DANGER: LOCAL CORRUPTION IS CONTAGIOUS![1]

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Abstract

Corruption is a major problem, not only in developing countries. It deters economic growth, liability, enforcement of law, etc. Although it has been studied at national level from different perspectives, there is a recent growing body of research on local corruption. As far as we know, all these papers focused on corruption effects on votes. However, is there a mimetic corrupted behaviour on neighboring municipalities? We use data from Spain, due to the boom in local corruption in the 2000s, to reply this question. A panel database (2001-2010) on local characteristics, economic and cases of imputation for corruption at local level has been constructed. Our spatial econometrics methodology supports the hypothesis that corruption is not local-specific and two opposite outcomes arise: in one hand, local corruption is contagious and the probability of being `contagied´ increases 3.1 per cent for each neighbourhood municipalitied corrupted; in the other hand the likelihood to be publicy accused by a judge increases 6.7 per cent for each neighbourhood municipalitied accused. Although the former is alarming, the latter provides hope in the fight against local corruption.

Keywords: Local corruption; spatial econometrics; contagion effects.
JEL Codes: D72, D73, K42.

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INTRODUCTION

Corruption is a major problem, not only in developing countries. It deters economic growth (Mauro, 1995), liability, enforcement of law, etc. and votes are the only mechanism to punish it (or not).[5]

In Spain it is a growing and one of the most important recent social problem (See CIS´ surveys from the 80's until present).[6] As these surveys shows corruption has grown exponentially in Spain. In recent years, between 35 and 40% of those surveyed by the CIS said that corruption is one of the main problems of the nation, the second most important under the unemployment. This growth occurs not only in Spain. As can be seen in the recent report of the European Commission (2014), 76% of respondents believe that corruption is widespread in their country. This percentage is even higher in countries such as Greece (99%), Italy (97%) and Lithuania, Spain and the Czech Republic (95%). Therefore, it is a problem that people perceive with great concern and growing.

The problem of corruption in developed countries is quite different from corruption described by World Bank (Kaufmann et al, various years) or International Transparency: It is, above all, political corruption (Jiménez, 2013). This is the kind of corruption on which we focus in this investigation. This kind of corruption is probably due to a non-meritocratic system of political parties in some developed countries, against meritocratic one of public employees (Villoria and Jiménez, 2012).

Although studies have analyzed the possible spread of corruption among countries Becker et al (2009), and the effect of local corruption on different variables such as voting intentions (Jimenez and Garcia, 2012; or Ferraz and Finan, 2008), we did not find any paper in the literature that analyze the possible spatial spread of local corruption.

This paper aims to fill this gap by showing empirical evidence on whether there is spatial contagion in cases of corruption at the time to commit or when the justice detect it. First, if there were such spatial contagion in performing activities of corruption would be the existence of some negative spillovers of corruption outside the municipal boundaries. Therefore, the performance of an act of corruption not only generate welfare losses to the municipality that performs such activity, but generate a negative effect on nearby municipalities, since it would increase the likelihood that these municipalities commit corrupt acts in the future . Second, if the imputation of a municipality for the realization of a corrupt act increased the likelihood of nearby municipalities to be charged, would mean that there is some positive externality in the justice investigation. Once justice find a corruption case, the probability that nearby municipalities are charged in the future for corruption increase.

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[5] See detailed references at section two.

[6] CIS is the spanish acronymous of Sociological Research Center, a public organization into Ministry of Presidency which basically does statistical surveys on public opinions.

Show empirical evidence of the existence of this spatial pattern is the main contribution of the paper. To perform the empirical analysis we have a single database with all cases of imputed municipal corruption in Spain from 2000 to 2011.

The empirical results show the existence of a clear pattern of spatial contagion in both the embodiment of corrupt acts, as in the complaint by justice. These results allow us to draw conclusions from a set of public policy, such as the need for greater control of municipal actions to avoid negative spillover to other municipalities. These controls can be higher by a public body, or may be implementing greater transparency in municipal activities, so that the citizens of that town have greater control over their leader.

After this introduction, section two describes the scarce academic literature on this topic. Section three explains the database. Section four details the empirical strategy that used GIS data and a spatial data estimations model. Finally section five is devoted to results and policy implications.

LITERATURE REVIEW

Corruption is a complex phenomenon that can be approached from multiple perspectives, since as the social value of corruption affects the decision of an individual to engage in a corrupt act (Dong et al, 2012) to as information asymmetry can help reduce the level of corruption (Ryvkin and Serra, 2012). Within this vast literature we distinguish three elements analyzed in depth.

The first aspect is the analysis of factors that can influence the level of corruption in a country. One element is the level of political decentralization in a country. Economic theory predicts contradictory relationships between the level of economic and political decentralization and the level of corruption. For one, the least likely to attract good bureaucrats (Brueckner, 1999), the most prestigious of the central government (Persson and Tabellini, 2000), or possible double marginalization, which would generate an excess of corruption (Shleifer and Vishny, 1993), are some of the reasons that lead us to relate political decentralization with a higher level of corruption.

However, competition between local governments to engage citizens (Brennan and Buchanan, 1980), or the ease supervision and control of local bureaucrats, due to its proximity that provide better information (Persson and Tabellini, 2000), would lead to greater decentralization that would reduce the level of corruption. Empirically it has been attempted to answer this question. So, Fisman and Gatti (2002) show empirically as greater decentralization leads to a lower level of corruption in the country. This effect is maintained even when the level of decentralization of the country is considered endogenous and it is instrumented through the origin of the legal system of the country. More recently, Fan et al (2009) find a positive relationship between the number of bureaucratic levels (as a proxy of the level of decentralization) and the level of corruption, but only for less developed countries.

A second element that can affect the level of corruption in a country is the economic freedom existing in it. Countries with more economic freedom, supported by private initiative, tolerate worse corruption, which lead them to have a lower level. Pieroni and D'Agostini (2013) show econometrically as countries with greater economic freedom (policy competition, employment regulation or protection of property rights) obtained lower levels of perceived corruption.

A third element analyzed in the economic literature is the level of international integration. As countries integrate economically, increasing trade flows, foreign direct investment or the number of transnational companies, it is possible that good business practices and rejection of corruption is transmitted to the country, reducing the level of corruption. Sandholtz and Gray (2003) showed empirically the existence of this relationship, concluding that economic integration would help significantly to reduce the level of corruption. This same study shows a positive relationship between the level of corruption in a country and the level of its neighbors. Like Sandholtz and Gray (2003), Goel and Nelson (2007) find a positive relationship between the level of corruption in neighboring states and the level of corruption in the state analyzed. Authors use U.S. state level data over the period 1995-2004 to estimate what factors affect the average conviction for corruption in states considered.

A second topic analyzed in depth in the literature is the relationship between the level of corruption and political cost, in terms of votes, of political parties who are involved in them. Focusing on the case of Spain, widely used after the boom of local corruption in early 2000, Fernández-Vázquez and Rivero (2010) evaluated using OLS the effect of corruption cases on local election results in Andalucía (the most populous Autonomous Community in Spain) in the period 2003-2007. They do not find any electoral effect due to these cases. Costas-Pérez et al (2012) also analyse this topic using data from Spain (period 1999-2007) and employing a difference-in-difference estimator. They conclude that the average vote loss after a corruption scandal was approximately 4%, although the punishment is greater in cases receiving widespread attention by newspapers (up to 9%).

Finally, Jiménez and García (2012) expand the analysis of local corruption cases to the period 2000-2011, including not only local cases but also regional ones. Their estimations show two main conclusions: that following imputation in a local corruption case, voting abstention increases by an average of 1.8 percentage points; and that there are partisan effects by voters regarding local corruption.

This article focuses on the third topic widely analyzed in the literature such as the spatial spread of corruption among the different agents tested[7]. Like in health literature or in crime rates analyses (see for example, Messner and Anselin, 2004), corruption needs an econometric model that allows for countries interdependence; and Becker et al (2009) did it.[8] They support their results in that corruption spreads across national borders by business

[7] Spatial dependence on Public decisions (taxs, public expenditure, etc.) has been analyzed in papers as Brueckner (2003).

[8] Seldadyo et al (10) make a similar analysis but they focused on governance.

activity (economic integration) or by demonstration effects, among others. Using a cross-section of 123 countries the authors employ a spatial lag estimation of perceived corruption. It implies that the endogenous variable in a country *i* is an adjacency or inverse-distance related function of perceived corruption in other countries. They conclude that, although own country characteristics are more important than those of a country´s neighbors, there is evidence of contiguous effects of corruption. So, it is a regional phenomenon.[9] Similarly Seldadyo et al (2010) using spatial econometric models found a significant positive relationship between the level of governance of a country and the level of governance in neighboring countries. The authors show how the level of governance of the 10 closest neighboring countries significantly influences the level of governance in the country.

Although corruption is a very analyzed topic and that the spatial dependence in the decision making of agents has been tested empirically a lot of times, there are not in the literature, at least to our knowledge, any empirical article that analyze if exists contagion in corruption at local level. This fact is surprising considering that the spatial dependence in the level of corruption at the macroeconomic level (when the level of perceived corruption in the country in general is analyzed) has been tested econometrically. So we are looking for spillovers at local level, ie corruption contagion. If so, we provide new arguments to justify public spending increases for judges, police and supervising agencies in order to prevent corruption. These arguments are based on the positive externality of preventing new cases of corruption

DATABASE

The database consists on some annual data on all Spanish municipalities with population higher than 1,000, in the period 2000 to 2011 (n=3.413). It includes three main types of variables: local corruption cases (court imputation and the previous date of case), municipalities' characteristics and geographical data. The former is the number of corruption cases under judicial investigation by municipality in Spain, in the period 2000-2011. The register includes the starting year of the imputation. These cases include not only those in which the mayor is involved, but also cases involving any other person directly related to the party considered. We define an alleged offence as *a case of corruption* only when the accused has already been imputed or impeached by a judge. For these cases, we take into account not only the imputation date but also the previous date when the offence was committed. The database has been own-elaborated.[10]

Regarding municipalities' characteristics, we have included data provided by the Spain Economic Yearbook by La Caixa.[11] Data on population and economic activity have been

[9] Márquez et al (2011) replicate the analysis but using more observations and differente explanatory variables. They found a weak spatial correlation, so conclude that corruption is therefore not contagious. See also Attila (2008) for a similar topic.

[10] We use database constructed and explained in Jiménez and García (2012).

[11] http://www.anuarieco.lacaixa.comunicacions.com/

considered. With regard to geographical data, we have created two squared matrixes for the 3,413 municipalities, the adjacency matrix and the distance matrix. The adjacency matrix is a 0/1 matrix containing a 1 if the row municipality *i* is adjacent to the column municipality *j*. The distance matrix contains distances between each pair of municipalities, calculated from the respective coordinates (longitude and latitude). We used a spatial tool developed by means of the ArcGIS Model Builder in order to automatically detect adjacencies.[12]

The variables included in the analysis are the following ones:

(i) $Corrupted_i$: binary variable that takes the value 1 if there has been a case of corruption in the municipality *i* at any moment among the period 1999-2011. In some estimations, we use a variable that takes value 1 the year of imputed and following ones. Source: Own elaboration (see previous paragraphs).

(ii) *Imputated*: binary variable equal to 1 if a new case of corruption started in the municipality *i* at year *t*. We also consider the date when the offence was done. It was used in estimations included in Table 3.

(iii) *Bi-annual rate of* $population_{it}$: this variable is the average of two different growth rates, i) the annual variation of population from year *t-1* to year *t,* and ii) the annual variation of population from year *t-2* to *t-1*, for every municipality *i*. Costas-Pérez et al (2012) also use it, but they use four-years lagged growth rate.

(iv) *Local property gross tax base* $(IBI)_{it}$: this variable refers to the gross tax base of the local property tax in each municipality for every year of the database. We include it to capture the degree of urban development and its value, as state Fernández-Vázquez and Rivero (2010). Source: *Ministerio de Hacienda y Administraciones Públicas*.

(v) *Density of* $population_{it}$: this is the density of population of the municipality *i* at year *t*. Source: *La Caixa* municipal database.

(vi) *Index on Economic* $activity_{it}$: index that summarizes buying power by local consumers. Some economic indicators form it. Source: *La Caixa* municipal database.

(vii) $Island_i$: binary variable that takes value 1 if the municipality *i* is located at an island.

(viii) $Area_i$: municipality area in km^2. Source: *La Caixa* municipal database.

Table 1 shows the descriptive statistics by municipality. We consider two types of municipality: corrupt (C), which are those in which there has been at least one allegation of local corruption, and non-corrupt (NC).

Data show that corrupted municipalities have higher rates of population changes, they are richer in properties, with higher density and extension than non-corrupted municipalities.

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[12] We acknowledge Rafael Suárez assistance in this question.

The data also show that the municipalities free from corruption cases form a heterogeneous group. This is partly due to the fact that they are more than 3,000 (against close to 200 corrupted municipalities).

Table 1. Descriptive statistics by municipality (2004, 2008, 2010)

Variable	Mean		Standard Deviation		Minimum		Maximum	
	C	N-C	C	N-C	C	N-C	C	N-C
Demographical change	0.026	0.017	0.037	0.04	-0.10	-1	0.29	0,94
Properties local gross tax base (IBI)	2011364	283023	1e7	1532308	0	0	1.6e8	7.5e7
Density of population	765.13	348.4	1712.4	1254.7	5.73	0	17151.4	22401
Index on economic activity	131.5	22.4	521.5	91.2	2	0	7387	3935
Island	0.12	0.04	-	-	0	0	1	1
Area (km^2)	143.2	92.3	201.5	124.1	1	0	1675	1750

Source: Own elaboration.

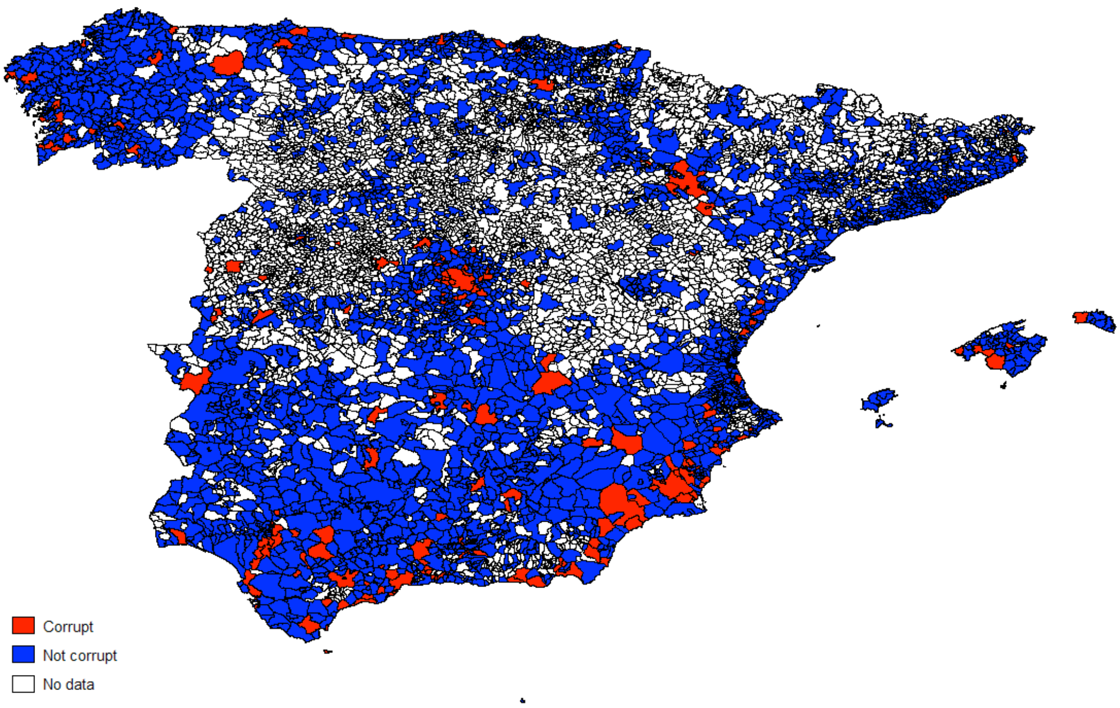
Note: C: Corrupted municipality; N-C: Non-corrupted municipality.

Following figure 1a show all municipalities included in the database. Red municipalities are corrupt ones while blue ones are not. These graphs show several questions. Firstly, the geographical distribution of lower municipalities across Spain in non-coastal regions (remember that those cities lower than 1,000 inhabitants are not included and they are most than 60 per cent of total municipalities in Spain).[13]

Secondly, that local corruption has been ocurred in almost all regions in Spain, so no region pattern appears. And finally, and the most important one, that some of the red circles are clustered, i.e., there is a geographical local pattern among municipalities accused.

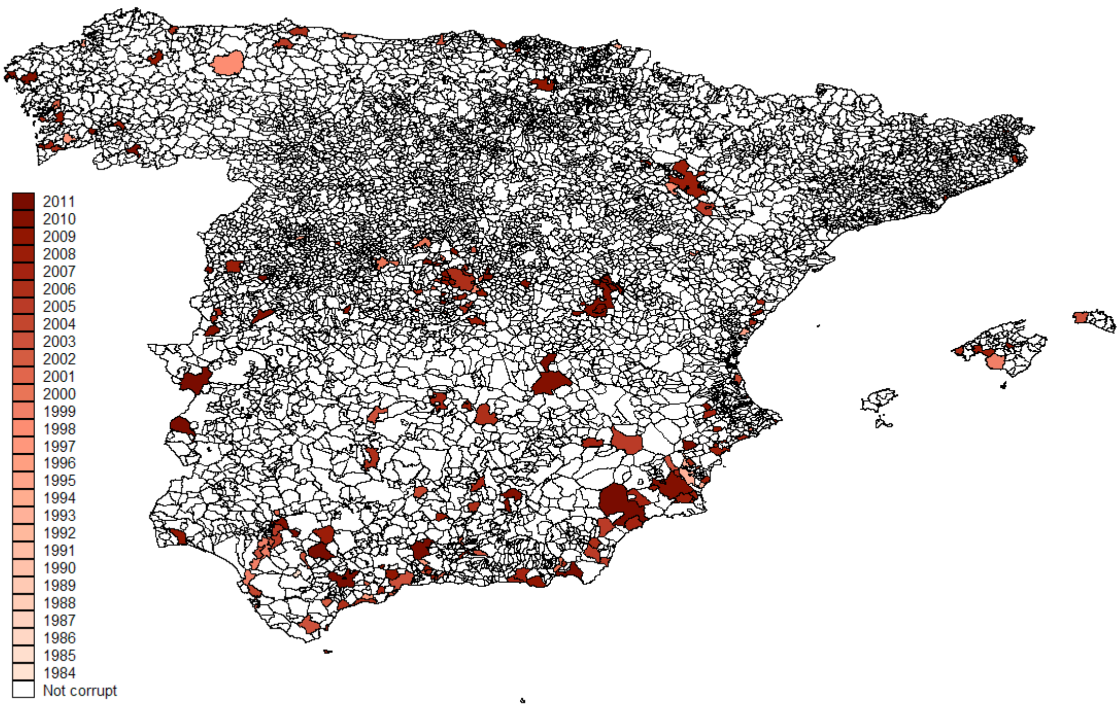
[13] Those regions are mainly Castilla-León, Castilla La Mancha, Madrid and Aragón.

Figure 1a. Local corruption. Mainland Spain and Balearic Islands. 2000-2011.



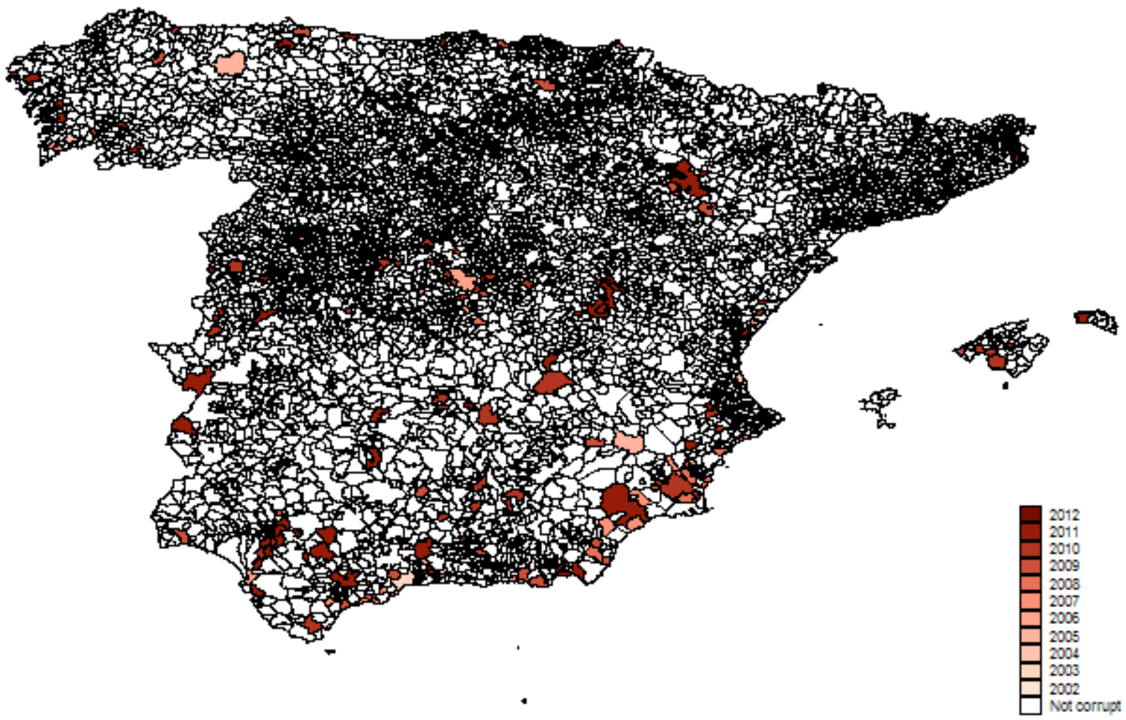
Source: Own elaboration. We include only municipalities higher than 1,000 inhabitants.

Figure 1b. Corrupt municipalities by year committed the corrupt act. Mainland Spain and Balearic Islands. 1984-2011



Source: Own elaboration.

Figure 1c. Corrupt municipalities by year were imputed. Mainland Spain and Balearic Islands. 2002-2012

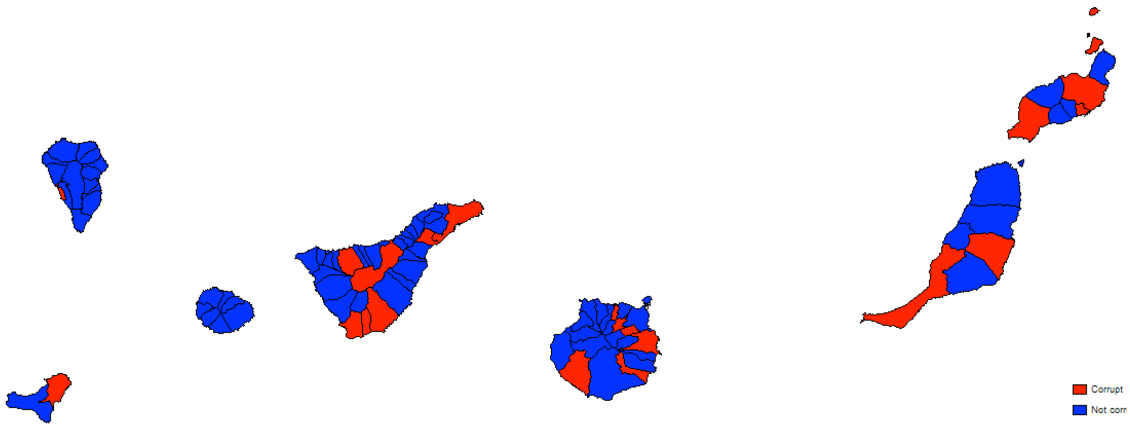


Source: Own elaboration.

Figures 1b and 1c show certain patterns of spatial spreading. There seems to be a municipality as to commit a corruption case, the contiguous municipalities commit corruption after some period, and so on. In the case of complaints the results are similar.

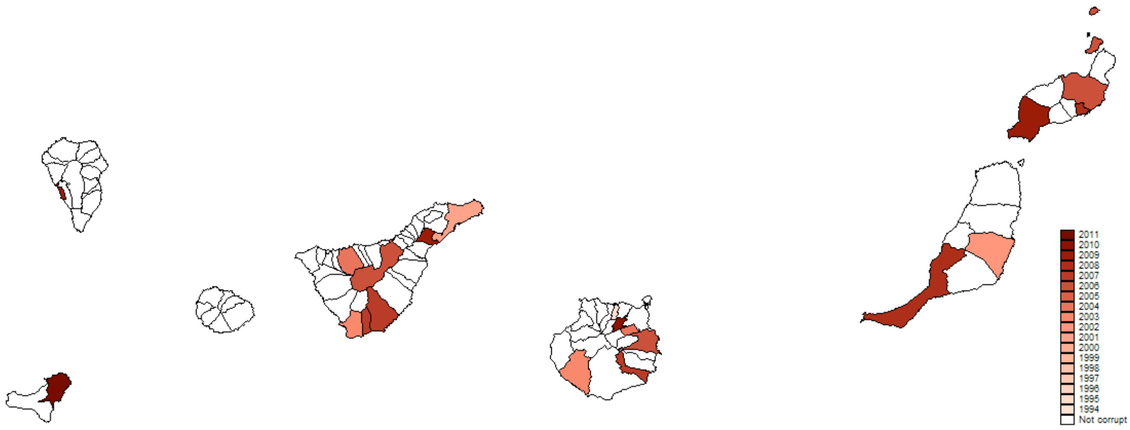
For Canary Islands, the local pattern is even more evident as can be seen in the following figures.

Figure 2a. Local corruption. Canary Islands. 2000-2011.



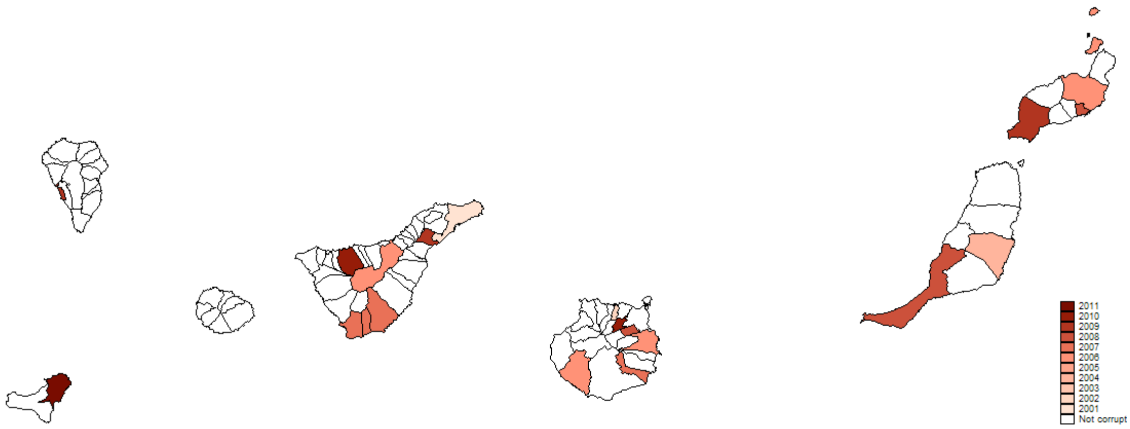
Source: Own elaboration.

Figure 2b. Corrupt municipalities by year committed the corrupt act. Canary Islands. 1994-2011.



Source: Own elaboration.

Figure 2c. Corrupt municipalities by year were imputed. Canary Islands. 2001-2011.



Source: Own elaboration.

Before modeling econometrically, it would be useful to test for the presence of spatial patterns in the distribution of corruption. A classical test used frequently is the Moran test, but it is designed for quantitative variables and should not be applied to binary data. A *t-test* comparing the percent of corrupted municipalities out of all the adjacent municipalies shows signifficant results (F=93.94, p= 0.0000).

In average, non imputated municipalities have 6.6% of their neigbours imputated, while 17.7% of the adjacent municipalities of the imputed ones have also been imputed. Therefore, statistical association is clearly showing a pattern of spatial correlation in the local corruption phenomenum in Spain. However, a more detailed econometric analysis needs to be implemented.

EMPIRICAL STRATEGY

As we have mentioned, our main goal is to test whether local corruption in Spain is contagious, i.e., whether it shows a spatial pattern so that if a municipality suffers a corruption case today, then the probability of having a new case of corruption in adjacent municipalities in that year or afterwads significantly increases. This objective is divided into corruption contagious and imputation contagious.

To achieve this objective, we implement an econometric model that allows for cross-sectional interdependence. However, we not only performed a cross-sectional analysis, but also implemented a dynamic approach which increases largely the number of observations and allows us to model the starting of a corruption case as a funtion of the neigbours cases of corruption in the past or contemporary. This issue, to our knowledge, has not been applied in the previous references we have detailed in section 2.

Our spatial econometric approach assumes that the channel of interdependence is positive related to adjacency or inversely with distance. So, the formal expression of our model is the following (as for example detailed in Becker et al, 2009):

$$\text{Prob}(p_i = 1 \mid X_i, W_i, C_i) = \Phi(\beta_0 + \lambda \sum_{j=1}^{N-1} w_{ij} p_j + \sum_{i=1}^{N} \beta_i X_i + \varepsilon_i)$$

$$\textit{where} \qquad [1]$$

$$\varepsilon_i = \rho \sum_{j=1}^{N-1} w_{ij} \varepsilon_j + v_i$$

where p_i is a binary variable that takes value 1 if the municipality *i* has suffered a local corruption case. Due to binary structure of endogenous variable, we implement *binomial probit* estimation models. **Φ** stands for the cumulative standard normal probability. Exogeneous covariates that contribute to explain the likelihood of being accused are denoted by X_i, and the most important variables are w_{ij} and the structure of error term. The former is an adjacency-related weight that takes value 1 if the municipality *i* is a neighbor of *j*. The latter split into two terms: a spatial correlation in the residuals (measure by ρ) and an *iid* error term.

Regarding the former, w_{ij} is an adjacency-related weight with the following two properties: $\sum_{j=1}^{N} w_{ij} = 1$ and w_{ii}=0. However, we use three differente approaches to this matrix: firstly, we consider a municipality-by-municipality matrix, which takes value 1 if two municipalities are neighbors; secondly we use a normalization approach that divides all unitary entry by the sum of all neighbors for each municipality; finally we apply an inverse euclidean distance matrix, calculated from the coordinates (longitude and latitude) of the center of the municipalities.

The contagion term in equation [1], $\lambda\sum_{j=1}^{N-1} w_{ij} p_j$, can be written using matrix notation as $W_i C_i$, where W_i contains the weights, based in distance or adjacency, for municipality *i* and C_i is the column 0/1 vector with $\{c_{ij}\} = 1$ if municipality *j* has been imputed:

$$p_i = \lambda W_i C_i + X'_i \beta + \varepsilon_i \qquad [2]$$

In all cases, the general equation [2] includes as explanatory variables (X) demographical variables, property taxes, density of population, area, economic activity and the dummy for island, as defined in section 3. As neigbour' s corruption (vector C_i) may be endogenous, as contagion is mutual, we used instrumental variables. The instruments, as in Becker et al (2009), are WX, W^2X, W^3X.

RESULTS

First of all, we estimate the binomial probit using a cross section data for last year considered (2010). The endogenous variable in this case takes value 1 if the municipality considered has been ever accused across the full period (and 0 in other case). Covariates considered are for year 2010.

Three Instrumental Variable estimations have been done over 3,047 municipalities (we exclude those which some missing values presented). The standard errors have been adjusted for error correlations among municipalities in the same province. The main explanatory variable is the neigbour´s corruption.

Table 2 shows results for the three matrixes considered: adjacency -i.e., the number of neighbors that have been accused any time in the period 2001-2010-; adjacency normalized and inverse distance matrix.

Table 2. Static Probit estimation. Instrumental variables.

Explanatory variables	**Adjacency**	**Normalized adjacency**	**Distance weights**
Neigbour corruption	0.439 (0.10)***	2.165 (0.57)**	2.089 (0.87)**
Demographical change	1.063 (2.04)	1.183 (1.94)	1.373 (1.97)
Property gross tax base	3e-8 (4e-8)	3e-8 (4e-8)	3e-8 (4e-8)
Population density	2e-5 (4e-5)	1e-7 (4e-5)	2e-6 (4e-6)
Index on economic activity	-1e-4 (7e-4)	2e-4 (8e-4)	1.9e-4 (8e-4)
Island	0.258 (0.115)**	0.237 (0.11)**	0.245 (0.12)**
Area	6e-4 (2e-4)***	9e-4 (2e-4)***	9e-4 (2e-4)***
Constant	-2.111 (0.06)***	-2.142 (0.06)***	-2.142 (0.07)***
Observations	3,047	3,047	3,047
Wald chi2(7)	198.76***	136.75***	126.67***
Wald test of exogeneity (Prob>chi2)	0.04	0.16	0.24

Note 1: *** 1%, ** 5%, *10% significance test. Standard errors are shown in brackets.

Wald test of exogeneity (last row of Table 2) shows that instruments are valid. The most important general conclusion of the models is that corrupted neighbors increase the likelihood to be a corrupted municipality. In fact, the adjacency model shows that for each corrupted neighbor a municipality has, its score (in the standard Normal distribution scale) increases by 0.43 units. That is a large effect and it is invariant for imputation date than for the date when the offence was implemented.

The only significant covariates are the dummy for municipalities located in islands, with higher probabilites to be corrupted; and the area size, larger municipalities are more likely to be imputed.

However, estimations in table 2 do not consider the potential time effect, i.e. the dynamic behaviour of local corruption in Spain. To solve this problem we consider the panel structure of data. In this case, the endogenous variable p_{it} takes value 1 if the municipality i has a local corruption case starting in year t. As once a municipality has been imputated there is no way back (that is, p_{it}=1 after the imputation year), and those observations do not add any information to the sample likelihood, we skip them from the panel estimation sample.

So, Table 3, reporting the panel data estimation, outperfoms cross-section analysis due to it considers likelihood to be corrupted if a neighbor municipality have been previously accused. We used the Arellano´s first differences Instrumental Variables estimation method. The model is linear, if the dependent variable is the binary p_{it}. The instruments are defined as above.

Moreover we separate estimations firstly for different matrix structures (as in Table 2), and secondly for the date of imputation (imputation column in Table 3) and when the offence was done (corruption column in Table 3). The latter question lets us to know not only whether contagious effect exists but also which of them is more important.

Table 3. Panel data. First differenced Instrumental Variables (Arellano)

	Adjacency		Normalized adjacency		Distance weight	
Explanatory variables	**Imputation**	**Corruption**	**Imputation**	**Corruption**	**Imputation**	**Corruption**
Neigbour corruption (or imputation)	0.067 (0.009)***	0.031 (0.058)***	0.383 (0.049)***	0.166 (0.05)***	0.365 (0.051)***	0.148 (0.05)***
Demographical change	-0.032 (0.015)**	-0.006 (0.017)	-0.028 (0.015)*	-0.012 (0.017)	-0.031 (0.015)**	-0.011 (0.017)
Property gross tax base	2e-9 (8e-10)***	-2e-10 (9e-10)	3e-9 (8e-10)***	-3e-11 (9e-10)	3e-9 (8e-10)***	-1e-11 (9e-10)
Population density	1e-4 (2e-5)***	1e-4 (2e-5)***	1e-4 (2e-5)***	1e-4 (2e-5)***	1e-4 (2e.5)***	1e-4 (2e-5)***
Index of economic activity	-5e-6 (2e-5)	-8e-5 (3e-4)**	-5e-6 (2e-5)	-8e-5 (3e-4)**	-4e-6 (2e-5)	-8e-5 (3e-5)**
Constant	0.004 (6e-4)***	0.002 (6e-4)***	0.004 (6e-4)***	0.002 (6e-4)***	0.004 (6e-4)***	0.002 (6e-4)***
Observations	27,417	27,417	27,417	27,417	27,417	27,417
Wald chi2(5)	109.69***	58.77***	115.48***	40.95***	105.56***	38.65***
R^2 (within/between/overall)	0.03/ 0.003/ 0.003	0.008 / 0.0008 / 0.0001	0.03 / 0.003/ 0.003	0.005 / 0.0005 / 0.0001	0.03 / 0.003 / 0.003	0.005 / 0.0006 / 0.0001

Note 1: *** 1%, ** 5%, *10% significance test. Standard errors are shown in brackets.

Panel data estimation yields several interesting outcomes. Firstly, that corruption appears in municipalities with higher changes in property gross tax base; those with higher increase in density of population; and, those in which population decrease along time.

But the most important result is significance and coefficient of corruption/imputation in the neigborhood: *ceteris paribus*, the contagious effect exists both for corruption and for imputation (from the corrupted perspective and for judicial one). Regarding the former, for each corrupted municipality you have as a neighbor, increases the likelihood of commit a crime by 3.1 per cent.

However, good news is that, using imputation date, for each imputed municipality you have as a neighbor, it increases the likelihood of exposing a case of judicial complaint by 6.7 per cent. This positive derivative offsets contagion problem and makes it much easier for Authorities to locate cases of local corruption and the allocation of law enforcement resources in certain areas.This contagious effect is not a new one. Becker et al (2009) conclude that "a change in a country's institutions to reduce corruption will also reduce corruption in neighboring countries". From another perspective, Carrell et al (2008), found that one additional college cheater creates 0.55 to 0.80 new college cheaters (they studied self-reported academic honor violations from the classes of 1959 through 2002 at the three major U.S. military service academies).

In our case, as in Carrell et al (2008) the contaigous effect must be consider as an evolving social norm of toleration or corruption versus congestion in enforcement of local governments.

CONCLUSIONS

Although corruption is a major problem in developing countries, a new version of this social problem has arises in recent years in developed ones: the political corruption. And this problem no only affects central or regional governments, but also local ones.

Academic literature has analyzed effects of corruption on some important topics as economic growth, liability, voting behaviour, etc. But, as far as we know, a geographical analysis at local level has not been implemented. In this regard, our main aim is to test whether a spatial interdependence exist in local corruption cases. This fact should be quite important to help authorities to found new corruption cases and to to allocate resources in judges and similars.

Using data from Spain, due to the boom in local corruption in the 2000s, a panel database (2001-2010) on local characteristics, economic and cases of imputation for corruption at local level has been constructed. Our empirical strategy is to implement an econometric model that allows for cross-sectional interdependence. However, we not only performed a cross-sectional analysis, but also implemented a dynamic approach which increases largely the number of observations and allows us to model the starting of a corruption case as a function of the neigbours cases of corruption in the past or contemporary.

Our spatial econometrics methodology supports the hypothesis that corruption is not local-specific and two opposite outcomes arise: in one hand, local corruption is contagious and the probability of being `contagied´ increases 3.1 per cent for each neighbourhood municipalities corrupted; in the other hand the likelihood to be publicy accused by a judge increases 6.7 per cent for each neighbourhood municipalitied accused. Although the former is alarming, the latter provides hope in the fight against local corruption.

These results allow us to draw some policy recommendations. The spatial contagion in performing corrupt behavior indicates the importance of combating local corruption, which not only generates welfare losses to the municipality, but generates negative spillovers on nearby municipalities. This makes socially negative spillover can be positive support from higher territorial agencies in combating local corruption, to help internalize. This help can be both bureaucratic supervision from a higher organism, such as setting sufficient transparency standards so that citizens of that municipality control its leaders. Regarding the spatial contagion in the complaint should recommend to the courts that once detected a case of municipal corruption, preliminarily investigated to nearby municipalities, as probability of having acted corruptly is greater. Empirical results seem to indicate that in the case of Spain this pattern of behavior by justice longer occurs.

References

Attila, J.G. 2008. Is Corruption Contagious? An Econometric Analysis. Norwegian Institute of International Affairs (NUPI) Working Paper No. 742. Available at SSRN: http://ssrn.com/abstract=1275804

Becker, S.O., Egger, P.H. and Seidel, T. 2009. Common political culture: evidence on regional corruption contagion. European Journal of Political Economy, 25, 300-310.

Brennan, G. and Buchanan, J.M. 1980. The power to tax. Cambridge University Press, New York.

Brueckner, J. 1999. Fiscal decentralization in LDC's: The effects of local corruption and tax evasion. Mimeo.

Brueckner, J. 2003. Strategic interaction among governments, an overview of empirical studies. International Regional Science Review, 26, 175-188.

Carrell, S.E, Malmstrom, F.V. and West, J.E. 2008. Peer effects in academic cheating. Journal of Human Resources, 43(1), 173-207.

Costa-Pérez, E., Solé-Ollé, A. and Sorribas-Navarro, P., 2012. Corruption scandals, voter information, and accountability. European Journal of Political Economy, 28(4), 469-484.

Dong, B., Dulleck, U. and Torgler, B. 2012. Conditional corruption. Journal of Economic Psychology, 33, 609-627.

European Commission. 2014. EU Anti-Corruption Report. Brussels.

Fan, S.C., Lin, Ch. And Treisman, D. 2009. Political decentralization and corruption: Evidence from around the world. Journal of Public Economics, 93, 14-34.

Fernández-Vázquez, P. and Rivero, G., 2010. Electoral consequences of corruption charges in Andalucía (Spain), 2003-2007. *Mimeo.*

Ferraz, C. and Finan, F. 2008. Exposing corrupt politicians: the effects of Brazil´s publicly released audits on electoral outcomes. The Quarterly Journal of Economics. 123(2), 703-745.

Fisman, R. and Gatti, R. 2002. Decentralization and corruption: Evidence across countries. Journal of Public Economics, 83, 325-345.

Goel, R.K. and Nelson, M.A. 2007. Are corrupt acts contagious? Evidence from the United States. Journal of Policy Modelling, 29, 839-850.

Jiménez, J.L. 2013. Corrupción local en España. Cuadernos Económicos ICE, Revista de Economía, 85, 23-41.

Jiménez, J.L. and García, C. 2012. Corruption and local politics: does it pay to be a crook? Working Paper IREA nº 12.

Márquez, M.A., Salinas-Jiménez, J. and Salinas-Jiménez, M.M. 2011. Exploring differences in corruption: the role of neighboring countries. Journal of Economic Policy Reform, 14(1), 11-19.

Messner, S.F. and Anselin, L. 2004. Spatial analyses of homicide with areal data. In: Goodchild, M., M.F., D.G., Janelle (Eds.). Spatially integrated social science. Oxford University Press. New York, 127-144.

Persson, T. and Tabellini, G. 2000. Constitutional determinants of government spending. Mimeo

Pieroni, L. and D'Agostino, G. 2013. Corruption and the effects of economic freedom. European Journal of Political Economy, 29, 54-72.

Ryvkin, D. and Serra, D. 2012. How corruptible are you? Bribery under uncertainty. Journal of Economic Behavior and Organization, 81, 466-477.

Sandholtz, W. and Gray, M.M. 2003. International integration and national corruption. International Organization, 57(4), 761-800.

Seldadyo, H., Elhorst, J.P. and De Haan, J. 2010. Geography and governance: does space matter? Papers in Regional Science, 89(3), 625-641.

Shleifer, A. and Vishny, R. 1993. Corruption. Quarterly Journal of Economics, 108, 599-617.