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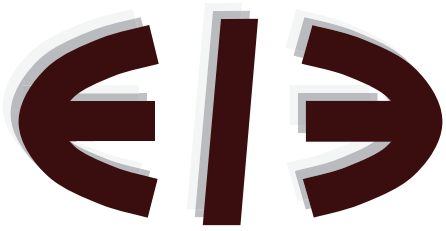

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Abstract

This work provides a new way to analyze of the effect of electoral system and corruption: through its degree of proportionality. It seems the correct way to consider them because their proportionality degree varies under the same PR, plurality and mixed system. Results show that those degrees of proportionality which allow both voters' and opponents' monitors to exercise their power, induce politicians to avoid corrupt behaviour. This happens when we increase plurality elements into PR. But it is beneficial only up to certain proportionality degrees, after which the corresponding level of corruption begins to grow. For governors the choice of their proportionality degree becomes, therefore, fundamental.

JEL Classification: D72, C23
Keywords: Electoral Systems, Corruption, Proportionality degree, Semi-parametric estimation

1. Introduction

Corruption is a widespread phenomenon that is difficult to capture in a single definition. The World Bank's definition of corruption – political and bureaucratic – is the 'abuse of public power for private benefit'. It is generally found in the public sector involving government officials. Corruption is identified as 'the single greatest obstacle to economic and social development'.[1] This is the reason why a growing number of theoretical and empirical papers in economic, social and political literature have studied the causes of corruption. This work advances empirical studies on the political determinants of corruption;[2] in particular, it analyses how the proportionality degree of electoral systems affects corruption.

The role of electoral systems as a way of reducing corruption was first emphasized by Schumpeter (1950). In the following years, the theoretical literature which studied the link between electoral systems and corruption increased, often with ambiguous conclusions (Persson and Tabellini,1999, 2000, 2002; Myerson, 1993). Although empirical studies have confirmed that countries with proportional systems have much more widespread corruption than countries with majoritarian representations, the empirical question on the effects of the electoral system on corruption remains open for three reasons: 1) the difficulties in measuring corruption; 2) the results are not robust to the inclusion of control variables or the use of data from different years (Treisman, 2007); 3) in our knowledge, so far no studies have been made on the effect of the proportionality degree of electoral systems on corruption. Our work concentrates on the last point.

Indeed, previous works have identified proportional (PR), majoritarian and (rarely) mixed electoral systems using dummy variables but this is misleading because they may be designed with different degrees of proportionality even under the same electoral rule. For example, the PR degree of proportionality may vary according to factors such as the precise formula used to allocate seats,[3] the number of seats in each constituency or in the elected body as a whole,[4] and the level of any minimum threshold for election. The same holds for plurality (because some of them have a larger proportional element than others) and, especially, for mixed rules because they combine PR and majoritarian elements in different proportion having very wide range of proportionality degree.

Therefore, in order to consider electoral systems properly, a continuous measure of the degree of proportionality of an electoral rule is needed. The use of the Gallagher disproportionality index as a

[1] The World Bank.

[2] Here, we are referring to *political corruption*; it is defined as the misuse of public office for private financial gain by an elected official (Treisman, 2000).

[3] Ranking PR formulas have been approached both theoretically (Gallagher 1992; Lijphart 1986; Loosemore and Hanby 1971) and empirically (Gallagher 1991; Blondel 1969). The most widely accepted ranking is Lijphart's (1986), which considers the Hare and Droop largest remainder (LR) methods to be the most proportional, followed by the Sainte-Lagu¨e highest-average (HA) method, followed by Imperiali LR, d'Hondt HA, and Imperiali HA.

[4] Generally, the wider the district magnitude, the more proportional the PR.

measure of the proportionality degree of an electoral rule is the first contribution that the present work gives to the empirical literature. Our hypothesis is that, theoretically, the effect of electoral rules on corruption greatly depends on the characteristics of responsiveness and accountability that PR and plurality representations have, respectively. These characteristics define the level of the monitoring power of opponents and voters over politicians and this shapes their incentive to adopt corrupt behaviour. Therefore, the monitoring power of minorities and voters is the key to the interpretation of the correlation between the proportionality degree of an electoral system and corruption. We argue that proportionality degrees reached through certain combinations of PR and plurality elements, place side by side the monitoring power of voters and minorities towards politicians; both the objective that defines the trade-off between representation and the accountability of political parties which characterize the two 'extreme' electoral rules is maximized; it is surely beneficial for the reduction of corruption. Otherwise, variation in the degree of proportionality which leave the two monitoring effects independent each other, may only weaken such effects, and corruption increases.

In terms of the relationship between the proportionality degree of electoral rules and corruption we expect that intermediate proportionality degrees may be correlated to less/high corruption rather than extreme ones. This mathematically translates in a nonlinear curve with corruption taking its minimum/maximum value within the range of proportionality.

The second contribution that this paper offers focuses on empirical methodology. Indeed, we conducted a cross-country analysis over 75 countries from 1984 to 2010 using both parametric and semi-parametric panel data techniques. The latter are, in general, very recent and they have never been employed in this field of literature. The results confirm that electoral systems characterized by intermediate proportionality degree may work better or worse than extreme systems. Graphically, we find that the relationship between the proportionality degree of electoral rules and our measure of corruption (which summarizes the efficiency of government) is a sine curve function; this functional form appears very new and offers an interesting interpretation. Starting from very high degrees of proportionality and shifting to less proportional systems, corruption starts increasing because the lower monitoring power of minorities is not sufficiently substituted by the voters' monitoring. This happens because the proportionality degree is still high. Moving toward always lower proportionality degrees the monitoring power of opponents (ensured by PR elements) is flanked by the increasing monitoring power of voters (ensured by plurality elements), thus resulting in the decrease of corruption. Finally, systems with relatively very low degrees of proportionality, maintain strong plurality characteristics, that is, there is a high accountability of incumbent politicians to voters, while the monitoring of minorities weakens. This provides fertile ground for

corrupt behaviour, causing corruption to start increasing again. The policy implications of such a result are straightforward: one cannot speak of an electoral systems which is better or worse than another in fighting corruption; only certain proportionality degrees characterizing electoral rules assure that corruption could be minimized.

The remainder of this article is organized as follows. The next section summarizes the theoretical and empirical literature on the link between electoral systems and corruption, and clarifies the theoretical framework for the empirical analysis. Then we present a description of data and variables. In section 4 we discuss both the parametric and semi-parametric specifications of the empirical model and the results, followed by the conclusion.

2. The literature and the theoretical framework

The principal agent theory defines the relationship between electoral rules and corrupt behavior of politicians and bureaucrats (Kunikova and Rose-Ackerman, 2005; Persson et al., 2003). Because of the asymmetry of information in the principal-agent relationship, politicians and bureaucrats have opportunities to extract rents; politicians face a trade-off between rent-seeking and appearing incorrupt and honest to their voters in order to increase the probability of re-election and decrease the probability of detection for corrupt behavior. The incentive to extract rent by politicians is affected by the characteristics of electoral rules.

For legislative bodies, electoral rules define how votes are converted into sets of legislators. The basic distinction is between proportional systems (PR) and plurality/majoritarian systems. In PR systems legislative seats are allocated on the basis of the total votes won by each party. More precisely, in an open list PR system, voters may express preferences over particular candidates within a party, while in a closed list PR system party leaders determine the order in which individual politicians are ranked on the party list. Once the total number of seats awarded to a party is determined, that number of politicians from the top of the list are elected. By contrast, in majoritarian systems, the candidate or the party with the greatest number of votes wins all the seats in a district.

There is a general consensus among scholars that an ideal electoral system cannot be designed. It is widely argued that "the choice between majoritarian and proportional elections is a trade-off between accountability and responsiveness" (Persson and Tabellini, 2003). Majoritarian elections have the twin virtues of strength and accountability of the party government. 'Strength' means a single-party government: cohesive parties with a majority of parliamentary seats are able to implement their manifesto policies without the need to engage in post-election negotiations with coalition partners. At the end of their tenure in office governments remain accountable to the electorate, who can remove them if they wish to, but the government is not always responsive to

changes in popular opinion. Proportional elections grant accurate representation of voters' desires, but without the assurance of a clear cut majority governments are less accountable for their decisions.

In the light of such characteristics, theoretical literature has studied the link between electoral systems and corruption according to the *district size* and the *electoral formula*. If the *district size* (i.e. the number of seats in a district) is considered, in majoritarian systems characterized by small districts with only one candidate in each, the incumbent (who is already well known in the constituency) is more likely to reach a relative majority. However, in a proportional system, large districts that appoint several candidates are more likely to push aside new candidates who got a minority of votes. Myerson (1993) and Ferejohn (1986) showed that small districts increase the barriers to entry. Therefore, PR with a large district magnitude tend to have smaller barriers to entry and stiffer competition, leading to smaller incumbent rent. Referring to the *electoral formula* (i.e. how votes are translated into seats), when voters vote for an individual candidate, there is a direct link between individual performance and individual reappointment because voters base the valuation of their representatives on their ability to represent interests of the community. Thus the incumbent faces strong incentives to perform well in order to maximize the probability of re-election. However, when voters vote for a list the chances of re-election depend on the candidate's rank in the list, and so each candidate has a weaker incentive to perform well. Therefore, according to that dimension of the analysis, the incentive for corruption in a PR is higher than in a majoritarian system (Persson and Tabellini (1999; 2000; 2002). The empirical works of Persson, Tabellini and Trebbi (2003), Gagliarducci, Nannicini, Naticchioni, (2011) suggest that countries with proportional systems have much more widespread corruption than countries with majoritarian systems. Kunicova and Rose Ackerman (2005) find that closed lists PR are more corrupt than open lists PR, and both are more corrupt than plurality systems. Golden and Chang (2001) and Chang (2005) conclude the opposite: open list PR and plurality systems could lead to more corruption than closed list PR. Golden and Chang (2007) show that the previous relationship fails to hold up once district magnitude is under a certain threshold.

The common features of those empirical papers are, firstly, to consider mixed systems marginally or not and, secondly, to identify electoral systems always with a dummy variable, neglecting their proportionality degree.

With regard to the first feature, mixed electoral rules, like PR and plurality representation, can be designed with different degrees of proportionality. In particular, one may think of mixed electoral systems like those systems characterized by an intermediate proportionality degree with respect to the extreme PR and plurality representations. Mixed systems uses both PR and plurality features for

elections to the same legislative body, that is, some members are elected nominally and others from a party list. Nowadays, the study of those mixed rules are becoming an interesting topic in political science literature because more and more countries are adopting them. Kostadinova (2002) argues that mixed systems allow countries to enjoy the benefits of minority representation (within the Parliament) and, at the same time, they produce less fractionalization than proportional systems. Mixed rules are usually adopted with the hope that the advantages of both extreme electoral designs can be enjoyed in a 'best of both worlds' scenario (Shugart and Wattenberg, 2001). Therefore, in recent years, the interest on the part of political and economic scientists to explore the effects that electoral systems have on economic and political variables has grown because of the need to properly analyze mixed rules.

About the second feature and according to that just said above, electoral systems are heterogeneous categories. Ideally, one can locate the various possible electoral systems on a continuum from the most to the least proportional. The correct way to consider electoral systems is to measure their proportionality by using a continuous measure of the proportionality degree. Political literature provides the Gallagher disproportionality index of electoral outcomes (see section 3).

Our theoretical framework in the analysis of the link between the degree of proportionality and corruption is based on the characteristics of electoral rules; they shape the rent seeking incentive of politicians which depends on both the probability of re-election and the probability of detection for corrupt practices. The higher accountability of plurality rules makes voters the monitor of politicians while the higher representativeness of PR rules makes opponents/minorities the monitor of politicians. We argue that for certain proportionality degrees, the monitoring power of voters and minorities coexist, balancing the trade-off between accountability and responsiveness that reduces corruption. Otherwise, if the variation in the degrees of proportionality maintains the responsiveness of PR and accountability of majoritarian representation independent, they weaken their effect in fighting corruption. If our argument is correct, empirically we should find a non-linear relationship between the proportionality degree and corruption which shows both minimum and maximum levels of corruption in correspondence to electoral systems with an intermediate degree of proportionality.

3. Data and variables

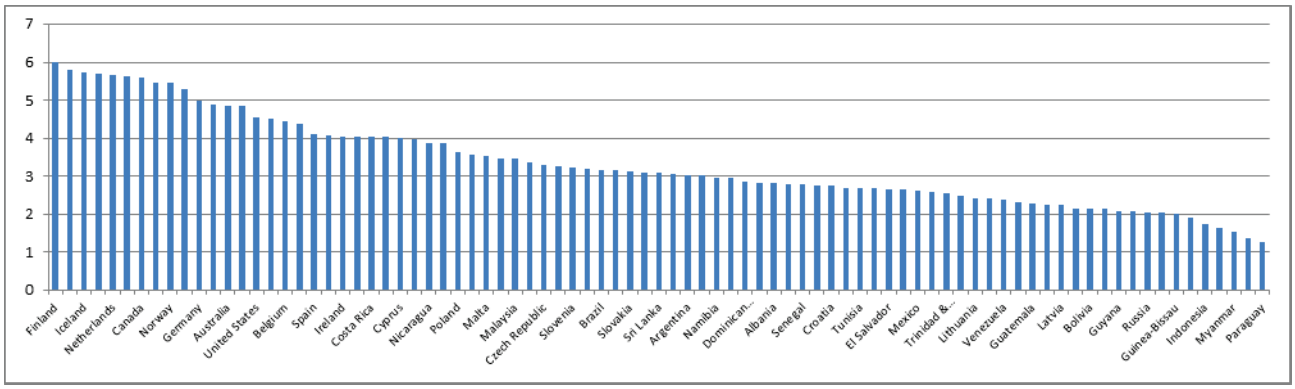
The dependent variable of our empirical analysis is a measure of corruption. At a macroeconomic level, the three most popular indices based on corruption perception are the Corruption Perception Index (Transparency International), the Control of Corruption index (the World Bank) and the Corruption index (the International Country Risk Guide - ICRG). We choose to measure corruption using the Corruption index because the database of the ICRG provides the longest time series of

corruption data (from 1984 to 2010;[5]) for about 150 countries. Moreover it is highly correlated with the two other corruption indices mentioned above.

The Corruption index (thereafter *Corr*) is expressed on a scale reflecting the perception of respondents. The Corruption index is based on comparable information done by assigning a risk point between the interval [0, 6] where 0 represents the highest risk of corruption and 6 the lowest.

Figure 1 shows an overview of the corruption distribution for different countries. For each country in the figure we calculated the mean over years (1984-2010). To the left with a high index value (meaning low corruption risk) we find the Scandinavian countries and the three countries of Oceania (Australia, New Zealand and Papua New Guinea). European countries in the dataset show low/medium level of corruption while countries in Asia, Africa and South America have the highest value.

Fig 1. Mean of Corruption index over years



The main regressor of the analysis is the Gallagher disproportionality (of the electoral outcome) index; this is especially useful for comparing proportionality across electoral systems. The Gallagher index (or least squares index) is a representation index of political parties within a Parliament; it may be considered as a very good proxy for the measure of proportionality of an electoral system because of the link between the kind of electoral system and the kind of political parties representation. Indeed, theoretical literature states (see Persson and Tabellini, 2000) that the electoral system that guarantees a greater representation of political parties is a more proportional one while the less representative one is less proportional. Blais (1988) confirmed that it is possible to classify electoral systems according to their electoral outcomes. Moreover, empirical studies have shown that a majoritarian system produces a higher level of dis-proportionality than a proportional representation system (Lijphart, 1994; Anckar and Akademi, 2001), whereas a mixed-electoral system produces an intermediate level (Powell and Vanberg, 2000; Anckar and Akademi, 2001). The Gallagher index (thereafter *GI*) is constructed as

[5] ICRG table 3B, published by The PRS Group.

$$GI = \sqrt{\frac{1}{2}\sum_i (v_i - s_i)^2}$$

where v_i and s_i are respectively the share of votes and of seats of a single political party (i=1,....,n political parties) at elections in each country in the time span under consideration.[6] The index can take values from 0 to 100 with 0 indicating perfect proportionality between seats and votes and 100 meaning that the only seat at stake goes to the winner. Clearly the bounds of the *GI* (0 and 100) are only theoretical values. The *GI* between the investigated countries ranges from 0.26 to about 33.[7] Countries in the database that have experienced plurality, PR and mixed systems fall in this range, as shown in table A.1 (Appendix A). In the time span 1980-2011, some countries maintained the same electoral system while other countries changed it. In table 1 below we provide the descriptive statistics of *GI* according to the three electoral rules. It can be noticed that the mean of *GI* within PR is lower than that within the mixed system and, in its turn, is lower than that within plurality; it confirms that *GI* is a good proxy for electoral systems. But, looking at the range of variation of the *GI* within the three systems, it can happen that, for the same value of *GI*, electoral systems overlap. This happens because the *GI* is a proper representation index. The upper bound of the *GI* (33.25) is very far from the theoretical value of 100 of perfect disproportionality. This means that also countries under plurality rules have a relatively strong proportionality. Therefore, the distribution of the *GI* says that all the three systems have a certain degree of proportionality; moving from PR to majoritarian systems, the proportionality degree decreases because more and more plurality elements are present.

Table 1: *GI* statistics according to electoral systems, 1980-2011

PR				MIXED				PLURALITY			
Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
4.6	4.4	0.26	29.4	7.8	4.9	0.91	30.2	14.4	7.5	1.3	33.25

The literature studying the causes of corruption names a long list of variables claimed as statistically significant determinants. They can be divided into four groups: 1) economic and demographic, 2) political, 3) judicial and bureaucratic, 4) religious and geo-cultural (de Haan and Seldadyo, 2005). A typical empirical study limits its attention to a small number of variables of particular interest. Unfortunately, it is almost impossible to find the 'true determinants' of corruption: a variable found significant in a particular specification of the model becomes insignificant in an alternative model, or when other variables are incorporated. In our empirical model, we will include control variables that belong to the four groups mentioned above. We start

[6] http://www.tcd.ie/Political_Science/staff/michael_gallagher/ElSystems/Docts/ElectionIndices.pdf.
[7] See table 2 of the descriptive statistics.

by including the first three control variables in the list below and, in order to test the robustness of results, we add a set of control variables believed as the most robust determinants of corruption. The full list of control variables is the following:

- Per capita GDP, in natural log (thereafter *lngdp*): it controls for structural differences in economic development (de Haan and Seldadyo, 2005). By far the strongest and most consistent finding of the new empirical work is that lower perceived corruption correlates closely with higher economic development (La Porta et al. 1999, Treisman, 2000) and it can be found in each region of the world (Treisman 2007). Kaufmann et al. (1999) and Hall and Jones (1999) question the causal relationship between corruption and income: the per capita GDP is high because of low corruption. For this reason we treat *lngdp* as endogenous. We choose the population rate of growth (thereafter *deltapop*) as instrumental variable for the per capita GDP.
- Government stability (thereafter *gov_stab*): it controls for quality of government. The higher the quality of government, the lower the probability of corruption (de Haan and Seldadyo, 2005). For this variable there is not presumption of endogeneity; therefore we treat it as strictly exogenous.
- Democratic accountability (thereafter *dem*): it controls for the level of democracy of a country. There is a general consensus that democracy reduces corruption (de Haan and Seldadyo, 2005). We treat this variable as strictly exogenous.
- Women (thereafter *wom*): it is the proportion of seats held by women in national parliaments (%); it controls for the gender dimension of corruption. Conventional wisdom states that women in public life can be an effective anticorruption strategy because women are less corruptible than men. Studies have confirmed that there is a link between higher representation of women in government and lower levels of corruption (Dollar et al., 1999; Goetz, 2004; Sung, 2003). We treat this variable as strictly exogenous.
- Trade openness (thereafter *export*) negatively affects corruption (Fisman and Gatti, 2002; Bonaglia et al., 2001). It is proxied by the share of export/GDP and is treated as exogenous.
- General government consumption expenditure (thereafter *G*) – in % of GDP: it controls for government size. There is no consensus among authors on the theoretical relationship between government size and corruption (Fisman and Gatti, 2002; Bonaglia et al., 2001; Ali and Isse, 2003). We treat this variable as strictly exogenous.
- Net enrollment primary rate, in natural log (thereafter *lnschool*): it controls for human capital development. Empirical literature found contrasting evidence (Ali and Isse, 2003; Frechette, 2001). We treat this variable as strictly exogenous.

- Ethno-linguistic fractionalization (thereafter *ethnic*), as cultural variables, tends to increase corruption (Lederman et al., 2005; La Porta et al., 1999). We treat this variable as strictly exogenous.

Table 2 below shows the descriptive statistics of all the variables.[8]

We follow the standard practice of counting a country as democratic according to its rate of Polity IV political freedom score. Polity IV provides data on democracy level and regime duration. The Polity IV index is a combined polity score ranging from -10 (strongly autocratic) to +10 (strongly democratic). Two different thresholds are frequently used for this purpose: the strictest measure defines countries which score 6 or higher on the combined index (Raknerud and Hegre, 1997) as democratic, whereas more lenient studies have taken score 3 as their threshold (Gleditsch and Hegre, 1997). In this work, we follow the latter example and define as a democracy the countries whose score of Polity IV index is greater than +3 in the year of election.

Table 2: Statistics

Variable	Mean	Std. Dev.	Min	Max	Observations
corr	3.39	1.42	0	6	n = 85; T = 25
GI	7.64	6.54	0.26	33.25	n = 85; T = 23
lngdp	8.26	1.46	4.9	10.9	n = 83; T = 31
gov_stab	7.63	2.01	1	11.5	n = 85; T = 25
dem	4.92	1.79	0	11.5	n = 85; T = 25
wom	14.4	10.1	0	47.3	n = 84; T = 28
export	0.27	0.3	2.93e-06	6.85	n = 80; T = 31
G	0.18	0.08	0.03	1.55	n = 81; T = 31
lnschool	4.48	0.2	2.9	4.6	n = 81; T = 18
ethnic	0.37	0.23	0	11.5	n = 83; T = 32

4. Econometric specifications and results

The empirical analysis is twofold: parametric and semi-parametric

4.1 Parametric and semi-parametric analysis

We start with a description of the parametric specification of the model. In order to test the hypothesis specified in section 2 we choose a cubic specification of the link between corruption and the proportionality degree of the electoral system as the more general nonlinear function. Therefore, the estimated equation is

$$corr_{i,t} = \sum corr_{i,t-j} + \beta_1 GI + \beta_2 GI^2 + \beta_3 GI^3 + \sum \delta\, regressors_{i,t} + \alpha_i + \mu_t + \varepsilon_{i,t} \quad (1)$$

of country i at time t; α_i is a country-specific effect, μ_t is a time-specific effect. Two lags of the dependent variable are introduced because of the dynamics of corruption. Indeed, previous empirical analyses on corruption consider corruption as a dynamic phenomenon where past levels of corruption affect present levels (Aidt, 2003). The linear, quadratic and cubic terms of *GI* catch

[8] Table A.2 and A.3, Appendix A, provides respectively the detailed description of all the variables and the correlation matrix of regressors.

the nonlinear specification of the model. The other regressors are those described in the previous section.

Equation (1) is a dynamic panel data model which has been estimated using Arellano-Bover (1995)/Blundell-Bond (1998) system GMM panel data techniques.[9] The empirical analysis has been conducted on a panel of 75 countries over 27 years (from 1984 to 2010).

An important issue here is to deal with the possibility of endogeneity of the Gallagher index. All the theoretical literature studying the link between electoral rules and corruption considers the first as a *determinant* of corruption and not the reverse. In this respect two other considerations must be made: 1) it seems unlikely to think that the perception of corruption (as a menace to foreign investments as the Corruption index means) may affect the way in which electoral systems are designed by politicians; 2) if the electoral system were affected by corruption, the choice of one electoral rule rather than another would be a statement of corruption for incumbent politicians and they would risk dismissal from office. However, an endogeneity problem may arise when dealing with political institutions, that is, there may be some omitted factors that influence electoral systems and simultaneously influence corruption.

In order to verify the exogeneity of *GI* we perform the C test (or the "difference in Hansen test") on the *GI* variable. Under the null, the Hansen statistic tests the validity of a subset of orthogonality conditions. To perform the *C* test we have to estimate two models, one where *GI* is exogenous and another where the *GI* is endogenous. The estimation of the first model gives us a Hansen statistic (called H1) and the estimation of the second model gives us another Hansen statistic (called H2). We need to use the same set of exogenous instruments for both estimations, that is we have to assume that all the other orthogonality conditions hold, i.e. all the other included and excluded instruments remain exogenous. H1 and H2 are both distributed as a Chi^2 with the dof of H2 smaller than the dof of H1. The *C* test on *GI* is simply a test of H1-H2. The test statistic H1-H2 is distributed as Chi^2 with dof equal to the number of regressors being tested for endogeneity (in our case 3, *GI,* GI^2 and GI^3). If they are endogenous, then H1-H2 will be high because H1 is high while H2 is not. In order to deal with the general endogeneity issue, system GMM treats the model as a system of equations—one for each time period—where the predetermined and endogenous variables in first differences are instrumented with suitable lags of their own levels. As IV for the *GI* we also use the year of independence of a country. Indeed, we may argue that during the independence period countries build legal, economic and social structures, write constitutions, choose influential leaders, establish political institutions, and choose electoral system. Therefore, after the fight for independence each country starts a process of nation formation which determines,

[9] We used the Stata command *xtabond2* provided by David Roodman (Roodman, 2009).

among others, the levels of legislative representation preferred through an electoral system in order to guarantee each other the right to participate in the institutional development. It is reasonable to believe that, after some years from independence, politicians agreed to increase the degree of proportionality (lowering thresholds or entry barrier) to improve the efficiency of the government system (Boix 1999). Thus, the date of independence can be considered an exogenous instrument, that is, a variable that is correlated with the endogenous regressor and orthogonal to the error term.

To support the above reasoning about the validity of the independence date (thereafter *indepdate*) as IV for the Gallagher index, following Clougherty and Seldeslachts (2013), we provide a simple diagnostic test where the result is shown in table A.4 (Appendix). We estimate random effects panel data regressions of *GI* on *indepdate, indepdate*^{2} and *indepdate*^{3}.[10] The last raw of table A.4 shows the Wald test that *indepdate, indepdate*^{2} and *indepdate*^{3} are jointly significantly different from zero. The Wald test is distributed as a Chi^2 (in parentheses there is the p-value). The null hypothesis of the Wald test is that lags are jointly equal to zero; for every regression in table A.4 the null is rejected at 1%.

Moreover, we may test the over-identifying restrictions in order to provide further evidence of the instruments' validity (Baum et al., 2003). After the estimation of equation (1), if the Hansen test improves with the additional instruments, it indicates that these instruments influence corruption only indirectly via the Gallagher index. See table A.5 in Appendix. We estimate equation (1) with and without *indepdate, indepdate*^{2} and *indepdate*^{3} as IV. Column (b) and (b') show respectively the results of two estimations; the last column of table A.5 displays the Chi^2 (and the p-value) of the Hansen test whose null is that the over-identification restrictions are valid. As we can see, the Hansen test in (b) is better than in (b') confirming that *indepdate, indepdate*^{2} and *indepdate*^{3} are good instruments for the Gallagher index.

The two checks just performed above about the validity of the independence date as IV allow now to assess the exogeneity of *GI* through the C test. We will show and comment the result of the C test later in the results paragraph.

In order to control for heteroskedasticity, every estimated equation has cluster-robust standard errors. The second-to-last row of table 7 shows the Chi^2 (and the p-value in parenthesis) of the Hansen test whose null hypothesis is that over-identification restrictions are valid; we do not reject the null and the model can be considered correctly specified.[11] The last row of table 7 displays the

[10] In those estimations we introduce *dem* and *gov_stab* as strictly exogenous regressors and all the IV, *indepdate, indepdate*^{2}, *indepdate*^{3} and *deltapop*. If we include in the estimation all the exogenous regressors, nothing changes.

[11] We also compute, but we do not show, the difference-in-Hansen test in order to test the joint validity of the full instrument set; we do not reject the null.

p-value of the Arellano-Bond test for second-order autocorrelation in the first differenced residuals: in all the specifications there is no autocorrelation of residuals.

The previous parametric analysis of the relation between corruption and Gallagher index assumes a cubic polynomial functional form. A more general approach to the estimation of non-linear models is a non-parametric regression that does not require the specification of the underlying functional form (Li and Racine, 2007).

The parametric analysis of corruption takes advantage of a rich econometric specification. A dynamic model for panel data accounts for the persistence of corruption, its lagged response to explanatory variables and residuals autocorrelation. Furthermore, some of the explanatory variables can be endogenous. Non-parametric methods for panel data are not as well developed as the parametric ones, and a dynamic model like (1) can hardly be estimated in a non-parametric setting. It is well known how a full non-parametric analysis faces the "curse of dimensionality" given by the rate of convergence of estimators being inversely related to the number of covariates. A widely accepted answer to this problem is provided by semi-parametric models where some components enter with a non-specified functional, while others are parametric. Here we apply the methods of Baltagi and Li (2002) to the panel data model:

$$y_{i,t} = x'_{i,t}\gamma + g(z_{i,t}) + \mu_i + v_{i,t}, \qquad i = 1, \dots\dots, N; t = 1, \dots\dots, T \qquad (2)$$

where $x_{i,t}$ is a vector of explanatory variables, $z_{i,t}$ is a variable with a nonlinear relation to the dependent variable, μ_i denotes fixed effects and $v_{i,t}$ are i.i.d random errors. The function $g(z_{i,t})$ is not specified.

Model (2) can be transformed by taking the first difference to eliminate individual fixed effects. The new equation contains a non-linear component $g(z_{i,t})$-$g(z_{i,t-1})$ that represents the main problem for model estimation. The solution advanced by Baltagi and Li (2002) is to approximate $g(z)$ with the series $p^k(z)$, where $p^k(z)$ is the vector of the first k approximating functions. This implies that $g(z_{i,t})$-$g(z_{i,t-1})$ is approximated by $p^k(z_{i,t})$-$p^k(z_{i,t-1})$. Spline functions are among the most used to approximate an unknown function. Splines are piece-wise polynomial functions defined over intervals of the support of z delimited by $1,\dots,k$ knots. The methodology advanced by Baltagi and Li (2002) proceeds with the estimation of the parameter vector γ with the series method. This estimate is used to build an estimate of the error component $v_{i,t}$ that becomes the dependent variable in the non-parametric estimation of $g(z_{i,t})$.

We use this panel regression method to estimate a model of corruption where we distinguish a non-parametric component $g(GI_{i,t})$ and a linear relationship between a set of control variables and the corruption index. In order to concentrate our analysis on the non-parametric relationship, we make some simplifying specification choices. The model is static, aiming at an estimation of the long-run

relationship. Questions with omitted dynamics are tackled with the use of country time series made up of five-years averages and the introduction of time dummies among regressors. The use of time averages also has the advantage of reducing the attenuation bias which derives from possible measurement errors in the variables.

4.2 Results

In order perform the *C* test, table 3 below shows the parametric estimation of equation (1). Column (A) and (A') displays the estimations where *GI*, GI^2 and GI^3 are treated respectively as exogenous and endogenous (only with *lngdp*, *dem* and *gov_stab* as control variables). This allows us to calculate the statistic (H1-H2). It is distributed as a Chi^2 with dof=3 and it is equal to 6.82. Looking at the critical value of the Chi^2 distribution with 3 dof, the test says that at 1% and 5% we do not reject the null (*GI* is exogenous) while at 10% we reject the null (*GI* is endogenous). However, in both cases, the coefficients of *GI*, GI^2 and GI^3 are significant. When we gradually introduce all the control variables mentioned above (as from specification (B)), the coefficients of *GI*, GI^2 and GI^3 remain significant only when they are treated as exogenous, and (H1-H2) becomes smaller confirming that the Gallagher index is exogenous.[12] This is the reason why the specifications from (B) to (F) in table 3 are estimated with *GI*, GI^2 and GI^3 exogenous.

See (A). The coefficients of *GI*, GI^2 and GI^3 are all highly significant, as well as the two lags of *corr* and all the included control variables. In order to graph the effect of the *GI* on corruption, we use the following long-run equation:

$$corr = -\frac{0.05}{0.07}GI + \frac{0.004}{0.07}GI^2 - \frac{0.0001}{0.07}GI^3 + \frac{0.04}{0.07}lngdp + \frac{0.02}{0.07}dem - \frac{0.04}{0.07}gov\_stab \qquad (3)$$

[12] We do not show the estimations with *GI*, GI^2 and GI^3 endogenous. They are available upon request. In the notes at table 2, for every specification, we display the (H1-H2) statistic.

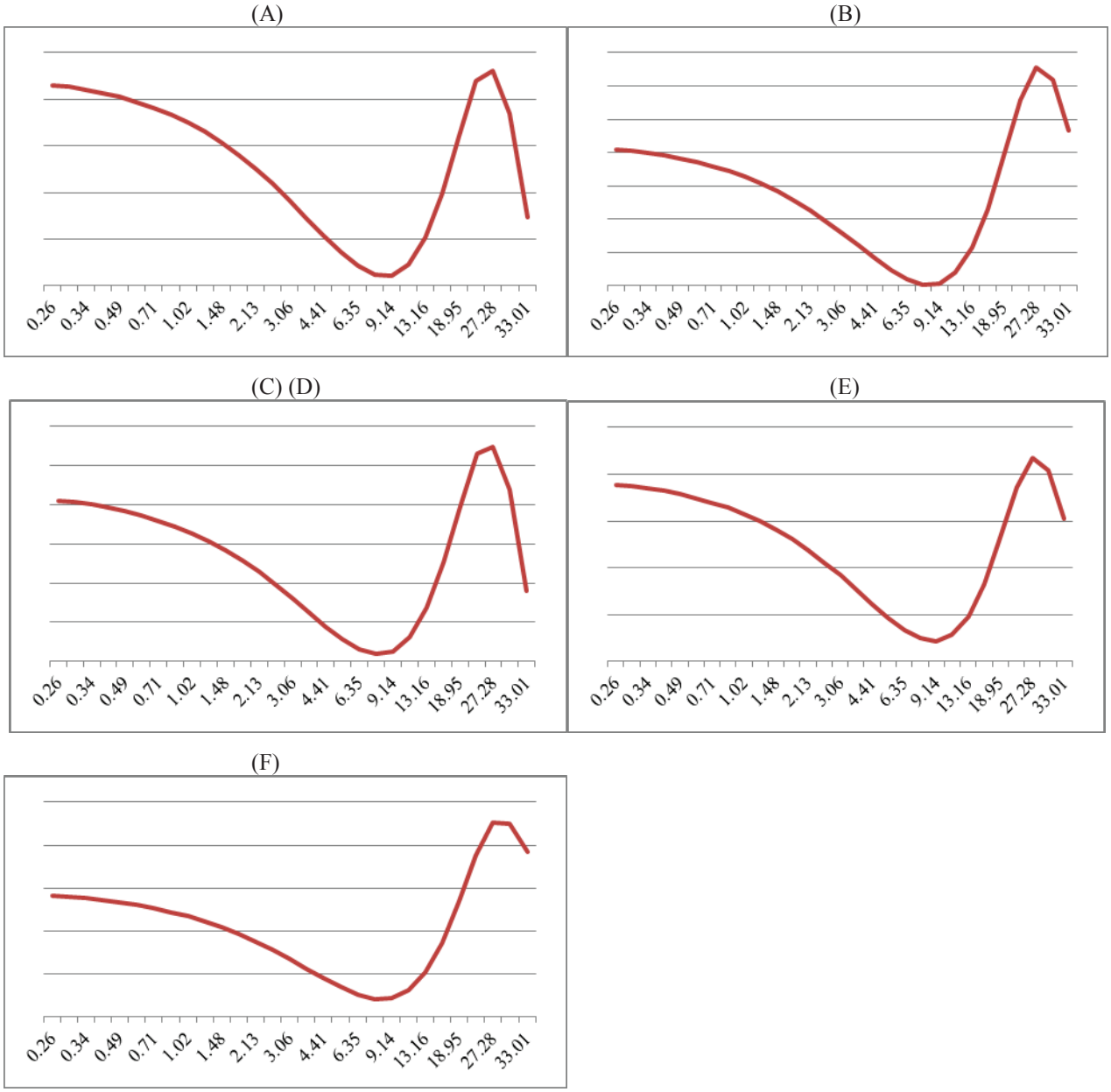
Table 3: Parametric estimations. Dependent variable: *GI*

	(A)	(A')	(B)	(C)	(D)	(E)	(F)
corr(-1)	1.14***	1.04***	1.09***	1.08***	1.07***	1.15***	1.08***
	(22)	(13)	(16)	(16)	(16)	(12)	(15)
corr(-2)	-0.21***	-0.22***	-0.21***	-0.20***	-0.20***	-0.24***	-0.2***
	(-5.2)	(-5.8)	(-5)	(-4.8)	(-4.8)	(-3.7)	(-4.8)
GI	-0.05**	-0.2**	-0.06*	-0.06*	-0.06*	-0.09**	-0.07*
	(-1.97)	(-2.5)	(-1.82)	(-1.95)	(-1.78)	(-2.04)	(-1.93)
GI^2	0.004*	0.02**	0.004*	0.005*	0.005*	0.006*	0.005*
	(1.93)	(2.4)	(1.83)	(1.91)	(1.78)	(1.91)	(1.89)
GI^3	-0.0001*	-0.0004**	-0.00009*	-0.0001*	-0.0001*	-0.0001*	-0.0001*
	(-1.86)	(-2.3)	(-1.76)	(-1.77)	(-1.67)	(-1.68)	(-1.76)
lngdp	0.04**	0.06*	0.05**	0.05***	0.05**	0.07	0.06**
	(2.01)	(1.7)	(2.06)	(2.6)	(2.4)	(1.4)	(2.13)
dem	0.02*	0.03**	0.03**	0.03***	0.03***	0.03**	0.03***
	(1.7)	(2.05)	(2.2)	(2.8)	(3)	(1.96)	(2.9)
gov_stab	-0.04*	-0.02	-0.04	-0.04	-0.04	-0.08**	-0.04
	(-1.74)	(-0.7)	(-1.5)	(-1.5)	(-1.4)	(-2.01)	(-1.6)
wom			0.002	0.002	0.002	-0.001	-0.002
			(0.83)	(0.9)	(1)	(-0.4)	(-0.7)
export				0.01	0.02	-0.05	0.03
				(0.3)	(0.6)	(-0.1)	(0.07)
G					-0.002	-0.005	
					(-0.7)	(-1)	
lnschool						-0.15	
						(-0.45)	
ethnic							0.04
							(0.45)
Time dummies	yes	yes	yes	yes	yes	yes	yes
N. obs.	1340	1367	1295	1242	1242	859	1252
N. instrum	39	36	40	43	44	45	44
Chi^2 (dof) (p-value	7.72 (6) (0.26)	0.9 (3) (0.8)	5.8 (6) (0.4)	5.4 (8) (0.7)	6.04 (8) (0.6)	6.08 (9) (0.7)	5.37 (8) (0.7)
p-value 2nd order autocorrelation	0.1	0.3	0.1	0.13	0.13	0.5	0.13

Notes. All regressions contain calendar year dummies (results not reported); the time span is 1984-2010. The dependent variable is *corr*. Standardised normal z-test values are in parentheses; cluster-robust standard errors. *lngdp* is treated as endogenous in every specification and it is instrumented with the population rate of growth. In (A') *GI*, GI^2 and GI^3 are treated as endogenous and they are instrumented with *indepdate, indepdate*^{2} and *indepdate*^{3}; in all the other specifications they are treated as exogenous. For (B): (H1-H2)=5.07; for (C): (H1-H2)=3.79; for (D): (H1-H2)=3.67; for (E): (H1-H2)=3.32; for (F): (H1-H2)=3.63. Significant coefficients are indicated by * (10% level), ** (5% level) and *** (1% level). Two-step estimations with Windmeijer (2005) correction.

In figure 2 below, on the horizontal axis we have constructed a scale of disproportionality index values starting with the minimum value (among countries) and increasing it by 1.1 to the maximum value; then we calculate the Corruption index according to equation (3) using the estimated coefficients of *GI*, GI^2, GI^3, *lngdp, dem* and *gov_stab*. In figure 2 we graph the relationship between the Corruption index and the Gallagher index for every specification in table 3.

Figure 2: Parametric fit of the relationship between corruption and the Gallagher Index



From the graph above, it emerges that the relationship between the proportionality degree of electoral system and corruption has a minimum and maximum value. The value of *GI* which maximizes the Corruption index (that is, which minimizes the level of corruption) is about 25, while the value of *GI* which minimises the Corruption index (that is, which maximizes the level of corruption) is about 8. This shape of the proportionality degree-corruption relationship offers an interesting interpretation. Initially, moving from the extreme left of the horizontal axis towards the right, while the very high proportionality degree of the electoral system slightly reduces, the Corruption index decreases (corruption increases) to its minimum value. It is reasonable to believe that this happens because the degree of proportionality remain high even after its reduction, implying the reduction of the monitoring power of opponents without introducing the voters'

monitoring on incumbent politicians (because no plurality element are added). That means fertile ground for corrupt actions.

Instead, is also reasonable to believe that *GI* starts increasing (for example, it goes beyond 8, according to our estimations) and then, that the proportionality starts decreasing, when electoral rule adds some plurality characteristic to the present PR characteristic. This means that the monitoring power of opponents (ensured by PR elements) is reinforced by that of voters' (ensured by plurality elements): the effects of responsiveness of PR and accountability of majoritarian representation, put together, are stronger at fighting corruption. This can be clearly seen in figure 2 starting from the *GI*=8; the Corruption index begins to grow as the *GI* rises up to the value of about 25 which maximizes the Corruption index. After reaching its maximum, the Corruption index decreases again. It is interesting to underline that in the increasing section of the Corruption index in figure 2 (which corresponds to the interval of *GI* [8-25]), the small reduction in the proportionality degree of implies that the marginal substitution between the monitoring power of opponents in favor of the monitoring power of voters is beneficial in fighting corruption. While considering electoral rules with a lower proportionality degree (*GI*>25), the same marginal substitution leads to a corruption increase: we can think that this happens because the monitoring power of opponents weakens too. To summarize, as figure 2 shows, we can find a value of the *GI* which maximizes the Corruption index (meaning minimising the level of corruption). This suggests that the 'best' proportionality degree that an electoral system should have must almost guarantee together the voters' and the opponents' monitoring power in order to re-enforce each other. Instead, proportionality degree such that the two monitoring powers maintain their independence are fertile ground for corrupt behavior for politicians. We check this result with the data; that is, we take the mean of the Corruption index of countries whose value of the *GI* is respectively around 8 and around 25. The first group of countries has a Corruption index mean of about 2.6 and the second group of countries about 3.2. This confirms our result. Looking again at table 1, the degree of proportionality which maximizes the corruption index (about 25) is more likely to characterize mixed as well as plurality systems. This is not surprising: those systems have, in any case, proportional characteristics which are put beside plurality elements. On the contrary, very high values of the *GI* are most likely to characterize PR systems where plurality elements are almost absent.

This result remains robust with the introduction of all the control variables that we listed above, as shown in table 2.[13]

[13] Every specification in table 2 are estimated by the two-step options with Windmeijer (2005) correction. Windmeijer (2005) finds that the two-step efficient GMM performs somewhat better than one-step in estimating coefficients, with lower bias and standard errors. And the two-step estimation with corrected errors are superior to robust one-step.

lngdp is always positive and significant (except in (E)) as expected, meaning that a greater level of economic development is correlated to less perceived corruption. *dem* is always positive and significant: the greater the level of democracy of a country, the lower the level of corruption. *gov_stab* is significant only in two specifications and it is negative; the sign does not confirm what we expected. Gradually introducing all the described control variables does not change the sign and the significance of the *GI*, GI^2, GI^3, but they are never significant.

The estimation of the parametric model (1) provided us with a peculiar non-linear relationship between the Gallagher disproportionality index and the Corruption index. We conducted a semi-parametric in order to confirm this particular functional form. Since endogeneity of *GI* has been ruled out by the *C*-test previously conducted, in the semi-parametric model we consider the variable of interest *GI* entering the regression equation as exogenous. However, we depart from that econometric specification by including in the linear component of the model only those variables that can be considered exogenous, on the basis of the results of the theoretical and applied literature. In particular, this is the case of democratic accountability (*dem*), government stability (*gov_stab*) and proportion of seats held by women in national parliaments, in log (*ln(wom)*). Table 3 presents the results of the estimation of five specifications of the model. All the specifications include time dummies to account for shifts in the relationships over the period 1984-2010. As done by Desbordes and Verardi (2012), we use B-splines both as base functions $p^k(GI)$ and to estimate $g(GI_{i,t})$.[14]

In the baseline estimates (G), the linear regressors are time dummies. Other regressions see the addition of one variable at a time. Estimates confirm that democratic accountability and government stability are significant explanatory variables of corruption.

Table 3: Semi-parametric Fixed Effects Estimation

	(G)	(H)	(I)	(L)
dem		0.128*** (3.62)	0.101*** (2.67)	0.113*** (2.82)
gov_stab			0.060* (1.92)	0.065** (1.97)
Ln(wom)				0.022 (0.22)
Times dummies	Yes	Yes	Yes	Yes
R^2	0.328	0.359	0.368	0.378
N. obs.	272	270	270	260

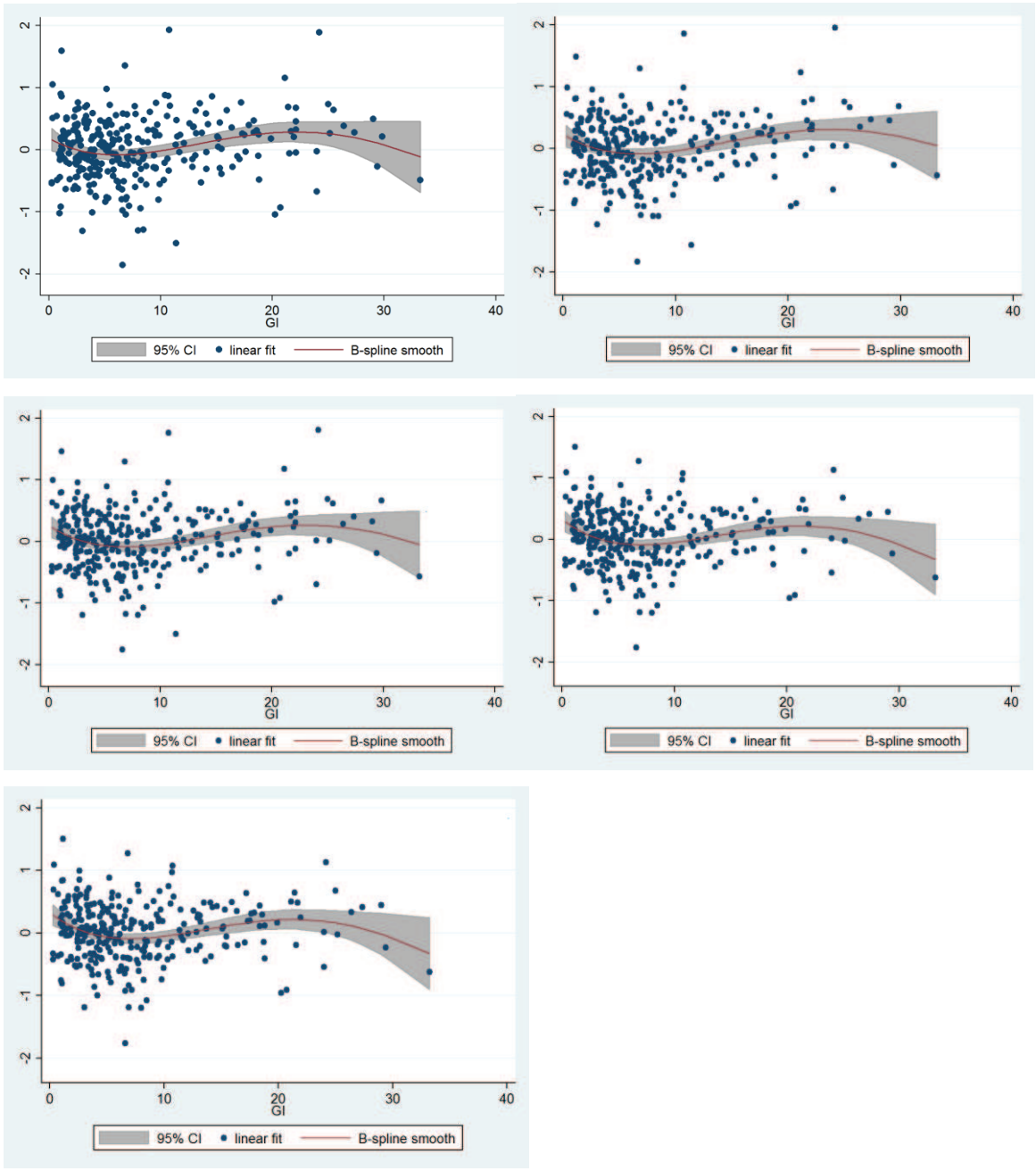
Notes. The dependent variable is *corr*. All regressions contain a non-parametric function of the Gallagher Disproportionality Index and time dummies for each five-year period (results not reported); the time span is 1984-2010. Standardised normal z-test values are in parentheses; robust standard errors. Significant coefficients are indicated by * (10% level), ** (5% level) and *** (1% level).

[14] Computations were made using the STATA command *xtsemipar* by François Libois and Vincenzo Verardi (2013).

Figure 3 shows the plot of the non-parametric estimate of $g(GI_{i,t})$ for each of the five specifications of the parametric component of the model. In particular, each panel displays the plot of the relation between *corr* and *GI* net of the fixed effects and the linear part of the regression equation.[15] In each graph the shaded area displays confidence intervals at 95% level of confidence. The five plots of the estimate of the function $g(GI_{i,t})$ show almost the same shape: a U followed by an inverted U. Hence, we find a substantial confirmation of the main result of the parametric analysis. As the graphs display, the results are confirmed not only by their shape, but also by their values. That is, the min and max of the Corruption index in the semi-parametric analysis fall approximately at a *GI*=8 and a *GI*=25 respectively, similar to the findings of the parametric analysis. This emphasizes even more the robustness of the relationship that we found between the proportionality degree of electoral rules and corruption.

[15] The variable on the vertical axis is re-centered around its mean value.

Figure 3: Non-parametric fit of the relationship between corruption and the Gallagher Index. Partial residuals centred around the mean.



5. Concluding remarks

This work offers a new way to analyze the relationship between electoral systems and corruption: through the degree of proportionality that electoral rules may define. It seems the correct way to consider them because their proportionality degree varies under the same PR, plurality and mixed system. In order to do that we use of the Gallagher dis-proportionality index as a measure of the proportionality degree of an electoral rule. Moreover, this index allowed us to properly consider mixed electoral systems in an empirical setting; it seems very important and interesting to consider the effect that they have on corruption and, thus filling the gap empirical literature has in this field, given that mixed rules are becoming the preferred choice of more and more governors. This work

advances also in the empirical methodology. Indeed, beside the traditional parametric analysis of the relationship between the proportionality degree of an electoral system and corruption, it provides a semi-parametric estimation. Results confirm our theoretical framework and show that the relationship between the proportionality degree and corruption is not linear. Graphically, this relationship appears as a sine curve, with the Corruption index reaching its minimum at low values of *GI*, and its maximum at high values of *GI*. The policy implications of this result are newsworthy. The reduction of the proportionality degree without adding some majoritarian elements in the distribution of the seats, only weakens the monitoring power of opponents (because the representativeness reduces) without the introduction of the voters' monitoring. It is not beneficial in fighting corruption. On the contrary, the contamination of the PR with plurality elements allows both monitors to exercise their power to induce politicians to avoid corrupt behavior. Enriching of plurality elements PR electoral systems is beneficial only up to certain proportionality degrees; after this the corresponding level of corruption begins to grow because the PR characteristics weaken too. It seems likely to imagine that the 'best' degree of proportionality in terms of corruption may characterize mixed as well as plurality rules. Our result is surely new and interesting and open new questions for political scientists: how to write electoral laws in order to guarantee the presence of action of the two kinds of monitoring. Further studies are needed in this field.

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Appendix A

Table A.1: Distribution of countries according to their electoral system, 1980-2011

PR	Mixed	Plurality
Argentina, Austria, Belgium, Costa Rica, Denmark, Ecuador El Salvator (since 1998), Finland, Guinea-Bissau (Since 2007), Guyana, Iceland, Indonesia, Ireland, Israel, Italy (since 1980 to 1993), Luxembourg, Malta, Moldova (since 1994), Mongolia 2009, Mozambique (since 1995), Namibia (since 1989), Netherlands, Nicaragua (since 1987), Norway, Paraguay, Peru (since 1981), Poland (since 1990 to 2006), Portugal, Luxembourg, Malta, Moldova (since 1994), Mongolia 2009, Mozambique (since 1995), Namibia (since 1989), Netherlands, Nicaragua (since 1987), Norway, Paraguay, Peru (since 1981), Poland (since 1990 to 2006), Portugal, Romania (since 1991 to 2006), Slovakia (since 1993), Slovenia (since 1992), South Africa, Sri Lanka, Suriname (since 1988), Sweden, Turkey (since 1984), Ukraine (since 2007), Uruguay (since 1985).	Albania (since 1992), Australia, Bolivia (since 1983), Brazil, Croatia (since 1993), Czech Rep. (since 1991), Dom. Rep., El Salvador (since 1983 to 1997), Germany, Greece, Guatemala (since 1986), Honduras (since 1982), Hungary (since 1991), India, Italy (since 1994), Japan, Lithuania (since 1993), Mozambique (in 1994), New Zealand (since 1993), Philippines (since 1999), Poland (since 2007), Romania (since 2007), Senegal, South Korea, Spain, Suriname (1980), Switzerland, Taiwan (since 1992), Ukraine (since 1998 to 2003)	Bahamas, Bangladesh, Botswana, Canada, Chile (since 1990), France, Jamaica, Mongolia (since 1993 to 2008), New Zealand (since 1980 to 1992), P. N. Guinea, Philippines (since 1988 to 1997), Thailand, Trinidad-Tobago, Ukraine (since 1994 to 1997), UK, USA, Zambia (since 1992)

Source: Database of Political Institutions 2012. Mixed systems are those in which both PR and plurality elements coexist. Our Elaboration.

Table A.2: Variables description

Corr	Corruption Index. It summarises the valuation of corruption within the political system; in particular, the presence of corruption is a threat to foreign investment because it 'distorts the economic and financial environment; reduces the efficiency of government and business by enabling people to assume positions of power through patronage rather than ability, and introduces an inherent instability into the political process'.[16] The result is that corruption makes it difficult to conduct business and, in some cases, it may force the withdrawal of investments. Source: ICRG, 1984-2010.
GI	Gallagher Disproportionality index. Source: Gallagher Electoral Disproportionality Data, 1945-2011. Source: http://www.tcd.ie/Political_Science/staff/michael_gallagher/ElSystems/Docts/ElectionIndices.pdf.
lngdp	Natural logarithm of gross domestic product at constant price 2000 US. Source: World Bank, 1980-2011.
pop	Urban population refers to people living in urban areas as defined by national statistical offices. Source: World Bank population estimates and urban ratios from the United Nations World Urbanization Prospects, 1980-2011.
gov_stab	Government stability. It is an assessment both of the government's ability to carry out its declared program(s), and its ability to stay in office. The risk rating assigned is the sum of three subcomponents (Government Unity, Legislative Strength, Popular Support), each with a maximum score of four points and a minimum score of 0 points. A score of 4 points equates to Very Low Risk and a score of 0 points to Very High Risk. This index ranges in the interval (0, 12). Source: ICRG, 1984-2010.
dem	Democratic accountability. Measure of how responsive a government is to its people, meaning the more responsive it is, the more likely it is that the government will fall peacefully, in a democratic society, but possibly violently in a non-democratic one. The points in this component are awarded on the basis of the type of governance the country in question has. This index ranges in the interval (0, 6). Source: ICRG, 1984-2010.
wom	Proportion of seats held by women in national parliaments (%). The data refer to Unicameral assembly or lower chamber of bicameral assembly. These data are comparable with United Nations Women's Indicators and Statistics Database – Wistat published by World Bank. Source: PARLIA database, 1980-2011. http://www.ipu.org/wmn-e/classif-arc.htm, http://www.ipu.org/parline-e/parlinesearch.asp, http://databank.worldbank.org/data/views/reports/tableview.aspx
export	Share of merchandise exports at current PPPs. This category follow the definitions of the System of National Accounts (SNA). Source Penn World Table 8.0. 1980-2011.
G	General government final consumption expenditure (% of GDP). Source: Penn World Table, 1980- 2011.
lnschool	Natural log of the net enrolment primary rate. It is the ratio between the number of children enrolled in primary schools and the total number of children of official primary school age. Source: World Development Indicators http://data.worldbank.org/indicator/SE.PRM.NENR, 1980-2011.

[16] http://www.prsgroup.com/ICRG_methodology.aspx

ethnic	The variable ethnic fractionalisation combines the language variable above with other information about racial characteristics (normally skin colour). Groups were classified as different if they spoke a different language and/or had different physical characteristics. Data source Source Key: eb=Encyclopaedia Brit, cia=CIA, sm=Scarrit and Mozaffar; lev=Levinson, wdm=World Directory of Minorities, census=national census data; upload from http://www.anderson.ucla.edu/faculty_pages/romain.wacziarg/downloads/fractionalisation.xls, 1980-2011.

Table A.3: Correlations

	GI	*lngdp*	*dem*	*gov_stab*	*wom*	*export*	*G*	*lnschool*	*ethnic*
GI	1								
lngdp	-0.24	1							
dem	-0.025	-0.41	1						
gov_stab	0.02	0.12	0.2	1					
wom	-0.35	0.32	0.27	0.17	1				
export	-0.22	0.35	0.13	0.12	0.30	1			
G	-0.16	0.42	0.19	0.001	0.38	0.25	1		
lnschool	-0.16	0.53	0.35	-0.02	0.14	0.10	0.22	1	
ethnic	0.09	-0.54	-0.39	0.01	-0.05	-0.13	-0.26	-0.41	1

Table A.4: Random effect panel data estimations.

	(a) *GI*	(a') GI^2	(a'') GI^3
indepdate	-0.001 (-1.06)	-0.07 (-0.3)	0.1 (0.27)
$indepdate^2$	-0.0002*** (-4.3)	-0.0005*** (-4.9)	-0.01*** (-4.4)
$indepdate^3$	1.03e-08*** (4.8)	2.47e-07*** (5)	5.45e-06*** (4.3)
dem	-0.4 (-1.4)	-13 (-1.5)	-353 (-1.5)
gov_stab	0.3* (1.74)	9.7* (1.65)	258 (1.5)
deltapop	34 (0.9)	967 (1)	22407 (0.9)
Time dummies	yes	yes	yes
N. obs	1635	1635	1635
Chi^2 (p-value)	40 (0.00)	58 (0.00)	27 (0.00)

Notes. All regressions contain calendar year dummies (results not reported); the time span is 1984-2010. Standardised normal z-test values are in parentheses; robust standard errors. in columns (a), (a') and (a'') the dependent variables are respectively *GI, GI^2* and *GI^3*. The last raw contains the Chi^2 of the Wald test. Significant coefficients are indicated by * (10% level), ** (5% level) and *** (1% level).

Table A.5: Estimations with and without IV.

	(b)	(b')
corr(-1)	1.14***	1.11***
	(22)	(19)
corr(-2)	-0.21***	-0.24***
	(-5.2)	(-5.5)
GI	-0.05**	-0.05
	(-1.97)	(-1.25)
GI^2	0.004*	0.004
	(1.93)	(1.18)
GI^3	-0.0001*	-0.0001
	(-1.86)	(-1.1)
lngdp	0.04**	0.07**
	(2.01)	(2.12)
dem	0.02*	0.03*
	(1.7)	(1.9)
gov_stab	-0.04*	-0.03
	(-1.74)	(-0.9)
Time dummies	yes	Yes
N. obs	1340	1365
Chi^2 Hansen test (dof)	7.72 (6)	6.34 (3)
(p-value)	(0.26)	(0.096)

Notes. All regressions contain calendar year dummies (results not reported); the time span is 1984-2010. The dependent variable is *corr*. Standardised normal z-test values are in parentheses; cluster-robust standard errors. Estimation in column (b) contains *indepdate, indepdate*^{2} and *indepdate*^{3} as IV, column (b') does not. Significant coefficients are indicated by * (10% level), ** (5% level) and *** (1% level). Two-step estimations with Windmeijer (2005) correction.