiti	4	2	1
Cambodia	4	2	2
Mali	4	3	0
Qatar	4	2	2
Slovenia	4	2	2
Tanzania	4	4	0
Azerbaijan	3	3	0
Côte d'Ivoire	3	2	1
Ecuador	3	3	0
Gabon	3	2	0
Georgia	3	1	1
Hong Kong	3	3	0
Honduras	3	3	0
Kuwait	3	1	2

Morocco	3	1	1
Mauritania	3	2	1
Malawi	3	1	1
Oman	3	1	2
Rwanda	3	2	1
Taiwan	3	2	1
Ukraine	3	1	1
Zimbabwe	3	0	2
Albania	2	1	1
Colombia	2	1	1
Germany	2	1	0
Spain	2	1	1
Guinea	2	1	1
Lithuania	2	1	1
Latvia	2	1	1
Mozambique	2	1	0
Nepal	2	2	0
Sudan	2	2	0
Singapore	2	1	1
Slovak Republic	2	0	2
Senegal	2	1	1
Somalia	2	0	0
Turkmenistan	2	2	0
Tunisia	2	0	2
Yemen	2	1	1
Zambia	2	0	1
Afghanistan	1	0	1
Bosnia	1	1	0
Belgium	1	1	0
Burkina Faso	1	1	0
Benin	1	1	0
Brunei	1	1	0
Bolivia	1	1	0
Bahamas, The	1	1	0
Belarus	1	0	0
Cameroon	1	0	1
Cuba	1	1	0
Djibouti	1	1	0
Dominican Republic	1	0	1
Eritrea	1	0	1
Jamaica	1	0	1
Jordan	1	1	0
Japan	1	0	1
North Korea	1	0	1
Luxembourg	1	1	0
Madagascar	1	1	0
Macedonia	1	1	0
Myanmar	1	1	0
Mongolia	1	1	0
Moldova	1	0	1
Niger	1	1	0
Netherlands	1	1	0
Norway	1	0	1
Nairu	1	0	1
French Polynesia	1	1	0
Portugal	1	0	1
São Tomé and Príncipe	1	0	0
El Salvador	1	0	1
Turks and Caicos Islands	1	0	1
Chad	1	1	0
Trinidad and Tobago	1	0	0
United Kingdom	1	1	0
Uruguay	1	0	0
Total	796	444	272

Notes: Cases are those first enforced in the headquarters country or in any third-country jurisdiction. The "foreign country" is the country where the act of (alleged) corruption took place.

The list of countries where public officials are seen to be on the receiving end of alleged bribery is more extensive (Table 3). At least one case is recorded in 128 countries. China leads the list with 88 cases, followed by Nigeria.

To compute the index of public administration corruption, $PACI_z^{ALL}$, all 796 cases, regardless of their outcomes, were considered (Table 4). The inclusion of all the cases is justified by the presence of a high burden of proof in order to lead to a conviction. Thus, false negatives are likely to be more numerous than false positives. However, in order to accommodate a more agnostic view on this issue, the study computes the index by excluding cases that have been dropped or have resulted in an acquittal. It also computes the PACI by excluding cases involving public agencies in charge of health and telecommunications sectors, for reasons discussed in Section IV of this paper. The combination of these alternatives results in the computation of four versions of the PACI, whose reciprocal Spearman rank correlations range between 0.885 and 0.945 (Table 5). These computations will be discussed in their entirety in the succeeding section.

The probability of observing zero cases, under the condition that probability of corruption is equal in all foreign countries, $\Pr\_zero\_cases_z^{PACI}$, is used to rank those countries that have no observed cases of corruption first enforced abroad, and also to exclude very small countries for which the available information is not deemed to be sufficient. Canada and Finland, for instance, reported zero cases of corruption (first enforced abroad) involving their public officials. For Finland, such probability equals 1.3 percent—being a middle-sized economy, it is rather unlikely for Finland not to observe any cases, if the probability that public officials accept bribes were the same in Finland as in the rest of the world. For Canada, on the other hand, $\Pr\_zero\_cases_z^{PACI} = 0.0000$. In this case, the signal provided by the PACI, indicating that the level of corruption in Canada is low, is very strong and illustrates that Canada, which is a bigger country, generates more information than Finland.

Table 4. Public Administration Corruption Index (PACI), 1998–2012

Country	$PACI_z^{All}$	$\Pr\_zero\_cases_z^{PACI}$	Country Rank	Rank difference, WB CCI	Rank difference, TI CPI
Canada	0	.0000	1	-10	-11
Switzerland	0	.0000	2	-2	-3
Australia	0	.0000	3	-4	-4
Sweden	0	.0001	4	-1	0
Ireland	0	.0002	5	-9	-12
Denmark	0	.0018	6	4	4
Finland	0	.0128	7	6	6
United Kingdom	2.5877	.0000	8	-2	-2
Japan	3.0173	.0000	9	-10	-9
Netherlands	3.5209	.0000	10	2	1
Germany	3.7233	.0000	11	-1	-2
Belgium	3.7869	.0000	12	-5	-4
Spain	8.5766	.0000	13	-5	-6
France	10.584	.0000	14	-2	-1
Singapore	14.457	.0000	15	12	12
Portugal	19.104	.0053	16	-4	-4
Norway	19.398	.0058	17	11	11
USA	21.542	.0000	18	3	4
Italy	22.299	.0000	19	-22	-11
Taiwan	25.406	.0000	20	-4	-4
Mexico	29.169	.0000	21	-35	-31
Korea	46.024	.0000	22	-5	-7
Austria	47.048	.0000	23	14	15
Dominican Republic	50.168	.1362	24	-52	-42
Colombia	65.027	.0462	25	-27	-17
Luxembourg	80.352	.2881	26	13	15
Slovakia	90.961	.1109	27	-2	-11
Bahamas	99.065	.3644	28	-97	-94
El Salvador	99.224	.3650	29	-38	-10
Malaysia	106.33	.0005	30	-8	2
South Africa	107.88	.0038	31	3	-4
Jamaica	119.42	.4328	32	-33	-16
Turkey	119.52	.0002	33	-12	-20
Czech Republic	125.09	.0037	34	4	-2
Poland	126.97	.0004	35	-5	-21
China	144.86	.0000	36	-43	-26
Trinidad and Tobago	148.67	.5104	37	-10	-7
Morocco	149.08	.1337	38	-19	-22
Ukraine	154.79	.1440	39	-43	-51
Hungary	168.47	.0156	40	14	9
Tunisia	173.07	.3148	41	-7	9
Saudi Arabia	190.41	.0018	42	-8	-17
Belarus	192.31	.5945	43	-54	-46
Jordan	198.26	.6038	44	9	17
Kuwait	202.40	.2271	45	20	11
Uruguay	204.31	.6129	46	25	21
Brazil	213.22	.0000	47	-6	0
Lithuania	217.46	.3986	48	9	15
Cuba	236.84	.6555	49	13	4
India	241.05	.0000	50	-14	-22
Thailand	255.67	.0041	51	0	5
Qatar	264.63	.2205	52	29	29
Slovenia	268.99	.2260	53	31	31
Romania	276.02	.0551	54	-1	-11
Venezuela	281.10	.0199	55	-45	-47
Russia	310.28	.0001	56	-35	-42
Ecuador	315.46	.3863	57	-29	-40
Peru	322.84	.2125	58	0	9
Honduras	339.15	.4128	59	-28	-28
Brunei	351.31	.7522	60	-63	-64
Latvia	367.92	.5806	61	27	20
Costa Rica	378.61	.2050	62	30	22
Pakistan	380.54	.2687	63	-44	-50

Greece	388.59	.0272	64	31	27
Iran	396.82	.1331	65	-5	-10
Oman	460.90	.5215	66	29	45
Afghanistan	472.13	.8091	67	-52	-27
Bosnia	472.90	.8094	68	14	-6
Bolivia	475.10	.8101	69	-20	-24
Benin	479.11	.8116	70	-29	-1
Philippines	496.68	.0488	71	-6	-21
Algeria	533.93	.1536	72	4	-4
Croatia	539.26	.3286	73	31	18
Yemen	545.67	.6931	74	-18	-9
Cameroon	576.26	.8407	75	-33	-33
Argentina	586.46	.0653	76	7	-1
Macedonia	672.15	.8617	77	6	-5
Bulgaria	696.83	.3662	78	34	35
Vietnam	714.14	.1863	79	-11	-9
Sudan	775.28	.7726	80	-38	-32
Indonesia	846.45	.0586	81	-15	-26
Panama	884.80	.5075	82	20	32
Bahrain	900.87	.6414	83	52	57
Senegal	924.21	.8054	84	38	23
Syria	955.45	.5925	85	2	27
Côte d'Ivoire	1061.6	.7538	86	-26	-30
Albania	1144.2	.8396	87	-1	-13
Burkina Faso	1171.6	.9181	88	39	34
Gabon	1176.1	.7748	89	15	21
Madagascar	1219.9	.9212	90	47	10
Egypt	1253.2	.2575	91	19	34
Iraq	1268.1	.4917	92	-28	-17
Azerbaijan	1280.8	.7911	93	-9	-17
Serbia	1356.3	.5968	94	31	30
Kenya	1481.5	.6669	95	-6	-16
Bangladesh	1549.4	.6365	96	-18	-24
Haiti	1651.8	.7849	97	-20	-21
Niger	1812.2	.9463	98	14	-1
Georgia	1819.6	.8480	99	38	-4
Mozambique	1900.6	.9001	100	27	21
Burma	1929.8	.9495	101	-20	-18
Turkmenistan	1947.4	.9024	102	-14	-15
Zambia	1961.4	.9030	103	10	17
Nigeria	2101.2	.1354	104	-5	-10
Ghana	2191.0	.6941	105	46	54
Chad	2207.3	.9557	106	-9	-15
Mongolia	2302.7	.9575	107	32	40
Tanzania	2307.3	.8408	108	28	35
Guinea	2410.7	.9203	109	5	-6
Djibouti	2425.4	.9596	110	29	41
Kazakhstan	2475.6	.4112	111	8	27
Congo	3088.9	.8234	113	8	12
Equatorial Guinea	3102.5	.8790	114	-8	-9
Mauritania	3242.8	.91164	115	55	52
Liberia	3426.8	.8152	116	10	11
Libya	3550.3	.5086	117	19	26
Zimbabwe	4122.5	.9298	118	5	33
Uzbekistan	4290.9	.8695	119	9	13
Cambodia	4645.2	.9174	120	9	16
Nepal	5354.4	.9633	121	43	25
Sao Tome & P.	5905.4	.9832	122	27	41
Uganda	5911.4	.9034	123	29	28
Mali	6340.1	.9388	124	58	54
Malawi	8598.1	.9657	125	40	47

Notes: Index computed using all cases regardless of outcome and administration. Countries for which $PACI_z = 0$ have been ranked according to the negative of $\Pr\_zero\_cases_z^{PACI}$. Countries for which $PACI_z = 0$ and $\Pr\_zero\_cases_z^{PACI} > 0.015$ and countries for which $PACI_z > 10000$ have been excluded from the list. WB-CCI: World Bank Corruption Control Index, 2005. TI-CPI: Transparency International Corruption Perceptions Index, 2005.

$\Pr\_zero\_cases_z^{PACI}$ provides a useful indication of the precision of the PACI also for countries with at least one case of corruption on record. For smaller countries, the signal that the PACI provides is rather noisy because of the rarity of observed corruption events. For example, the probability of observing zero cases in Tunisia would be equal to 0.31 in a situation where the level of corruption is the same everywhere in the world. Notably, two cases were actually observed, close to twice as many as the expected figure if cases were distributed according to trade shares, with a resulting PACI of about 170 and a ranking measure for Tunisia similar to that indicated by the *WB-CCI* and the *TI-CPI* (see the last two columns of Table 4).

III. The PACI and perception-based measures: A comparison

The differences in the rankings yielded by the PACI and the WB-CCI and TI-CPI are also explored (see last columns of Table 4), where the perception-based measures are for the year 2005, the middle of the time interval of reference the PACI. A positive value indicates that a given country is considered to be relatively more corrupt based on the PACI. In most cases, differences are modest. However, results diverge considerably for a few countries.

These information are summarized by showing the Spearman rank correlations between the different versions of the PACI and the perception-based alternatives (Table 5). The rank correlations of $PACI_1$, the version which includes all cases (presented in Table 4), with perception-based measures are rather high, typically pegged at above 0.7.[9]

[9] Note that more corruption corresponds to lower values of the *WB-CCI* and the *TI-CPI* indices, but to higher values for the *PACI* and the *TI-GCB*.

Table 5. Spearman Rank Correlations between Different Indexes of Corruption

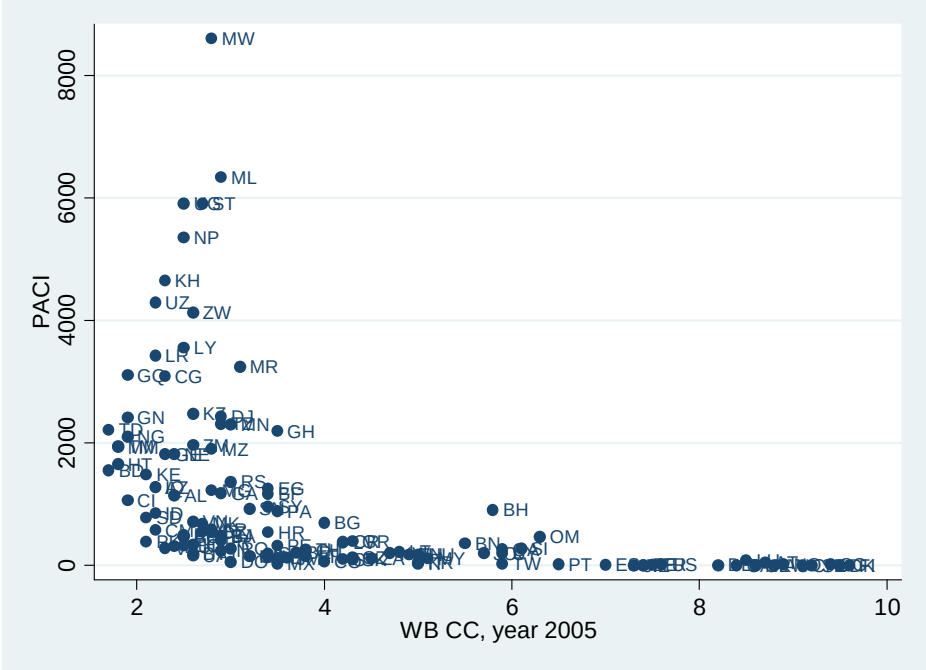
	$PACI_1$	$PACI_2$	$PACI_3$	$PACI_4$	TI-CPI	WB-CCI	TI-GCB
$PACI_1$	1						
$PACI_2$	0.938	1					
	(123)						
$PACI_3$	0.940	0.886	1				
	(123)	(123)					
$PACI_4$	0.885	0.945	0.941	1			
	(123)	(123)	(123)				
TI-CPI	-0.779	-0.736	-0.751	-0.729	1		
	(123)	(123)	(123)	(123)			
WB-CC	-0.768	-0.711	-0.729	-0.692	0.954	1	
	(123)	(123)	(123)	(123)	(123)		
TI-GCB	0.755	0.731	0.769	0.747	-0.800	-0.767	1
	(56)	(56)	(56)	(56)	(56)	(56)	

Notes: PACI: Public Administration Corruption Index, 1998–2012. The subscript indicates:
1: All cases, all administrations (the same values shown in Table 4; our preferred index).
2: All cases, with the exclusion of health and telecom administration.
3: Only "positive" and "ongoing" cases, all administrations.
4: Only "positive" and "ongoing" cases, with the exclusion of health and telecom administrations.
TI-CPI: Transparency International Corruption Perceptions Index, 2005. WB-CCI: World Bank Corruption Control Index, 2005. TI-GCB: Percentage of persons who answered "yes" to the question: "In the past 12 months, have you or anyone living in your household paid a bribe in any form?" Transparency International Global Corruption Barometer, 2005. Number of observations are between parentheses. All the estimated coefficients are significant at less than 1 percent. Countries for which $PACI_z = 0$ and $\Pr\_zero\_cases_z^{PACI} > 0.015$ and countries for which $PACI_z > 10000$ have been excluded.

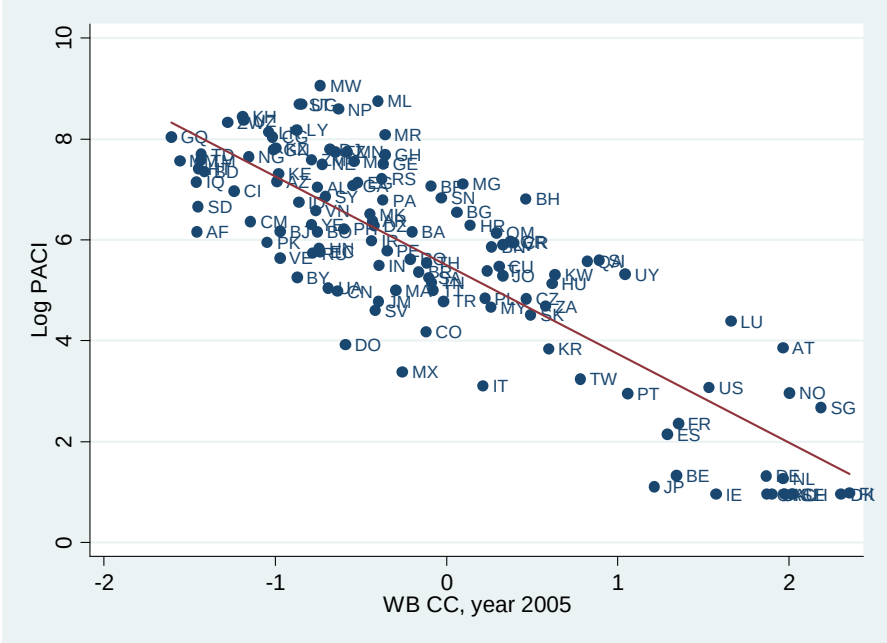
While the ranking based on the PACI is similar to the rankings based on the two most popular perception-based indices, the scales appear to be very different (Figure 1). Panel A shows a scatter diagram of the PACI together with the WB-CCI for 2005, while Panel B shows the same indices, with the PACI log-transformed. The Pearson correlation of log(PACI) and WB-CCI is quite high (equal to -0.841).

Figure 1. Comparison between PACI and WB Corruption Control Index

A. PACI vs. WB-CCI



B. Log(PACI) vs. WB-CCI



Notes: In Panel B, when the PACI equals zero (countries: FI, DK, IE, SE, AU, CH, CA), it has been set equal to arbitrary small numbers for the purpose of computing the log. Countries for which $PACI_z = 0$ and $\Pr\_zero\_cases_z^{PACI} > 0.015$ and countries for which $PACI_z > 10000$ have been excluded.

The study also seeks to examine whether the observed differences between the PACI and perception-based measures of corruption are systematic, and to the extent that they might be, what determines them. The residual of a linear regression between the log of the PACI and the WB-CCI (as in Figure 1.B) or the TI-CPI is considered and denoted as "measurement residuals" -- $mesres_{WB\text{-}CCI}$ and $mesres_{TI\text{-}CPI}$, respectively. Negative (positive) values indicate that a given country appears to be less (more) corrupt according to the PACI as opposed to the perception-based index used.

Whether these differences are correlated with $\Pr\_zero\_cases_z^{PACI}$ is determined first. If the precision of the PACI deteriorates significantly with respect to smaller countries, while the precision of the perception-based measures remains intact (or deteriorates to a lesser degree), then the absolute value of the measurement residuals could be expected to be positively correlated with $\Pr\_zero\_cases_z^{PACI}$. This, however, is not the case. The correlation between the absolute values of $mesres_{WB\text{-}CCI}$ and $mesres_{TI\text{-}CPI}$ and $\Pr\_zero\_cases_z^{PACI}$ is seen to be insignificant, pegged at −0.0524 and −0.1001, respectively. This result indicates that any problem which may beset the precision of the PACI in measuring corruption in small countries, would also be shared by the two perception-based alternatives.

Subsequently, the study selected a set of variables which may be linked to biases in favor of or against either measure.[10] Variables of an economic and demographic nature, namely: per capita GDP based on purchasing-power-parity (*gdp_cap*), population (*pop*), and the ratio of public expenditure over GDP (*r_g/gdp*) are considered. Variables that express the ease with which publicly relevant information is generated and debated upon, as well as the democratic attributes of a country, are also contemplated. Also included in such examination are *emp_rights*, an index of empowerment rights; *free_press* and *free_speech*, which respectively measure the operationalization of the guarantees to free press and free speech; *voice_acc*, a measure of voice

[10] A detailed description of the variables used is found in Appendix B.

and accountability; *democ*, an index of democratization; *checks*, which measures systems of checks and balances; and *stability*, which measures political stability. To test whether the observed residuals follow some recognizable geographic pattern, a set of geographic dummies is also considered. Pairwise correlations between $mesres_{WB\text{-}CCI}$, $mesres_{TI\text{-}CPI}$, and these variables are thus shown (Table 6). Results excluding the ten biggest (in absolute value) measurement residuals, roughly corresponding to ten percent of the available observations, are also presented.

Two of the geographic dummies are significantly correlated with both types of measurement residuals. Countries in the American continents, on average, appear to be less corrupt according to the PACI, compared to when either of the perception-based measures are used. The opposite, however, can be seen for countries in Africa and the Middle East. Populous countries also appear to fare better according to the PACI. Countries that are more democratic and have stronger checks and balances appear to be less corrupt on average when the PACI is used. The significance of some of the other variables, meanwhile, depends on which measurement residual is considered and on whether outliers are included. In interpreting the results, the squared estimated correlation coefficient should be noted to represent the fraction of the variance of the measurement residuals that is explained by a given variable (the R^2 of the bivariate ordinary least-squares regression). Such fraction is always rather small, even when the estimated correlation coefficient is statistically significant.

To go beyond simple bivariate correlations, a multivariate regression is also considered (Table 7). Here, the dependent variable is either $mesres_{WB\text{-}CCI}$ or $mesres_{TI\text{-}CPI}$ and the regressors consist of all the explanatory variables described earlier.[11] As in the bivariate analysis, results obtained by excluding the ten observations of the dependent variable having the greatest absolute value were also reported.

[11] The dummy for Europe and Central Asia was excluded to avoid the dummy variable trap. The estimated coefficients of the other dummies should then be interpreted as the estimated effect relative to that reference group of countries.

Table 6. Correlation coefficients between measurement residuals and selected variables.

All observations

	Dummy EU Asia	*Dummy Asia Pacific*	*Dummy America*	*Dummy Africa ME*	*Gdp_cap*	*Pop*	*R_g/gdp*
$mesres_{WB\text{-}CCI}$	-0.0604	-0.1405	-0.2507***	0.3621***	-0.0090	-0.2122**	-0.1182
	(0.5071)	(0.1211)	(0.0052)	(0.0000)	(0.9242)	(0.0185)	(0.1946)
$mesres_{TI\text{-}CPI}$	-0.1297	-0.0810	-0.2854***	0.4109***	0.0510	-0.2234**	-0.1010
	(0.1527)	(0.3732)	(0.0014)	(0.0000)	(0.5916)	(0.0130)	(0.2683)

	Free_press	*Free_speech*	*Voice_acc*	*Emp_right*	*Democ*	*Checks*	*Stability*
$mesres_{WB\text{-}CCI}$	0.0368	-0.0739	-0.0604	-0.0677	-0.2687***	-0.2180**	0.1518*
	(0.6876)	(0.4163)	(0.5067)	(0.4572)	(0.0033)	(0.0177)	(0.0938)
$mesres_{TI\text{-}CPI}$	0.1579*	-0.1221	-0.1620	-0.1415	-0.3310***	-0.2807***	0.1113
	(0.0823)	(0.1786)	(0.0735) *	(0.1184)	(0.0003)	(0.0021)	(0.2205)

Excluding the ten biggest outliers

	Dummy EU Asia	*Dummy Asia Pacific*	*Dummy America*	*Dummy Africa ME*	*Gdp_cap*	*Pop*	*R_g/gdp*
$mesres_{WB\text{-}CCI}$	-0.0400	-0.1297	-0.1928**	0.2860***	0.0478	-0.2234**	-0.0933
	(0.6737)	(0.1708)	(0.0408)	(0.0021)	(0.6315)	(0.0174)	(0.3278)
$mesres_{TI\text{-}CPI}$	-0.1200	-0.0758	-0.2216**	0.3476***	0.1124	-0.2319**	-0.0772
	(0.2056)	(0.4247)	(0.0184)	(0.0002)	(0.2585)	(0.0134)	(0.4186)

	Free_press	*Free_speech*	*Voice_acc*	*Emp_right*	*Democ*	*Checks*	*Stability*
$mesres_{WB\text{-}CCI}$	-0.0221	-0.0673	0.0019	-0.0391	-0.1882*	-0.2234**	0.2073**
	(0.8171)	(0.4787)	(0.9839)	(0.6904)	(0.0511)	(0.0195)	(0.0276)
$mesres_{TI\text{-}CPI}$	0.1159	-0.1104	-0.1161	-0.1153	-0.2682***	-0.2818***	0.1619*
	(0.2238)	(0.2443)	(0.2208)	(0.2241)	(0.050)	(0.0030)	(0.0866)

Notes: Number of observations. Panel A: between 124 and 117; Panel B: between 104 and 113. *P*-values between parentheses. * *p*-value < .1; ** *p*-value < .05; *** *p*-value < .001. For a description of the data, see Appendix B. Countries for which $PACI_z = 0$ and $\Pr\_zero\_cases_z^{PACI} > 0.015$ and countries for which $PACI_z > 10000$ have been excluded.

Table 7: Multivariate analysis of the determinants of the measurement residuals

Regressors	*Dep. var: mesres*$_{WB\text{-}CCI}$		*Dep. var. mesres*$_{TI\text{-}CPI}$	
	All observations	Excluding 10 outliers	All observations	Excluding 10 outliers
Asia & Pacific	-0.4102	-0.2714	-0.0992	0.1070
	(0.3213)	(0.2886)	(0.3243)	(0.2972)
America & Caribbean	-0.9691**	-0.6412*	-0.8116**	-0.4874
	(0.4018)	(0.3569)	(0.3778)	(0.3353)
Africa & Middle East	0.3450	0.4022	0.4826	0.4655
	(0.3502)	(0.3281)	(0.3624)	(0.3453)
Per capita GDP. PPP	11.7404	8.8195	21.7674*	11.8142
	(10.0708)	(9.5360)	(11.189)	(8.4577)
Pop	-0.0063	0.0052	-0.0008*	-0.0010**
	(0.0006)	(0.0006)	(0.0004)	(0.0004)
R_g/gdp	-0.0102***	-0.0097***	-0.0075*	-0.0010**
	(0.0035)	(0.0027)	(0.0041)	(0.0004)
Free_press	-0.0036	-0.0008	0.0127	0.0068
	(0.0120)	(0.0116)	(0.0113)	(0.0109)
Free_speech	-0.1566	-0.0559	-0.0909	-0.0357
	(0.2883)	(0.280)	(0.266)	(0.24089)
Voice_acc	0.4953	0.467	0.1817	0.2087
	(0.3785)	(0.361)	(0.3578)	(0.3176)
Emp_right	0.0734	0.0114	0.1048	0.0539
	(0.0777)	(0.0663)	(0.0790)	(0.0682)
Democ	-0.0440**	-0.0234	-0.03245*	-0.0247
	(0.0194)	(0.0176)	(0.0178)	(0.0164)
Checks	-0.0436	-0.0642	-0.0332	-0.0228
	(0.0457)	(0.0420)	(0.0404)	(0.0346)
Stability	0.1302	0.1582	0.1605	0.1560
	(0.1705)	(0.1491)	(0.1592)	(0.1467)
Observations	105	95	105	96
R-squared	0.328	0.295	0.354	0.337

Notes. OLS estimates. Robust standard errors are between parentheses. * * p-value < 0.1; ** p-value < 0.05; *** p-value < 0.001. For a description of the variables, see the note at the bottom of Table 6 and Appendix B. Countries for which $PACI_z = 0$ and $\Pr\_zero\_cases_z^{PACI} > 0.015$ and countries for which $PACI_z > 10000$ have been excluded.

Only few of the explanatory variables considered are statistically significant and all the regressors only explain 30 to 35 percent of the total variability of the measurement residuals. A significant negative effect for the dummy variable pertaining to the American continents, in three out of four cases, can still be found. The effect of the dummy variable on Africa and the Middle East, detected in the bivariate analysis, is now insignificant. Countries where the index of democratization (*democ*) is higher appear to be less corrupt according to the PACI. The same applies to countries having a high share of public expenditure over GDP (*r_g/gdp*). Population is also seen to have a significant effect in two out of four cases. Overall, differences between the PACI and the two leading perception-based cross-national measures of corruption appear to be rather idiosyncratic, at least with respect to the set of factors considered.

IV. The validity of the PACI

This section discusses the assumptions necessary for the PACI to be considered a valid measure of corruption. While Appendix A presents these assumptions formally, to show how they imply index validity, the focus here is on their overall meaning and, most importantly, on the extent to which they may hold in practice.

The first assumption is that the probability of observing a corrupt transaction involving firms from country *i* (and enforced first in the same country, or in third country jurisdictions) and public officials in country *j* does not depend on the identity of country *j*. It implies that the judiciary, when deciding which cases to pursue, does not "discriminate" based on the foreign officials´ nationality. The possibility of assessing the levels of corruption in the foreign country by looking at the geographical distribution of cases first enforced elsewhere hinges on this key assumption. Whether this assumption can be relied upon is an empirical question. McLean (2012) evaluated the relevance of foreign policy considerations and opportunities for enforcement

cooperation in determining the geographic distribution of FCPA cases, and found that bilateral frameworks for securities regulation and enforcement cooperation appear to be associated with higher levels of FCPA implementation. However, the magnitude of such an effect was found to be rather modest. The same study did not find other candidate explanatory variables to have any significant effect. Choi and Davis (2012) also found little evidence contradicting the first assumption.

The assumption could also be violated if the probability of detecting corruption cases depended on the conditions surrounding freedom of expression and information in the foreign country. However, the available data indicate that most cases are first enforced based on evidence gathered in the headquarters countries. Furthermore, supposing that the relevant perception-based measure is unbiased, the variables that capture a liberal environment for expression and the circulation of information in the foreign country would be expected to positively affect the *measurement residuals* introduced in the earlier sections (implying that the PACI in those cases would reveal a higher level of corruption compared to its perception-based counterpart). Three variables expressing the various dimensions of the ease of expression and circulation of information (*free_press*, *free_speech* and *voice_acc;* see Appendix B for a description) were considered and the results of both bivariate and multivariate analysis (Table 6 and 7) indicate a statistical significance only in very few cases, while pointing to the presence of marginal effects at most.[12]

Assumptions 2 and 3 in Appendix A are rather technical, and describe how the probability of offering a bribe, or accepting a bribe when offered, may depend on the level of corruption in the other country. Of more interest is assumption 4, which establishes that the number of cross-border transactions is proportional to bilateral trade flows. An alternative proxy for cross-border

[12] The probability of detection and enforcement may also be sector-specific. For example, corruption in the arms trade is likely to be more difficult to detect as national security concerns may limit the actions available to the judiciary (see also Rose-Ackerman 1999). To address such issues, the PACI could be computed separately for different sectors of the economy.

transactions would be foreign direct investments (FDI) (as in Choi and Davis 2012 and Mclean 2012). However, many transactions are not reflected in FDI flows, nor stocks, and FDI eventually enable trade flows between the countries involved. For these reasons, the choice of proxy made in this study seems to be more appropriate.

Differences in the scope of the public sector in different countries would also be a cause for concern. For instance, a pharmaceutical firm headquartered in country A successfully bribes hospital employees in country B and C in order to sell its products. If country B runs a public health system, the bribery incident would qualify as a case of cross-border corruption of a foreign public official. On the other hand, if country C's hospitals are managed by the private sector, the bribery incident would qualify as a case of private sector corruption and, as such, would not be included in this study's dataset. At first glance, neglecting this difference may be seen to lead to an underestimation of the level of corruption in country B with respect to C since, *ceteris paribus*, more corruption cases are registered in the former than in the latter, due to the wider scope of the public sector in country B. Apparently, in this case, trade flows would not serve as a good proxy for cross-national exchanges involving public officials in a given country, since for each dollar of imports there would be more interactions with public officials in country B than in country C. To account for this issue, this study computed the PACI without regard for cases involving procurement in the health and the telecommunication sectors (as opposed to transactions involving regulatory bodies in those sectors since they are invariably public). Arguably, these are the main sectors that are prone to stark variations in terms of government activism.[13] Different choices, however, seem to deliver similar results (see Table 5).[14]

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[13] Alternatively, the number of cases for the relative size of the public sector in different countries could be corrected. However, the concept of public sector is blurry, particularly in some countries. Generally, the decision on how to account for the variable scope of public sectors worldwide depends on the position which the researcher takes on conceptual issues that are the subjects of debate.

[14] If the interest lies in measuring the *magnitude* of public sector corruption, instead of its *frequency,* then cross-country variations in the scope of activities of the public sector should not be a cause for concern. The scope of government is also arguably endogenous over the long-run since corrupt elites have an interest in maintaining and possibly expanding their reach.

V. Discussion

The PACI reflects a narrow definition of corruption: the propensity of public officials to accept bribes from foreign firms.[15] In denominating the index as a general "public administration" measure of corruption, the study implicitly assumes that what is observed by means of cross-country corruption statistics is also informative of the level of corruption in the public sector as a whole. Obviously, this assumption may be put to question, especially since levels of corruption may vary sensibly across public institutions within a given country. This article, however, argues that adopting narrow definitions of a phenomenon is desirable because it facilitates the testability of the assumptions on which hinges any extensive interpretation of the resulting measures.

For this reason, the PACI represents a welcome departure from most indices of governance currently available, where "sometimes it is not clear what precisely is being measured, rendering questionable the validity of at least some of the proxies" (Klitgaard and Light 1998). Such a state of affairs may reflect a situation "experienced in many 'new areas' of the social sciences: an explosion of measures, with little progress toward theoretical clarity or practical utility" (Klitgaard et al. 2005, 414). Quite likely, as "open data" become more widely available, more measures of governance, based on hard data, and narrowly defined like the PACI, would be ushered (see the discussion in Picci 2011, 117–119). Such a development, in turn, will facilitate greater theoretical clarity.

Data availability, as seen, poses certain constraints to the usefulness of the PACI. This limitation is the reason why this paper opted to demonstrate its application using a 15-year period.

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[15] A Bribe Payer's Corruption Index (*BPCI*) may also be computed along the same lines as the *PACI*, but using cases first enforced in the foreign country. However, the scarcity of data proves to be an obstacle towards its computation.

However, when comparing this attribute of the PACI with the TI-CPI, it should be noted that Transparency International has warned against making comparisons with their index across time, in light of annual changes in the methodology and country coverage. In other words, to some extent, the advantage of having a yearly measure is more apparent than real.[16] As more countries sign the OECD Anti-Bribery Convention, more cases are likely to be reported, lending more precision to the PACI and allowing its computation for shorter intervals of time. Also, more data would permit the separate computation of the PACI for different sectors, and the resulting measures could eventually be aggregated into a general index.

This paper shows that, under a set of assumptions, the PACI is valid in the sense that it registers a higher value in countries where the probability that a transaction is corrupt is higher. The validity of the index is sufficient in delivering a correct ranking of countries. In a previous version of this article, it was shown that under a further assumption, the PACI represents the *probability* that a transaction is corrupt, relative to a world average. To illustrate, if the PACI equals 200 for a given country, it would imply that the probability of corruption in that country is twice a world average. However, it is left for future studies to explore the plausibility of such an interpretation, which may be appealing due to its practical applications but may be unrealistic. A better understanding of this issue would be welcome, considering that current cross-national measures of corruption are wanting in this respect. For example, in the 2014 TI-CPI, Germany and Turkey registered scores of 79 and 45 and rank 12th and 64th in the list of countries, respectively. The differences imply that the (perceived) level of corruption in Turkey is considerably higher than in Germany, but the index used does not allow any interpretation regarding *how much* more corruption there is in the latter compared to the former.

[16] Recent changes in the way the TI-CPI is computed should assure that "[it] will better capture changes in perception of corruption in the public sector of [a given] country over time. However, due to the update in the methodology, 2011 CPI scores are not comparable with CPI 2012 scores" (Transparency International 2012).

Under this light it should also be interpreted the finding that the PACI is highly correlated with the main perception-based measures of corruption, but it has a different scale. It was shown earlier that the scales become comparable once the log of the PACI is taken. If the PACI indeed approximates the probability that a transaction is corrupt with respect to a world average, then the *exponential* of the WB-CCI and the TI-CPI would be approximately proportional to levels of corruption. Thus, further work in this direction might help clarify the scales of existing perception-based indicators.

Other venues for future research could be foreseen. First, the availability of the PACI spurs a reassessment of the literature on the causes and consequences of corruption. As mentioned earlier, more data would allow the computation of the PACI for separate sectors of the economy. It would also be interesting to study the differences among several versions of the same indices, computed by focusing on different jurisdictions (along the lines of the presentation in Table 1). Since they all measure the same concept of corruption, they are expected to provide similar results. Thus, any variance among them could be explained by sampling error but also, possibly, by the violation of one or more of the maintained assumptions—the bigger the violation, the bigger the divergence. Tests for the validity of the maintained assumptions could be developed by leveraging on the magnitude of such observed differences.

Lastly, the same intuition behind the use of judicial statistics in this article, could be applied to other domains. The essential ingredients needed for this are data culled from different jurisdictions that convey information on crimes committed in a given country by actors residing in another country. Some types of financial crimes may possibly lend themselves to a treatment based on the methodology introduced in this paper.

Appendix A. Assumptions and validity of the PACI.

For a corrupt transaction to occur, both parties must be willing to engage in it. Firms headquartered in country *i* may decide to offer bribes to public officials in the foreign country *j*, with a probability that depends on the attributes of the foreign country. In particular, the probability that firms would offer bribes may be higher if the perceived level of corruption in the foreign country is high. This is because high levels of corruption would imply a lower risk of being caught and a higher social tolerance for bribery. The probability that a public official in the foreign country accepts a bribe when offered one may also depend on the attributes of the headquarters country. For example, if the latter is known to be proactive in curbing cross-border corruption, public officials may be deterred because the discovery of a corrupt act in the headquarters country may be followed by prosecution in the public officials' respective countries.

The probability that a public official in country *j* accepts a bribe, when he perceives that there is no risk of getting caught following a case first enforced in the headquarters country, is defined by $pr\_corr\_FO_j$. The advantage of this concept is that, logically, it does not depend on the attributes of the headquarters country, as it purely reflects the propensity of country *j*'s public officials to accept bribes. This probability is identified as the level of corruption demonstrated by public officials in the foreign country. Meanwhile, a measure of corruption is deemed valid if it is monotonically increasing in the level of corruption.

Definition. The PACI is valid if: $\partial PACI_z / \partial pr\_corr\_FO_z > 0$.

The expected number of corruption cases observed and enforced first in the headquarters country *i*, involving public officials in the foreign country *j*, is determined as follows:

$$cases\_obs\_HQ_{i,j} = pr\_obs\_HQ_{i,j} \cdot corr\_exch_{i,j} \qquad \text{(Eq. A1)}$$

where $corr\_exch_{i,j}$ is the number of occurrences of corruption involving firms headquartered in country *i* and public officials in country *j* (which will later be equate to its expected value) and $pr\_obs\_HQ_{i,j}$ is the probability that the corrupt exchange is observed, and enforced first in the headquarters country.

The expected number of corrupt exchanges is:

$$corr\_exch_{i,j} = pr\_bribe\_HQ_{i,j} \cdot pr\_bribe\_FO_{i,j} \cdot transactions_{i,j} \qquad \text{(Eq. A2)}$$

where $pr\_bribe\_HQ_{i,j}$ is the probability that a firm headquartered in country *i* proposes a bribe to public officials in foreign country *j,* while $pr\_bribe\_FO_{i,j}$ is the probability that the public official in *j* accepts the bribe offered by the firm headquartered in *i.* Meanwhile, $transactions_{i,j}$ is the total number of business transactions involving firms in country *i* and public officials in foreign country *j*.

This formulation simply states that in order for a corrupt transaction to occur, both parties have to agree upon its execution. The possibility of extortion is ruled out, so that the probability that a transaction is corrupt is equal to a product of probabilities. Statistical independence between these events is not assumed, and the possibility that the probabilities of offering and accepting bribes are interdependent will be explicitly discussed subsequently.

Assumption 1

The probability that a corrupt transaction involving firms from country i and public officials in country j is observed and first enforced in country i does not depend on the identity of the foreign country j:

$$pr\_obs\_HQ_{i,j} = pr\_obs\_HQ_i$$

This assumption is of key importance because it is the basis for using the geographic distribution of the cases involving country *i* firms to infer levels of corruption *in all other countries*.

Assumption 2

The probability that for a given cross-border transaction, a firm headquartered in country i offers a bribe to public officials in country j is as follows:

$$pr\_bribe\_HQ_{i,j} = pr\_corr\_HQ_i \cdot \theta(pr\_corr\_FO_j),$$

where $\theta(.)$ *is a continuous and differentiable monotonically increasing function, and* $\theta(0) = 1$.

This assumption describes how the probability that a firm will propose a bribe increases with the level of corruption in the foreign country. The probability that a firm will offer a bribe abroad if it perceives that there is no risk of being caught following a case initiated in the foreign country is expressed by $pr\_corr\_HQ_i$. If such a risk is present, it would serve as a disincentive for firms in country *i* to propose a bribe. The second multiplicative factor, $\theta(.)$, is meant to capture such a deterrence effect. It equals one when there is no perceived risk that a corrupt transaction will be caught following a case first enforced in the foreign country, and it increases with the level of corruption of the foreign country.[17]

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[17] In fact, the argument of the function $\theta(.)$ should more appropriately be taken as *expectations* of levels of corruption in the foreign country. This, in particular, would lead to the possibility of expectations being partly self-fulfilling: in a country with a (initially, possibly undeserved) reputation for corruption, foreign firms would be prone to offer bribes more often, leading to more corrupt transactions. Considering $pr\_corr\_HQ_i$ instead of expectations is justifiable if the latter is assumed to depend monotonically from that underlying probability.

Assumption 3

The probability that a public official in country j accepts a bribe when offered one by a firm headquartered in country i is as follows:

$pr\_bribe\_FO_{i,j} = pr\_corr\_FO_j \cdot \delta(pr\_corr\_HQ_i)$

where $\delta(.)$ *is a continuous and differentiable function, and* $\delta(0) = 1$

Symmetrically, with respect to Assumption 2, this assumption expresses the probability that a public official accepts a bribe, and its dependence on the level of corruption in the headquarters' country. The probability that a public official accepts a bribe if he perceives that there is no risk of getting caught following a case first enforced in the foreign country and then "spilling over" into the domestic jurisdiction, is expressed by $pr\_corr\_FO_j$. This may be seen as the "underlying" probability of corruption of public officials in the foreign country *j*. Assumption 3 admits the possibility that, all else being equal, public officials in a given country may be more wary of accepting a bribe from a firm headquartered in a country that is very proactive in curbing cross-border corruption. It affirms that such a deterrence effect is functionally the same for all foreign countries – the function $\delta(.)$ does not depend on *j*.

Assumption 4:

Bilateral transactions are proportional to the value of exports from country i to country j, x_{ij} *, according to a constant factor k:* $transactions_{ij} = k \cdot x_{ij}$

This assumption makes the number of cross-border transactions dependent on an observable variable – bilateral trade.

Given Assumptions 1, 2, 3 and 4, equation (Eq. A1) becomes:

$$cases\_obs\_HQ_{i,j} = pr\_obs\_HQ_i \cdot pr\_corr\_HQ_i \cdot \theta(pr\_corr\_FO_j) \cdot pr\_corr\_FO_j \cdot \delta(pr\_corr\_HQ_i) \cdot k \cdot x_{ij} \quad \text{(Eq. A2)}$$

By substituting this expression into the definition of the $PACI_z$ (Eq. 1), proving the following becomes straightforward:

Proposition 1. The $PACI_z$ is valid: $\partial PACI_z / \partial pr\_corr\_FO_z \geq 0$.

Assumptions 1-4 guarantee that the *PACI* is valid in the sense that higher levels of probability of corruption of foreign public officials results in a higher value for the index.

Appendix B. Data sources

Corruption cases. The main sources of data are Trace International Compendium´s, a database on international anti-bribery enforcement (http://www.traceinternational.org/compendium), US DOJ and SEC documents, and OECD reports (various years). Other databases and publications, such as Shearman and Sterling 2013, Transparency International 2009 and 2013, and Cheung *et al*. 2012 were consulted. Various news sources, such as the Wall Street Journal Risk and Compliance Journal (http://www.wsj.com/news/risk-compliance-journal), and anti-corruption blogs like the FCPA Blog (http://www.fcpablog.com) were considered. Cases reported in multiple sources were laboriously consolidated to avoid double counting. The reference period for each case is the year when the bribe was allegedly paid. However, in some instances, this date had to be presumed from the available data. A small number of cases could not be considered for the computation of the *PACI* because of lack of information on the identity of one of the two countries involved. All cases linked to the United Nations Oil-for-Food Programme, which allowed Iraq to sell oil in exchange for food, medicine and other humanitarian goods, were excluded because of their peculiar origin. All the coding reflects information available on April 1, 2015. Raw data are available at http://www2.dse.unibo.it/picci/measure_corruption.html

Exports: Barbieri and Keshk 2012.

Gdp_cap: Gross domestic product based, per capita. Expressed in PPP dollar per person. Source: IMF-World Economic Outlook, October 2014 (variable name: PPPPC) (http://www.imf.org/external/Pubs/ft/weo/2015/01/).

The secondary source of the following variables is the "Standard data" of the Quality of Government Institute dataset (Teorell et al. 2013) which assembles various sources. The May 2014

release of the dataset was used. A brief description of each variable is provided, taken verbatim from that dataset's codebook. The original source, which the codebook identifies, is indicated. "Variable name" indicates how the variable is tagged in the codebook.

Pop: population. Source: Heston, Summers and Haten 2012. Variable name: pwt_pop).

R_g/gdp: the share of public expenditure over GDP (Source: Heston, Summers and Haten 2012. Variable name: pwt_gsg)

Emp_right: empowerment rights index (Source: Cingranelli and Richard 2010. Variable name: ciri_empinx_new). It is an "additive index constructed from the Foreign Movement, Domestic Movement, Freedom of Speech, Freedom of Assembly & Association, Workers' Rights, Electoral Self-Determination, and Freedom of Religion indicators. It ranges from 0 (no government respect for these seven rights) to 14 (full government respect for these seven rights)."

Free_press: freedom of the press index (Source: Freedom House. Variable name: fh_fotpc3). "The press freedom index is computed by adding four component ratings: Laws and regulations, Political pressures and controls, Economic Influences and Repressive actions. The scale ranges from 0 (most free) to 100 (least free)."

Free_speech: freedom of speech (Source: Cingranelli and Richard 2010. See Teorell et al. for details. Variable name: ciri_speech). "This variable indicates the extent to which freedoms of speech and press are affected by government censorship, including ownership of media outlets".

Voice_acc: Voice and Accountability (The World Bank. Variable name: wbgi_vae). "'Voice and Accountability' includes a number of indicators measuring various aspects of the political process, civil liberties and political rights. These indicators measure the extent to which citizens of a country are able to participate in the selection of governments. This category also includes indicators measuring the independence of the media […]."

Checks: a measure of "checks and balances" (Source: Database of Political Intitutions Variable name: dpi_checks). "Equals 1 if the Legislative Index of Political Competitiveness

(dpi_lipc) or the Executive Index of Political Competitiveness (dpi_eipc) is less than six. In countries where dpi_lipc and dpi_eipc are greater than or equal to six, dpi_checks is incremented by one if there is a chief executive, by a further one if the chief executive is competitively elected (dpi_eipc greater than six), and by a further one if the opposition controls the legislature […]."

Democ: index of democratization (Source: Vanhanen 2011 Variable name: van_index). "This index combines two basic dimensions of democracy – competition and participation – measured as the percentage of votes not cast for the largest party (Competition) times the percentage of the population who actually voted in the election (Participation). This product is divided by 100 to form an index that in principle could vary from 0 (no democracy) to 100 (full democracy). (Empirically, however, the largest value is 49)."

Stability: political stability (Source: The World Bank. Variable name: wbgi_pse). "'Political Stability' combines several indicators which measure perceptions of the likelihood that the government in power will be destabilized or overthrown by possibly unconstitutional and/or violent means, including domestic violence and terrorism."

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