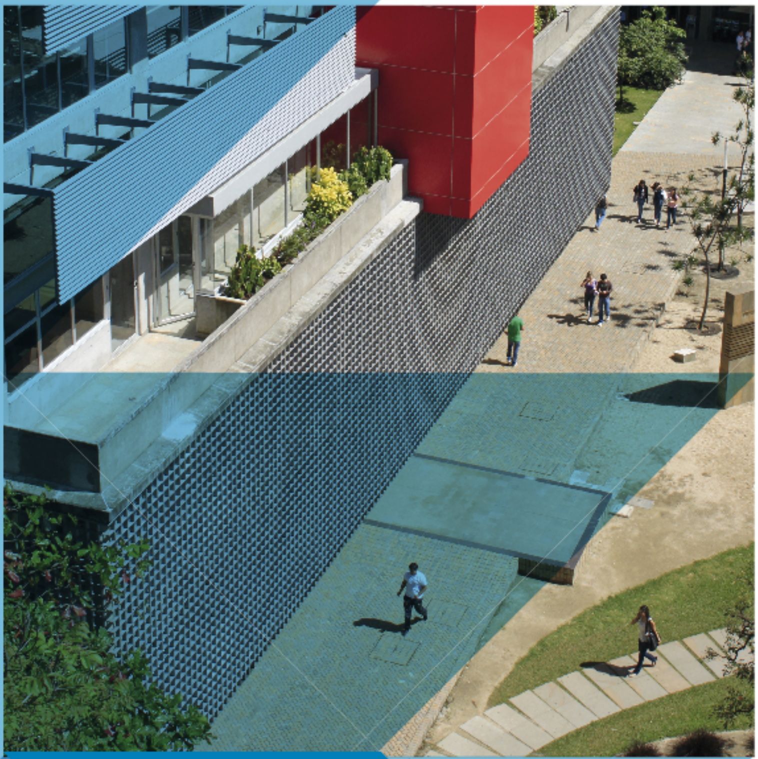

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# Corruption: Transcending borders

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# Corruption: Transcending borders

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**Abstract**

Is corruption capable of spreading across national borders? This paper uses panel data for 120 countries from 1995 to 2012 to evaluate whether the corruption levels of neighboring countries, as weighted by the relative joint border length, affects domestic corruption. Including country fixed effects allows us to control for unobservable country specific aspects and our results suggest a positive and statistically significant relationship. In general, a ten point increase in the weighted *freedom from corruption* index of neighboring countries is associated with a one point increase of the domestic *freedom from corruption* index. This result is robust to a variety of alternative specifications, such as a GMM estimation or including additional control variables. The proposed effect becomes stronger as income increases and the relationship is only positive for countries with a GDP per capita above US$1,600 (in 2000 US$). For the richest countries, the estimated coefficient rises up to 0.43.

JEL Classification: D73, F63, O57, R10
Keywords: corruption, neighborhood effects, panel data

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# 1 Introduction

Neighborhood effects have long been recognized in numerous fields of economics and recently the literature on corruption determinants has caught on. As a variety of cultural aspects do not necessarily recognize national borders, this may also hold for corruption. With the annual costs of corruption estimated to equal 5% of global GDP (US$ 2.6 trillion), it is vital to understand how corruption can be influenced.[1] Thus, if we had convincing evidence for neighborhood effects across national borders, the gains from policies fighting corruption become a new dimension. Recently, Becker et al. (2009) found spillover effects for corruption in cross country studies. Márquez et al. (2011) on the other hand conclude that neighboring countries simply show similar characteristics and corruption does *not* vary with the behaviour of adjoining countries. Thus, the major studies on neighborhood effects in corruption across national borders have not reached a consensus.

The following pages revisit the relationship between the corruption levels of neighboring countries and domestic corruption levels in a panel setting. Becker et al. (2009) and Márquez et al. (2011) use one observation per country in their studies. The main downfall of using a pure cross-sectional study is that one cannot control for unobservable country-specific aspects (see conclusion of Treisman, 2000). However, given unique historical, cultural, and regional characteristics of every single country, this distinction can be important in the context of corruption determinants. The advantages of using panel data with fixed effects have been shown in several macroeconomic topics lately (e.g., for goverment size and openness by Ram, 2009).

Another extension of this paper consists in the number of observations. The mentioned reference papers use 120, 123, and 171 observations, whereas we are able to incorporate over 1,600 annual observations from 120 countries. As Becker et al. (2009) and Márquez et al. (2011) focus on using values averaged over several years (due to the spatial econometric approach), their analyses highlight the mid- to long-term aspect of corruption determinants. However, corruption data shows substantial year-to-year variation within countries. On average, the yearly absolute change in the *freedom from corruption* index (*FFC*) lies at 2.69 points on a scale from 0-100. Further, these changes do not appear to be deviations around a time-invariant country-specific mean. The average absolute difference between the earliest

[1] Estimate from OECD (2013). World Bank president Jim Yong Kim recently labeled corruption "public enemy number one" (World Bank, 2013).

and the most recent observation of a country amounts to 12.69 points on the *FFC* scale in our sample. Thus, using annual observations allows us to capture these within-country variations in corruption levels.

The following section briefly describes our methodology and the data used. Section 3 explains our findings and section 5 concludes.

## 2 Methodology and Data

In order to test potential neighborhood effects of corruption across countries, we use an OLS regression framework, estimating country $i$'s corruption level in year $t$ as:

$$FFC_{it} = \alpha_0 + \alpha_1 NCI_{it} + \alpha_2 \boldsymbol{X}_{it} + \alpha_3 \boldsymbol{Z}_i + \epsilon_{it}. \tag{1}$$

We choose the *FFC* as our dependent variable, provided by the Heritage Foundation, which ranges from 0 (totally corrupt) to 100 (absolute freedom from corruption). The index is available for the years 1995 to 2012, depending on the country, and is mainly built on the Corruption Perceptions Index. Notice that higher values indicate *less* corruption. The *FFC* is mostly built on the Corruptions Perception Index (CPI) and the correlation between the two is almost perfect (0.968). Unlike other corruption indices, the CPI – and thus the *FFC* – incorporates information from both private risk assessments and surveys and has therefore been preferred recently (see Serra, 2006, p. 229, for a deeper discussion). Beyond that, the *FFC* is highly correlated to the Control of Corruption index from the World Bank (0.954).

Our measurement for corruption levels in neighboring countries is the *N*eighbors' *C*orruption *I*ndex ($NCI_{it}$), which will be explained in detail below. $X_{it}$ contains control variables previously found important in determining corruption levels, including GDP per capita (*lngdpcap*), population size (*lnpop*), government size (*gov*), urbanization (*urban*), imports (*lnimp*), and the duration of secondary education (*edu*).[3] We choose the length of secondary education as representative for an educational measurement because of data availability

Additional information is derived from the U.S. Department of Commerce, Country Commercial Guide, 2008 - 2011; Economist Intelligence Unit, Country Commerce and Country Report, 2008 - 2011; Office of the U.S. Trade Representative, 2011 National Trade Estimate Report on Foreign Trade Barriers; and official government publications of each country. Also see Heritage (2013).

[3] Variables beginning with *ln* imply the application of the natural logarithm, as is common for these variables.

throughout the sample period. All the above variables have been consistently found to influence corruption levels in the associated literature (e.g., see Treisman, 2000, Fisman and Gatti, 2002, or Billger and Goel, 2009). Table 1 displays summary statistics and sources.

**Table 1:** Summary statistics.

| **Variable** | **N** | **Mean (Std. Dev.)** | **Min. (Max.)** | **Description** | **Source** |
|---|---|---|---|---|---|
| *FFC* | 1,627 | 43 (24.0) | 4 (100) | Freedom from corruption, ranging from 0 – 100 | Index of Economic Freedom |
| *NCI* | 1,627 | 40.4 (19.4) | 5 (93.5) | Average *FFC* score of neighboring countries, weighted by shared border length | Derived from Index of Economic Freedom and the CIA World Factbook |
| *lngdpcap* | 1,627 | 8.2 (1.6) | 5.0 (11.4) | Natural logarithm of GDP per capita (constant 2000 US$) | World Bank |
| *lnpop* | 1,627 | 16.1 (1.4) | 12.2 (19.6) | Natural logarithm of total population | World Bank |
| *gov* | 1,627 | 15.8 (6.1) | 2.0 (39.5) | General government final consumption expenditure (% of GDP) | World Bank |
| *urban* | 1,627 | 59.5 (22.1) | 7.6 (100) | Urbanization rate | World Bank |
| *lnimp* | 1,627 | 3.7 (0.5) | 2.124 (5.4) | Natural logarithm of imports of goods and services (% of GDP) | World Bank |
| *edu* | 1,627 | 5.6 (1) | 3 (8) | Secondary education, duration years | World Bank |
| *freepress* | 1.5 | 43.4 (23.0) | 5 (99) | Freedom of the press, ranging from 0 – 100 | Freedom House |
| *lntrade* | 1.6 | 4.4 (0.5) | 2.7 (6.1) | Natural logarithm of exports plus imports (% of GDP) | World Bank |

Further, $Z_i$ contains country fixed effects, incorporating any time-invariant aspects of a country. This covers other important corruption determinants, which have been pointed out, such as colony status, legal system, degrees of latitude from the equator, or federal structure (See Treisman, 2000, and Serra, 2006). It also reasonably controls for country characteristics, which only change slowly over time, such as religious or ethnic fractionalization (Dincer, 2008) or the share of protestants in society (e.g., Fan et al., 2009).

$NCI_{it}$ stands for our measurement of the neighboring countries' corruption levels. We use information about the length of shared borders (in kilometers) from the CIA World Factbook (CIA, 2013) to construct the average corruption score of all neighboring countries, weighted by the length of the common land border. For a total border length of $totalborder_i$ of country $i$ and a common border of length $commonborder_{ij}$ with country $j$, the index becomes

$$NCI_{it} = \sum_{j=1}^{k} \frac{commonborder_{ij}}{totalborder_i} FFC_{jt}, \tag{2}$$

assuming $k$ neighboring countries of country $i$. Finally, we exclude islands from the analysis, as we only consider land borders. During our analysis, we also tested for additional spatial autocorrelation (Moran's I test), employing a weighted spatial matrix (Jeanty, 2010). Using a balanced panel from 2001 – 2010 (the test requires a balanced panel) then reveals that we fail to reject the null hypothesis of zero spatial dependence at the 5 percent significance level. Thus, it is unlikely that additional spatial attributes are confounding our analysis.

# 3 Empirical Findings

Table 2 displays our main results from estimating the effect of $NCI_{it}$ on domestic corruption levels, subsequently including control variables. In order to facilitate comparability, all regressions use observations where all explanatory variables are available.

Column (1) only incorporates the $NCI$ as a regressor and we already note an intimate relationship between the two variables. Including country dummies and GDP per capita then highlights the crucial importance of fixed effects, as the Hausman test clearly recommends using fixed effects over random effects. This means that country-specific unobservables, such as cultural, historic, or geographic differences are important in determining corruption levels. The coefficient associated with the $NCI$ remains significant, suggesting a positive relationship between domestic corruption and corruption in neighboring countries. Moving from column (3) to (5), we add the remaining explanatory variables from equation 1. In terms of our main variable of interest, the $NCI$ remains significant, mostly on the five percent level, and settles around a magnitude of 0.1. This means that a rise of the $NCI$ by ten points (say from 60 to 70) would lead to a rise in the domestic $FFC$ index by one point (say from 60 to 61).

With respect to the remaining control variables, we mostly confirm the existing literature. A higher GDP per capita and more education is associated with less corruption. The non-significance of government size could potentially be explained by using annual data, as the low year-to-year variation in government size may not be strong enough to reveal a potential

We also tested for the presence of a nonlinear relationship, including a squared and a cubed term, but none of these ever reach conventional significance levels.

**Table 2:** OLS results.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Dependent variable: *FFC* | | | | | | |
| *NCI* | 0.86*** | 0.10** | 0.10* | 0.10** | 0.10** | -0.78*** |
| | (0.021) | (0.051) | (0.050) | (0.052) | (0.051) | (0.232) |
| *lngdpcap* | | 4.41*** | 4.85*** | 5.64*** | 3.54** | 0.47 |
| | | (1.215) | (1.351) | (1.363) | (1.385) | (1.596) |
| *lnpop* | | | -2.39 | 0.38 | 1.05 | 5.49 |
| | | | (3.077) | (4.022) | (3.946) | (3.983) |
| *gov* | | | | 0.14 | 0.10 | 0.10 |
| | | | | (0.105) | (0.103) | (0.103) |
| *urban* | | | | -0.25* | -0.22 | -0.34** |
| | | | | (0.150) | (0.151) | (0.151) |
| *lnimp* | | | | 0.58 | 0.11 | 0.11 |
| | | | | (1.299) | (1.275) | (1.271) |
| *edu* | | | | | 4.26*** | 4.02*** |
| | | | | | (0.804) | (0.781) |
| *NCI* × *lngdpcap* | | | | | | 0.11*** |
| | | | | | | (0.028) |
| Country fixed effects | | yes | yes | yes | yes | yes |
| Chi$^2$ value of Hausman test[a] | | 32.05*** | 33.16*** | 36.64*** | 55.16*** | 51.54*** |
| *N* | 1,627 | 1,627 | 1,627 | 1,627 | 1,627 | 1,627 |
| # of *Countries* | 120 | 120 | 120 | 120 | 120 | 120 |
| adj. $R^2$ | 0.486 | 0.912 | 0.913 | 0.913 | 0.915 | 0.916 |

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[a]Testing for fixed versus random effects.

relationship. Interestingly, the suggested coefficient is positive, confirming previous findings by Billger and Goel (2009).

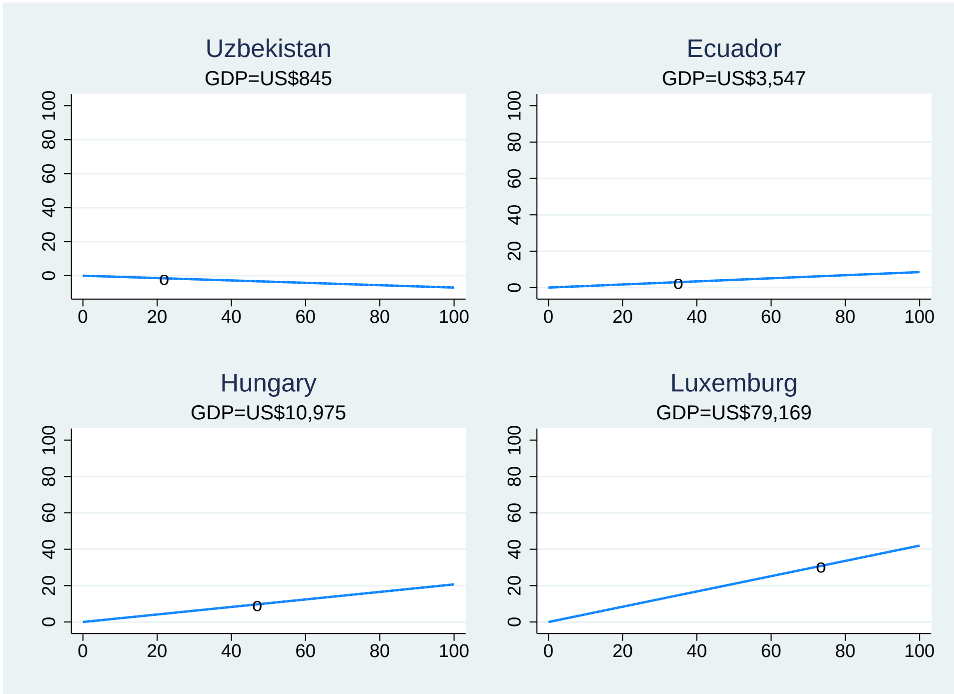
Finally, column (6) introduces an interaction term between the $NCI$ and GDP per capita. As the suggested effect of the $NCI$ on $FFC$ is positive, we also wish to examine whether this effect changes along the lines of other factors. Interestingly, the effect does not vary with the size of international trade or other variables identifying interaction with foreign countries, such as the size of imports, foreign direct investment levels, or common languages. However, richer countries seem to experience a stronger relationship between neighboring and domestic corruption. Column (6) suggests that the positive effect of $NCI$ on $FFC$ sets in for countries with a GDP per capita over about US\$1,600 (lngdpcap = 7.38). In 2012, this threshold level roughly corresponds to countries like Honduras, Mongolia, or Paraguay. One possible reason for this finding is that people may become aware of what happens in surrounding countries as their standard of living rises. For instance, the poorest nations may have neither the opportunity (television, radio etc.) nor the interest in what happens in neighboring countries, simply because they are too worried about their own survival. As income increases, so does the awareness of one's surroundings. However, this interpretation is of course purely speculative.

Figure 1 shows the marginal effect of $NCI$ on $FFC$ at different levels of GDP, representing four sample countries in 2012. A circle in the graph marks the respective country's $NCI$ score in 2012. In the first graph we notice a country whose GDP level is not high enough to offset the $NCI$ effect, causing a negative slope. Thus, an improved $NCI$ would theoretically generate an increase in levels of corruption, although the effect is far from being significant at this level. However, as we gradually increase development levels over Ecuador and Hungary to Luxembourg, the net effect becomes stronger and neighbors matter more. Although speculative, if Hungary had Luxembourg's neighbors, their $FFC$ level would rise by almost 10 points.

# 4 Robustness Checks

Table 3 tests the validity of our main results, using specification (5) of table 2 as a reference point. First, we include an indicator for press freedom and consider a different measurement

The threshold is determined by $\dfrac{\partial freecorr}{\partial NCI} = -0.78 + 0.11 \times lngdpcap = 0$.




*Notes:* x-axis = *NCI*, y-axis = Marginal effect on $FFC$.
circle = $NCI$ score of country in 2012.

**Figure 1:** Marginal effect of *NCI* on $FFC$

for trade. We then move to including an overall time trend and time fixed effects. Finally, the last two columns consider a balanced data set and address potential endogeneity problems by applying a GMM estimator.

First, we follow Brunetti and Weder (2003) by including an indicator for press freedom, provided by Freedom House. We do not include $freepress$ in the main regressions, because we lose observations and, as column (1) in table 3 shows, it does not affect the coefficient of $NCI$ in a notable way. As with government size, it may be that press freedom moves slowly over time and we therefore do not find a significant effect on corruption levels. Column (2) then includes international trade instead of just imports. Although the majority of papers on corruption determinants employ imports (Treisman, 2000, Fisman and Gatti, 2002, or Fan et al., 2009), other studies use total trade as a fraction of GDP, such as Sandholtz and Koetzle (2000) or Knack and Azfar (2003). With respect to the $NCI$, column (2) shows that our results do not depend on which trade measure is used.

Further, including a general time trend or time fixed effects generates similar results for the coefficient associated with the $NCI$. Even with the restrictive framework of two-

**Table 3:** Robustness checks.

| | (1) | (2) | (3) | (4) | (5) Balanced 2001 – 2010[a] | (6) GMM |
|---|---|---|---|---|---|---|
| Dependent variable: *FFC* | | | | | | |
| *NCI* | 0.11** | 0.10** | 0.11** | 0.09* | 0.21*** | 0.26*** |
| | (0.051) | (0.051) | (0.051) | (0.051) | (0.072) | (0.069) |
| *lngdpcap* | 3.16** | 3.34** | 3.98** | 4.01** | 2.31 | 9.45*** |
| | (1.446) | (1.378) | (1.698) | (1.758) | (1.751) | (1.362) |
| *lnpop* | 0.90 | 0.60 | 1.69 | 1.08 | -5.19 | -2.46*** |
| | (4.147) | (3.949) | (4.188) | (4.175) | (4.638) | (0.350) |
| *gov* | 0.19** | 0.10 | 0.10 | 0.09 | 0.36*** | 0.47** |
| | (0.092) | (0.102) | (0.103) | (0.108) | (0.119) | (0.183) |
| *urban* | -0.20 | -0.22 | -0.20 | -0.19 | -0.01 | -0.07 |
| | (0.159) | (0.150) | (0.173) | (0.171) | (0.214) | (0.081) |
| *edu* | 4.58*** | 4.24*** | 4.28*** | 4.32*** | 3.61*** | 1.90*** |
| | (0.832) | (0.804) | (0.811) | (0.794) | (0.963) | (0.693) |
| *lnimp* | -0.73 | | 0.30 | 0.53 | 1.19 | -5.21*** |
| | (1.323) | | (1.320) | (1.410) | ( 1.434) | (1.287) |
| *freepress* | -0.00 | | | | | |
| | (0.038) | | | | | |
| *lntrade* | | 1.17 | | | | |
| | | (1.424) | | | | |
| *year* | | | -0.04 | | | |
| | | | (0.096) | | | |
| Time fixed effects | | | | yes | | |
| Country fixed effects | yes | yes | yes | yes | yes | yes |
| $N$ | 1,541 | 1,627 | 1,627 | 1,627 | 944 | 1,506 |
| # of *Countries* | 118 | 120 | 120 | 120 | 110 | 119 |
| adj. $R^2$ | 0.914 | 0.915 | 0.915 | 0.914 | 0.955 | 0.677 |

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[a]Only using countries for which all variables are available for all years between 2001 – 2010.

way fixed effects, the $NCI$ remains significant with its magnitude only decreasing marginally. Column (5) then considers a balanced panel, as we want to make sure that our results are not driven by outliers or countries with fewer observations. Even though country fixed effects should control for this in the main analysis, this may serve as a useful robustness check, since countries with consecutive observations for all variables from 2001 – 2010 provide more consistency. The significant results from table 2 hold, but now government size is significant, which means an increase in government expenditure causes a reduction in corruption levels (confirming results from Fisman and Gatti, 2002, or Billger and Goel, 2009).

Finally, column (6) uses a generalized method of moments estimator (GMM), addressing potential problems stemming from endogeneity. In the context of the $NCI$, domestic corruption levels can be affected by neighboring corruption levels or vice versa. In the context of other variables, such as GDP per capita, it has been shown that corruption levels also affect development levels (see Mauro, 1995, and Treisman, 2000). The instruments used in this specification are values lagged by one year of all variables, except population size, since past observations are unlikely to be a consequence of present observations. The results from GMM estimations then show that the effect of all variables is significant, except for the coefficient associated with the urbanization rate. Overall, the results displayed in table 3 support our main findings.

## 5 Conclusion

This paper analyses whether corruption in neighboring countries can affect domestic corruption levels, using panel data for 120 countries from 1995 – 2012. Our contribution lies in accounting for country fixed effects and in using a sizeable data set (over 1,600 observations as opposed to between 120 and 171 in reference papers). Both extensions are possible by using annual and newly available data.

Our findings suggest a positive and significant relationship between the level of corruption in neighboring countries and domestic corruption levels, confirming findings by Becker et al. (2009). Our most complete specification suggests a coefficient of 0.1, taking into account the most persistent control variables found in the literature. This means that an increase in the $FFC$ index in neighboring countries (as weighted by their relative shared border) by ten

The GMM results also remain robust to using values lagged by two, five, or ten years.

points, say from 60 to 70 on a scale from 0 to 100, would be associated with a rise in the domestic *FFC* index by 1 point.

Finally, this finding varies across income levels. Specifically, the relationship is only found to be positive for countries with income levels over US$ 1,600 (in constant 2000 US$). Above that level, the effect increases with income. Intuitively, this could mean that citizens of poor countries are either not aware of many aspects in neighboring countries (lack of radio, news outlets, television) or simply have to meet basic needs, so any interactions with neighboring countries are limited. For the richest country in our sample (Luxembourg with a GDP per capita of US$ 87,716), the effect rises up to 0.43.

In terms of policy relevance, these findings suggest that activities aimed at reducing corruption levels within one country may well spill over into neighboring countries, thus producing a positive externality. Given our analysis of yearly observations, this contagion effect may happen quicker as previously thought.

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