Housing Bubbles and Zoning Corruption: Evidence from Greece and Spain

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Abstract

This study examines whether the steep rise in housing prices fueled by cheap credit following the inception of the Eurozone in 2001 exacerbated corruption of zoning authorities in two member states that experienced housing bubbles: Greece and Spain. The adoption of the euro led to exogenous variation in credit conditions that altered housing developers' incentives to offer bribes for illegal construction and public officials' incentives to accept them. We use novel datasets with objective measures of the incidence of zoning corruption at the regional level for both countries. Covering the periods 2003-2008 for Greece and 2000-2008 for Spain, we estimate negative binomial regression models for each country. Controlling for other variables that may affect corruption such as unemployment rate, population density, and educational attainment we find that corruption significantly increased as the housing bubble unraveled. The positive relationship between housing prices and corruption persists after carrying out robustness checks involving zero-inflated variants of the negative binomial model.

Keywords: Corruption, Housing Price Bubbles, Eurozone, Greece, Spain

JEL Classification: H83, K42

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1. Introduction

The creation of the European Monetary Union (EMU) in 1999 led to significant changes in the financing systems of many EMU member states. Cheap credit and a surge in intra-EMU capital flows due to the perception of a dramatic decrease in financial risk transformed the economies of some of the EMU periphery such us Greece and Spain. The increased supply of loanable funds at cheaper rates helped expand economic activity in these two member states for a decade but also led to housing bubbles and other significant side effects, such as a marked increase in certain forms of corruption. This paper explores an overlooked yet important implication of housing bubbles, the rapid rise in zoning corruption from the inception of the EMU till the burst of the Greek and Spanish housing bubbles in 2008.

The empirical literature has long identified a link between monetary policy and housing prices (as examples, Sutton, 2002, Tsatsaronis and Zhu, 2004, and Holt, 2009), which in the context of the EU periphery led to mortgage loans at even negative interest rates (Varoufakis, 2011). Furthermore, several papers have emphasized the existence of a positive relationship between housing prices and the availability of credit (mortgage lending) in the cases of Greece (Himoniti-Terroviti, 2005; Brissimis and Vlassopoulos, 2009) and Spain (Gimeno y Martínez-Carrascal, 2006; Gentier, 2012).

Certainly, there are many potential determinants of housing prices and causality between housing prices and interest rates cannot be established from simple observational studies. Low interest rates do not necessarily lead to housing prices increases as the housing markets in the US, Greece, and Spain have recently shown. However, the combination of cheap credit associated to relaxed standards for mortgage lending, a windfall in property tax revenues, and a citizenry avid for benefiting from booming housing prices created an excessive focus on housing construction both in Greece and Spain.

In addition to the relationship between credit availability and housing prices, increasing housing prices also sparked competition between localities for the creation of new residential areas with the goal of enlarging budget revenues (Gómez-Antonio, Hortas-Rico, and Li, 2014). As an example, just before the bubble burst, tax revenue in Spain was at least two percentage points higher due to the housing sector (Fernández-Villaverde and Rubio-Ramírez, 2009). Finally, as predicted by Minsky (1986), investors entered the housing market at an increasing rate as the housing bubble unraveled – a phenomenon that mirrors the contagion in the US housing bubble [Bayer, Mangum and Roberts (2014)].

Zoning corruption is defined as crimes by zoning officials for personal gain (Rose-Ackerman, 1975). We exploit the unprecedented supply of cheap credit due to adoption of the euro by Greece and Spain as the source of exogenous variation in housing prices which altered housing developers' and zoning officials' propensity to corruption. Other than discussions in the popular media of the potential link between fast rising prices in the housing market and zoning corruption, to the best of our knowledge to date there has not been any formal testing of the hypothesis linking the two.[1] Our empirical strategy follows recent work that has similarly relied on natural resource windfalls as external shocks that influence corruption [Maldonado, (2010); Caselli and Michaels, (2013); Vicente (2013)].

Much of the research in the field of the economics of corruption has been hampered by the use of subjective measures of corruption and the lack of a proper identification strategy. Our study addresses the aforementioned challenges in studying corruption by employing objective counts of corruption (public records in Greece, media reports in Spain) and focusing on a time window when zoning corruption was influenced exogenously by the residential construction boom induced by the adoption of the euro. The housing price swings movements created the opportunity and incentives for bribing public officials at the local level for rezoning land tracts for residential and commercial development projects. The acceleration in housing prices allows us to identify their role in zoning officials' corruption motives[2] separately from other confounding causal factors of corruption.

Using regional data, for the period 2003-2008 in the case of Greece and for the years 2000-2008 in the Spanish one[3], we estimate negative binomial regression models and run robustness checks using zero-inflated models for each country. As conjectured, increased housing prices are significantly linked with higher corruption of zoning officials both in Greece and Spain. Specifically, we find that an increase in housing prices by five percentage points within a month is associated with a 23.9% higher incidence of zoning corruption in a region of Greece, on average. Similarly, a five percent increase in housing prices within a quarter results to a 31.7% increase in the probability of another zoning corruption scandal in a

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[1] For an example of a discussion of the potential link between housing bubbles and corruption in the media for the case of China see the "China Daily" of April 22nd 2014: http://www.chinadaily.com.cn/opinion/2010-10/08/content_11382933.htm.
Bujko et al. (2015) uses corruption as an independent variable to explain "land grabbing" but does not discuss housing prices.

[2]While the higher incidence of corruption may have also affected housing prices, in this case the effect should have been in the opposite direction, putting a downward pressure on housing prices since the corrupt rezoning practices increased the availability of buildable land, thus increasing the available supply of housing. Sowell (2009) finds that the largest housing price increases occurred in housing markets where local governments imposed land use restrictions which reduced the supply of available land for housing.

[3] The discrepancy between the periods of analysis for the two countries is due to the fact that Greece joined the EMU in 2001, 2 years later than Spain and the different data generating process that gave rise to the datasets. Electronic records of zoning corruption counts with regional disaggregation in Greece were kept only after 2003. For Spain, the corruption data extraction process relied on web scraping giving considerably greater flexibility in extending the time dimension of the panel to 2000. It is not striking that objective counts of corruption coming from administrative and internet sources are not uniformly available.

region of Spain, on average. Our robustness results validate our empirical approach and give credence to our findings.

The rest of the paper is organized as follows. Section 2 presents a review of the literature. Section 3 takes a look at the raw data showing unadjusted trends in mortgage markets, housing prices and corruption counts in Greece and Spain. Section 4 discusses the data and methodology, and presents the empirical results and robustness checks. Section 5 concludes.

2. Literature review

The theoretical literature on the economics of corruption draws a common distinction between the determinants of corruption according to whether they influence the incentives of individuals or the opportunities to engage in corruption.

The first element focuses on agents' willingness to demand or offer a bribe and the presence of deterrent mechanisms (penalties such as fines). For the phenomenon studied in this paper, the incentives are provided by the profits housing developers may derive from rapidly increasing prices and the sharing into these profits in the form of bribes received by rent seeking corrupt public officials. As Rose-Ackerman (1988, p.278) puts it, "if bribes are offered there must be some prospective excess profits out of which to pay them". From the zoning officials' perspective, the housing bubble made corruption more appealing because it was not accompanied by a tightening of the penalties associated with misconduct [Aidt (2003)].This argument fits well into the classical model of crime by Becker (1968). Not only the surge in housing prices increased expected benefits of corruption but the bonanza years of expanding incomes and rising tax revenues delayed necessary institutional reforms (Fernández-Villaverde et al., 2013) that would have toughened the fines, increasing expected costs to violators.

The second element investigates whether windows of opportunity to undertake any corrupt acts exist. Rent-seeking by zoning officials is possible because local governments control land use rights and place restrictions on access to these rights. From this perspective, zoning officials function as "discriminating monopolists and fix market clearing rates for the services being offered" (Jagannathan, 1986). As long as government-generated shortages exist, rent-seeking over land development rights will persist (Lee, 1994). Zoning authorities make discretionary decisions to apportion land in the presence of excess demand and limited supply. The window of opportunity in our case arises from the relative scarcity of developable land and the possibility of expanding this supply by rezoning decisions controlled by local officials. Those willing to have access to more land are willing to pay a bribe. Among other areas of public service, Tanzi (1998, p. 14) notes that "decisions as to the particular use of private land (zoning laws) that determine whether the same piece of land can be used only for agriculture, and thus have low market value, or for high rise buildings, and thus can be very expensive…" are prone to bribery and, ultimately, corruption.

From a different perspective, Gomez-Antonio, Hortas-Rico, and Li (2014) exploit the interaction of housing availability and land-use policies to examine the degree of urban sprawl's spatial interdependency in Spanish municipalities. The natural variation in the supply of housing and zoning laws make land a commodity of differential value across jurisdictions. Similarly to our study, this creates economic incentives for zoning officials to exercise their discretionary power over land allocation to influence development patterns.

The empirical literature has strived to identify robust determinants of corruption, although no clear consensus has yet emerged. In general terms, due to practical difficulties in conducting natural field experiments on corruption only very limited work exists, and much of that analysis is on effective approaches to curbing rather than explaining corruption (Olken, 2007). The absence of clear-cut comparative case study settings prevents usage of matching methods or other quasi-experimental techniques. As a result, the empirical work has been restricted to focus on the identification strategies based on instrumental variables or careful analyses that exploit instances of exogenous variation in the determinants of corruption. It is in this latter strain of the literature where our paper fits.

In the strain of the empirical literature that employs instrumental variables of corruption, at the cross-country level a comprehensive attempt by Serra (2006) to find robust determinants of corruption employing Extreme Bounds Analysis arrives to the conclusion that income, history of democratic institutions, Protestant religion, colonial heritage, and political instability are all significant attributes. Similarly, numerous authors have found evidence about a causal link between human capital or market features and corruption. In this sense, a number of studies report a negative association between education level and corruption [Mauro (1997) Beets (2005), Lederman et al. (2005), and Cheung and Chan (2008)]; an exception is Frechette (2006). In addition, Beets (2005) finds that higher levels of unemployment are associated with higher corruption and Emerson (2006) presents theoretical and empirical evidence that market competition and (subjective measures of) corruption are negatively related.

There are also numerous studies that find a negative association between income level and the incidence of corruption [Lambsdorff (2006), Svensson (2005), Beets (2005), Treisman (2000), Husted (1999), Mauro (1997), and Chang (2010)]. However, Braun and Di Tella (2004) find GDP per capita to be positively correlated with corruption using panel data. Frechette (2006) uses data for 135 countries over a span of sixteen years, and employs a panel IV approach to find a positive relation between income and corruption.

More recently, the empirical literature on corruption has turned to within-country research. Illustratively, Olken (2007) carries out a field experiment in over 600 Indonesian village road projects to find that government audits reduced corruption significantly whereas, increased grassroots participation in monitoring had neglibible effects. Ferraz and Finan (2009) use audits of incumbent municipal politicians to construct enhanced measures of corruption that control for unobserved characteristics of the locale. Based on reduced-form as well as instrumental variable (IV) approach regression results, Brollo et al (2013) report that an increase in federal transfers by 10 percent amplifies the incidence of severe corruption by about 16%. Batzilis (2014) uses an IV approach to show that electoral competition at the municipality level reduced public spending corruption in Greece. He also reports higher incidence of corrupt spending in less populated, more rural municipalities.

A different strand of corruption literature uses natural resource windfalls as sources of exogenous variation to examine corruption. Maldonado (2010) exploits regional variation in economic conditions in Peru due to the relative abundance of mineral resources across regions which are exogenous as determined by nature. His results suggest that the increases in transfer funds due to positive shocks in international mineral prices affected corrupt practices in citizens' interactions with public officials, and these corrupt practices differed according to the size of the shock. Similarly, Caselli and Michaels (2013) use variation in oil output among Brazilian municipalities to find evidence of embezzlement in oil-rich municipalities. Vicente (2013) exploits the instance of oil discovery in Sao Tome and Principe to compare changes in corruption perceptions to Cape Verde using survey data in a Difference-in-Differences (DID) framework.

Indeed, much of the research on the determinants of corruption has been hampered by the use of subjective measures of corruption and the lack of a proper identification strategy. On the one hand, subjective or perceptions-based worldwide governance indicators are often plagued by imprecision [Kaufman, Kraay, and Mastruzzi (2010)]. In addition, systematic biases may undermine empirical analysis when different classes of respondents differ by design, or when the ideological orientation of the institution matters. Furthermore, subjective assessments might be driven by "halo effects"; i.e., negative evaluations when conditions are worsening and vice versa. However, Kaufman, Kraay, and Mastruzzi (2007a,b;2004) found little evidence of these biases in the context of the Worldwide Governance Indicators (WGI). Also when different data providers use each other's evaluations, endogeneity is introduced since perceptions errors are correlated; but again, Kaufman, Kraay, and Mastruzzi (2007c) dismiss this source of bias when using the WGI. In sum, subjective measures of corruption should be used with caution because they are prone to a host of sources of bias.

3. A look at the raw data: trends in mortgage interest rates, housing prices and corruption counts

The story line we weave together in this paper starts with a dramatic drop in mortgage interest rates beginning with the creation of the EMU. Financial markets' perception of risk convergence among EMU member states significantly reduced the financing burden in the EMU periphery. The availability of cheap credit led in Greece and Spain to an increase in economic activity excessively focused on housing construction,[4] accompanied not only by fast increasing-- and in retrospect highly speculative—housing prices, but eventually by a higher incidence of zoning corruption.

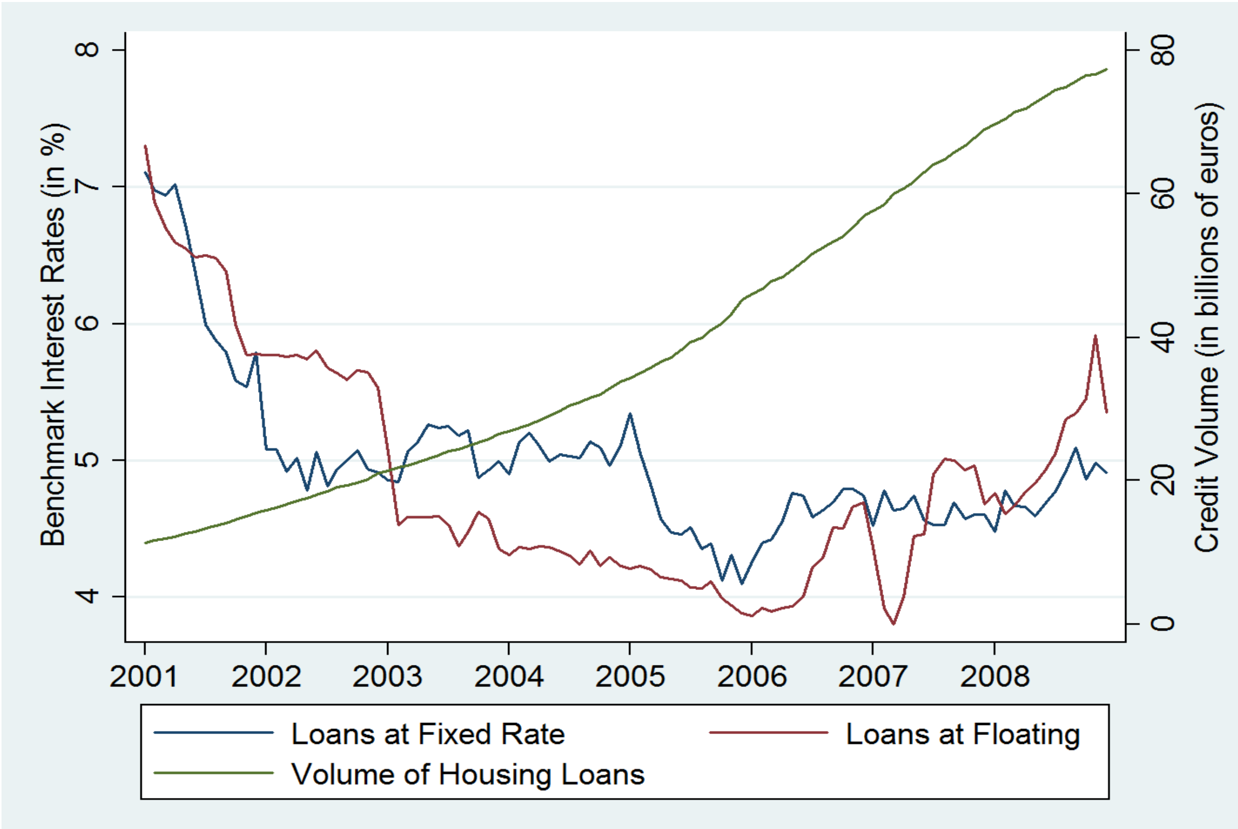
Within an environment of cheap credit, the average annual growth rate of loans for house purchase in Greece and Spain between 1999 and 2007 were 30.3 (the highest among Eurozone-founding member states), and 19.8 percentage points, respectively; by comparison, the EMU as a whole saw a more moderate increase of 10.4 percentage points, on average.

As Figure 1 clearly illustrates accession to the Eurozone significantly altered conditions in the Greek market for housing loanable funds. From the adoption of the euro in 2001 until the beginning of our empirical analysis in 2003 the cost of credit decreased by 30.7% (from 7.31% to 5.06%) for loans at a floating interest rate and by 31.8% (from 7.11% to 4.85%) for loans with fixed interest rates up to a year. As a result, within the span of two years credit to Greek households in the form of housing loans increased by 87.5% and continued trending onwards until 2008.

The majority of euro-denominated housing loans from domestic credit institutions to households in Greece was arranged on a variable rate basis until December 2006 and had maturities ranging from 15 to 20 years. Figure 1 depicts trends in lending costs and the volume of the total housing loans issued from January 2001 – when Greece entered the Eurozone – through December 2008. As benchmark interest rates we employ euro-denominated housing loan interest rates at floating rate and up to a one-year rate fixation. Since housing loans in non-euro currencies represented a mere 2.5% of the total over the period of analysis their interest rates are not presented.

[4] Households' preferences over house purchase were markedly different across EMU member states. For example, in 2006 the EMU owner-occupancy rate stood at 62.3% whereas the respective rates for Greece and Spain were 79.6% and 86.3%.

Figure 1: Volume of Housing Loans and Benchmark Interest Rates; Greece, Jan 2001 – Dec 2008:

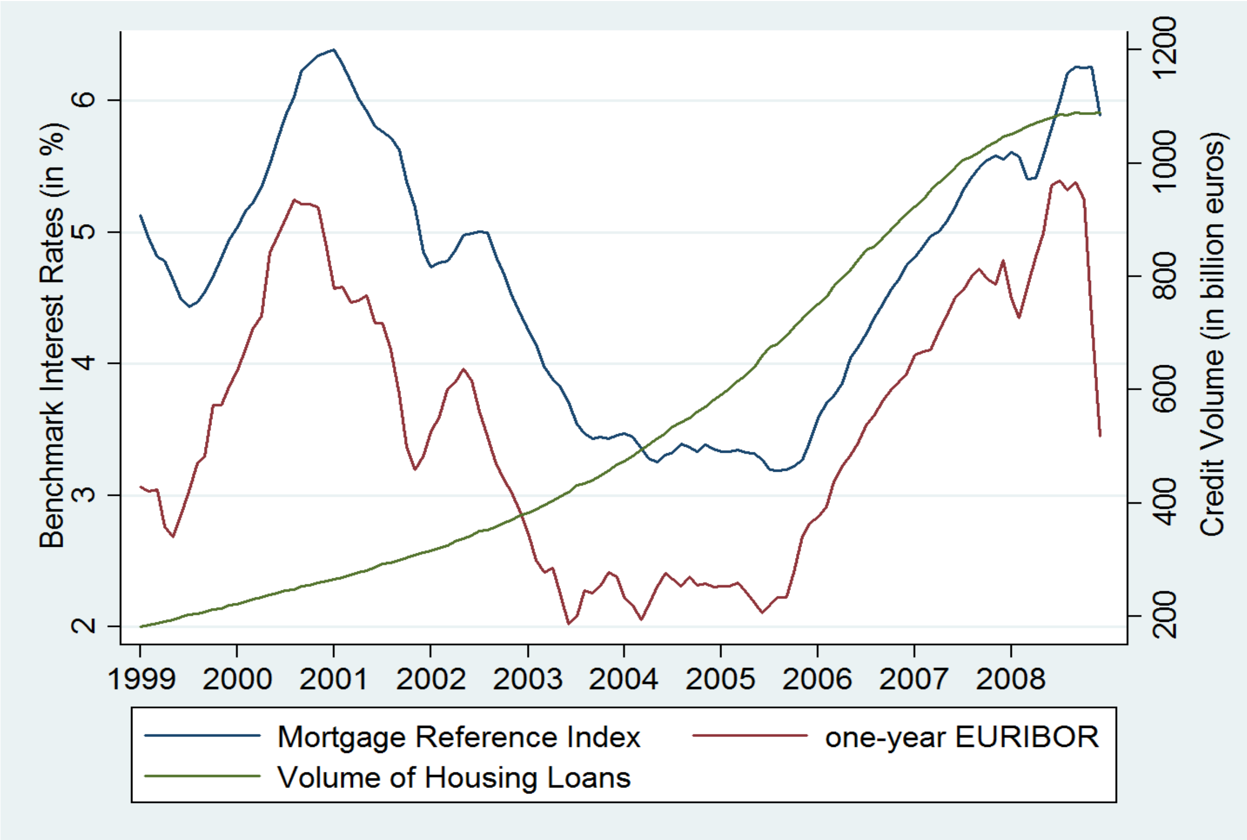


Source: Bank of Greece

In Spain, the share of variable-rate lending in new loans for house purchase remained well above 75 percentage points throughout the period of analysis. The interest rate was freely agreed between banks and lenders. That is, the interest rates for mortgage loans and credit were not fixed in any regulation[5]. To illustrate the evolution in time of the cost of mortgage borrowing we use the reference index for mortgages used by all lending entities. It is calculated as the average interest rates of mortgage operations with a term of three years or more and has been argued to measure precisely the evolution of the price of money in Spain (Bank of Spain, 2013). We also include the one-year EURIBOR rate since it was and still is the most widely used benchmark.

[5] To increase transparency, the Bank of Spain in 2011 established official benchmark rates for the mortgage market. These included the one-year EURIBOR (most widely used), the internal rates of return on government debt on the secondary market, with maturities of between two and six years, the five-year interest rate swap (IRS), the average rate for mortgages at over three years, granted by all Spanish financial institutions, and the average rate for mortgages of between one and five years, granted by all credit institutions in the euro area.

Figure 2: Volume of Housing Loans and Benchmark Interest Rates; Spain, Jan 1999 – Dec 2008:



Source: Bank of Spain

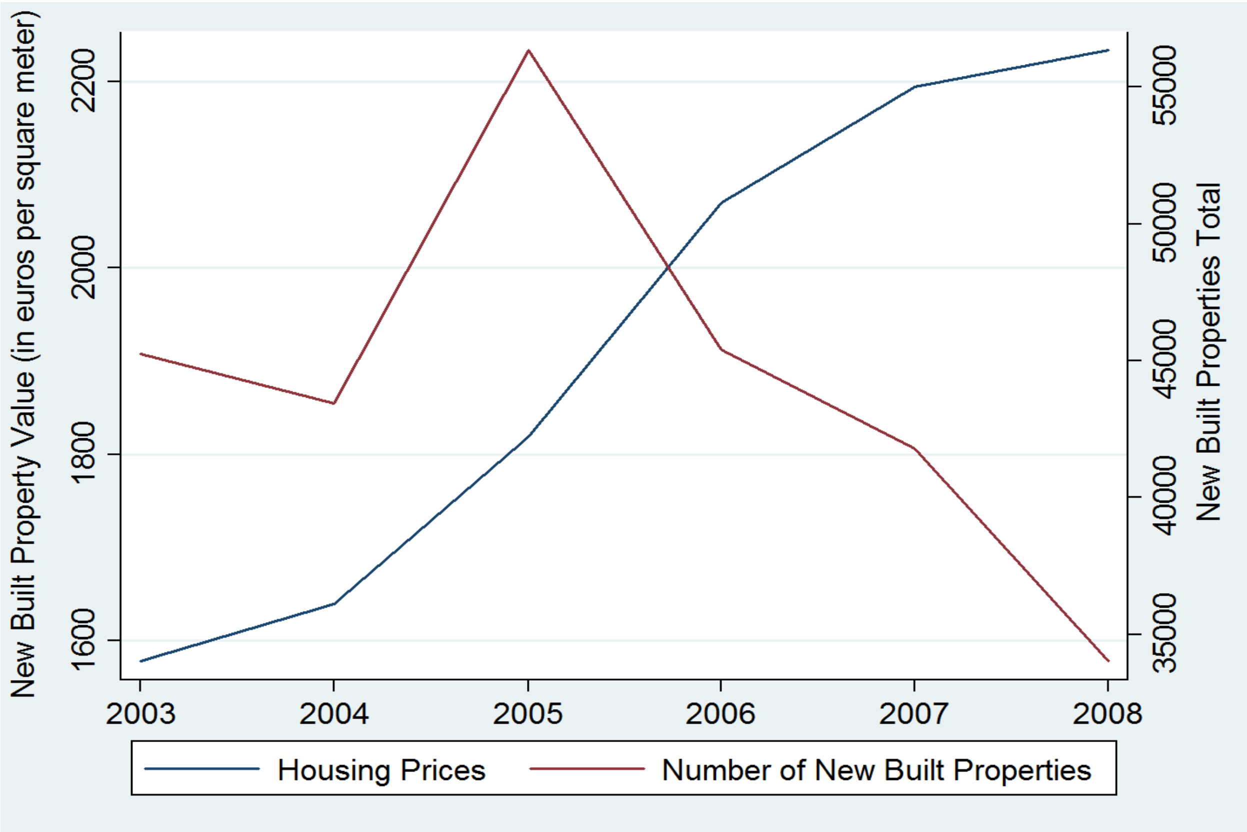
The cost of mortgage borrowing in Spain did not decrease immediately after the currency conversion in 1999 as Figure 2 shows. Mortgage interest rates began their free falling 2001 and stabilized at historically low levels from 2003 until 2006 when the housing bubble had matured. Specifically, the average mortgage rate and the one-year EURIBOR plunged by 46.7% and 39.1%, respectively. This sharp decrease in the cost of lending transformed the mortgage market which grew in volume by 64.7% from 2001 till 2006 and by an unprecedented 391.7% over the period of our empirical analysis.

The enormous growth in housing lending provided a strong and positive shock in housing demand which, subsequently, led to a construction boom. In 1999, there were 1.6 and 2.6 housing starts per 100 dwellings in Greece and Spain, respectively; by comparison housing starts averaged 1.2 for the whole EMU area. In the year of the Athens 2004 Olympics and peak of construction, housing starts per 100 dwellings increased to 2.1 in Greece.

By 2007, when the housing bubble in Spain had fully matured housing starts recorded 2.4 per 100 dwellings. In contrast, the EMU did not experience a housing construction boom as a whole; by 2005, 1.3

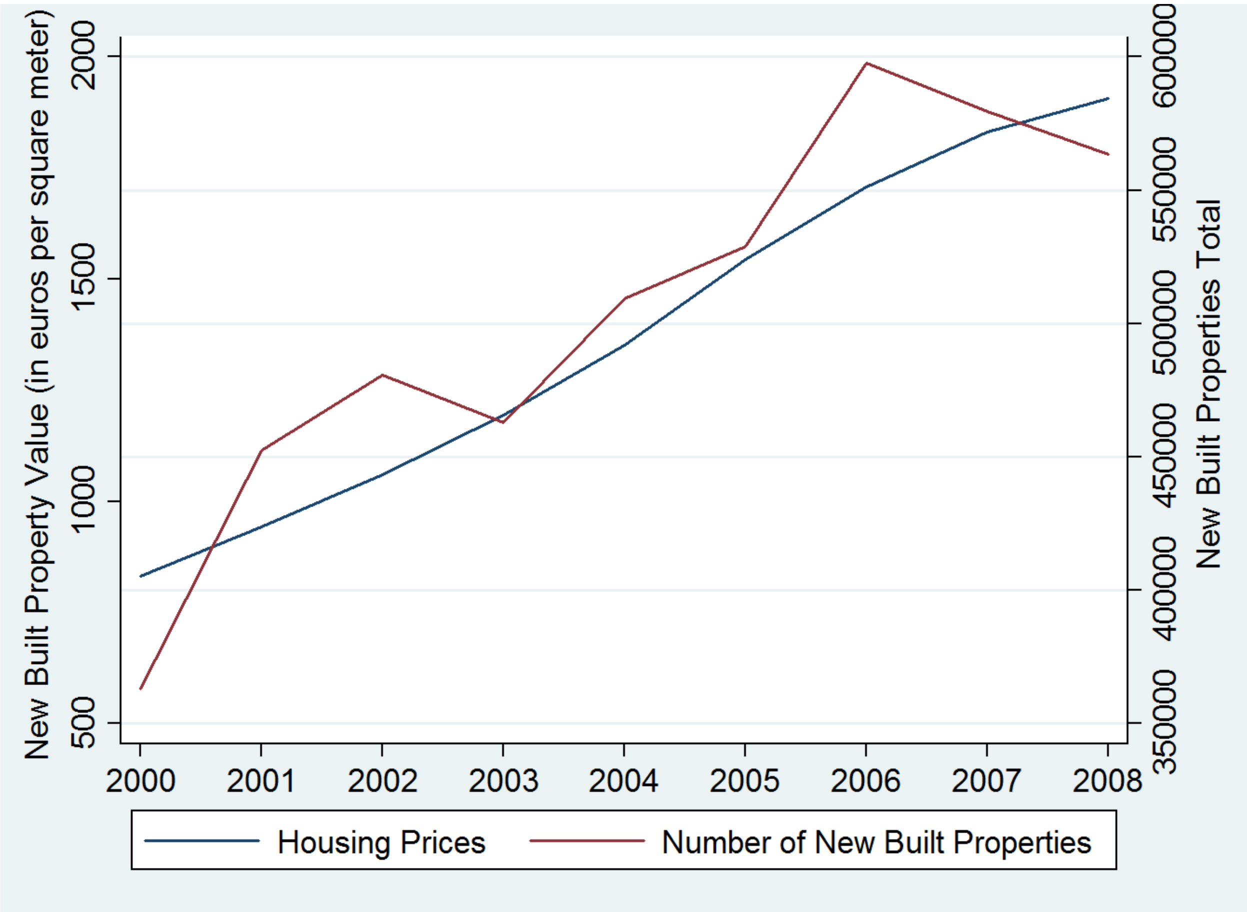
new housing starts per 100 dwellings were observed (ECB Structural Issues Report, 2009). Given the fixed supply of land, the increase in building permits issued put upwards pressure on housing prices as Figures 2 and 3 illustrate for Greece and Spain, respectively. Surging housing prices in combination with fixed, inflation-adjusted construction costs [Brissimis et al. (2007)] meant greater profit opportunities to housing developers. In turn, these profits translated into increased rent-seeking opportunities for corrupt public zoning officials from land re-zoning.

Figure 3: Housing Prices and Number of New Built Properties; Greece, 2003 – 2008:



Source: Bank of Greece and Hellenic Statistical Authority

Figure 4: Housing Prices and Number of New Built Properties; Spain, 2000 – 2008:

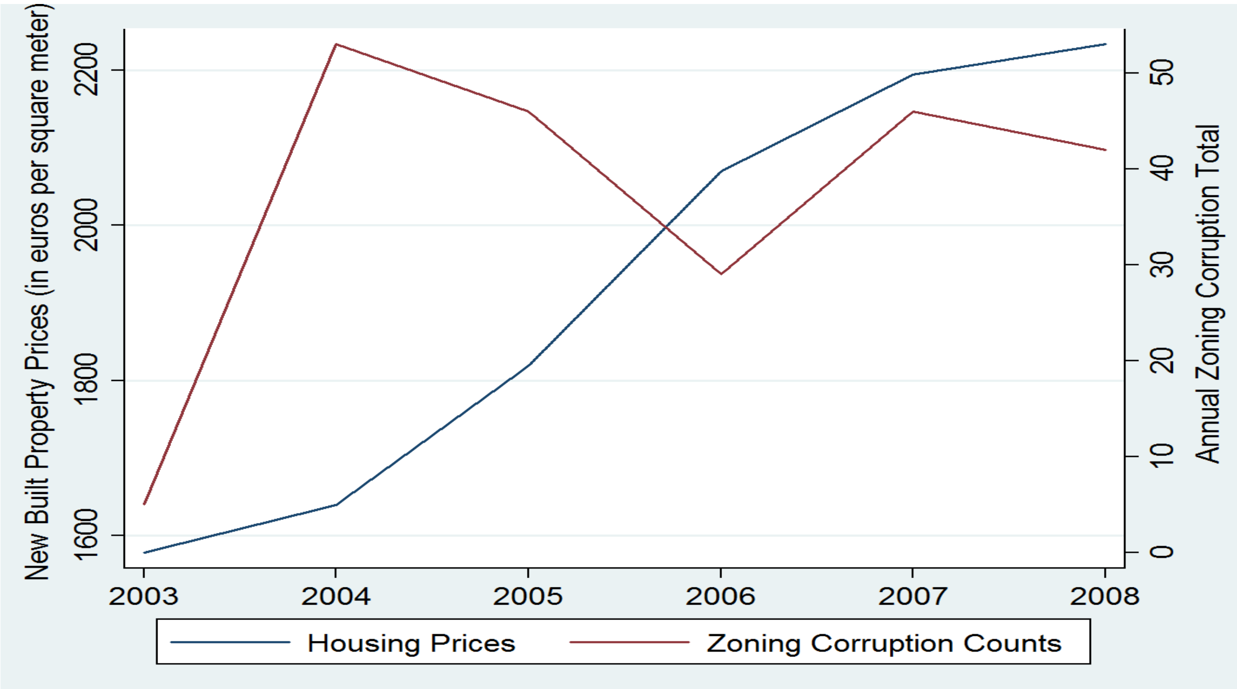


Source: Bank of Spain and Ministry of Public Works, Spain

Figures 5 and 6 reveal more corruption cases as housing prices trended upwards both in Greece and Spain. There is a large initial jump in corruption coinciding with the year Athens hosted the Olympics and then corruption persisted at levels at least thrice as large relative to corruption levels in 2003.[6]

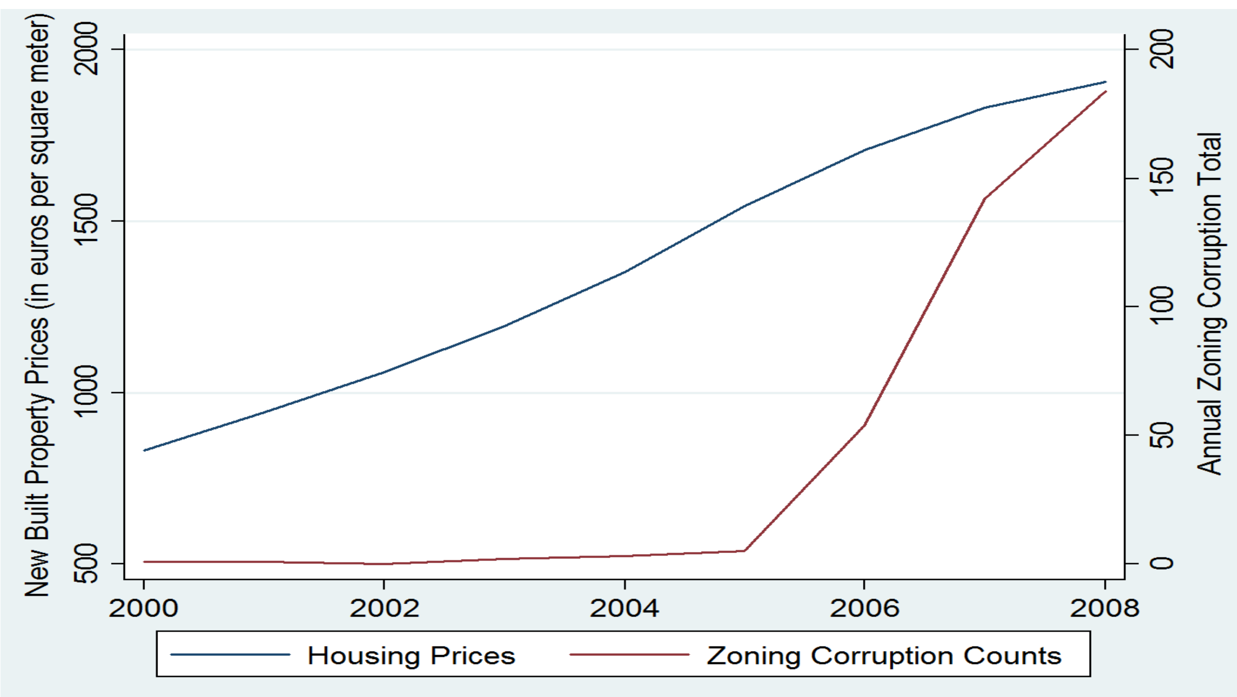
[6]Seligson (2006) warns that increases in legal indictments on record may be due to worsening corruption levels or alternatively reflect tougher monitoring by prosecutors in Greece. However, it was not until after the 2008 financial crisis started and the intervention of the "troika" commenced a little after that Greece experienced a tougher law enforcement stance. Similarly, the rise in reported corruptions cases in the public media may reflect an increase in corrupt activity or instead increased media interest or public administration scrutiny in Spain. Unlike in Greece, corruption was reported well after the beginning of the housing bubble. The mass of zoning corruption was revealed almost by 2007, the start of Spain's property bust. Regional and nationwide elections took place in 2007 and 2008, respectively, which could have acted as an additional incentive for prosecuting corruption.

Figure 5: Corruption Counts and Housing Prices in Greece, 2003 – 2008:



Source: Bank of Greece and Inspectors-Controllers Body for Public Administration

Figure 6: Corruption Counts and Housing Prices in Spain, 2000 – 2008:



Source: FundacionAlternativas, National Statistical Authority of Spain

As a step forward in identifying a link between housing prices and corruption counts we note the pairwise correlation coefficients between corruption counts and housing prices in Greece and Spain for the period 2000 – 2008 (Tables A.3a-b in the Appendix). Applying the Bonferroni adjustment, we find a positive and statistically significant correlation between housing prices and corruption for both countries. These associations are also fairly comparable between the Greek (ρ=0.33) and Spanish (ρ=0.26) cases. However, these estimates allow us only to get an understanding of the underlying association between corruption and housing prices, but do not have, of course, a causal interpretation.

4. Empirical Analysis

Our empirical analysis does not combine the national samples for Greece and Spain. Even though Greece and Spain are not dramatically different in many respects, there are sufficient institutional and economic differences not to warrant the assumption that the data are being generated by the same processes. Indeed, observed variability of the outcome variable (corruption counts) may exist not only because the data come from different sources for each country (inherent to the administrative nature of objective corruption measures, in our case) but also due to differences in the set of available data sources [Kaufman, Kraay, and Mastruzzi (2010)].

Although the comparable declines in mortgage rates these two countries experienced following the creation of the EMU would have permitted national aggregation, a subnational disaggregation at the regional level yields within country variation that provides superior variation across time and space for identification. Housing prices increased faster in regions with higher demand for housing coming from factors other than interest rates. For example, coastal regions could have experienced greater relative price swings possibly because tourism is more prominent there. Then, this would make zoning authorities in these regions more susceptible to receiving bribes for unlawful residential construction. Therefore, our hypothesis is that one would expect such differential incentives to generate different levels of corruption across regions, with illegal activities exacerbated in higher-profile regions.

4.1 Data

Our main dependent variable is an objective (non perception, non survey-based) metric of corruption at the regional level (EU classification: NUTS level 2).Due to the non-negativity and the arrival nature of the corruption observations, the dependent variable should be understood as a count (Bujko et al., 2015).

In the case of Greece we employ monthly prosecution records of the public administration from January 2003 through December 2008to measure zoning corruption. More specifically, the source of the dependent variable observations for Greece is the "Inspectors-Controllers Body for Public Administration of Greece", an internal audit service of the Greek public administration which among its other functions independently monitors zoning officials' implementation of public service.[7]There are six categories that relate to public administration malpractices but to make results directly comparable to those for Spain, we are only examining the "Corruption – Legal Indictments" category. Therefore, each observation represents the observed counts of legal indictments of zoning officials for regional corruption cases. Note that the use of corruption audits is relatively recent development in the literature and is becoming more prevalent (Olken, 2007; Ferraz and Finan, 2009; Caselli and Michaels,2013; Brollo et al., 2013).

The dependent variable for Spain depicts the number of published corruption scandals per quarter in a region from 2000 to 2008.The Spanish data on corruption were obtained from a team of researchers at the University of La Laguna (Canary Islands, Spain) that has already generated multiple publications on Spanish real estate corruption related to local public officials [Martín-Martín et al. (2010); Jerez-Darias et al. (2012)]. The identified cases of corruption deal with real estate crimes and the calculus of corruption counts is based on media reporting. This approach of corruption enumeration through newspaper reports is not new and it has also been used in previous studies of public corruption in Spain [FundaciónAlternativas (2007); Costas-Pérez, Solé-Ollé, and Sorribas-Navarro (2012)] and also for financial scandals and election law violations in Japan [Nyblade and Reed (2008)] and oil revenue embezzlement in Brazil [Caselli and Michaels (2013)].

Housing prices is the key independent variable of interest in the paper. Considering merely the current level of corruption assumes away any cases where a rise in housing prices triggered zoning corruption at a future time period. To understand better the dynamic effects of housing prices onto zoning corruption we also consider HPI lagged variants. This allows us to test whether the effects are immediate or delayed. To account for the time-consuming process a corruption count takes to mature we use an 18-month HPI lag. This period is the average duration for a dwelling to be constructed in Greece and accounts for the gradual exposure of a zoning scandal and coverage by Spanish media outlets as a legal indictment.

For Greece, housing prices are taken from the Housing Price Index (HPI) compiled by the Real Estate Market Analysis Section of the Bank of Greece. To accommodate comparability to the unit housing prices

[7] The data were obtained during our personal visit to the Inspectors unit in Athens in August 2014. Inspections are delineated into 16 categories that fully describe the nature of the violation. The six corruption-related categories incorporated in our measure of the dependent variable are: (1) Corruption - Other Legal Indictments; (2) Illegal Action; (3) Organizational Problems; (4) Violations of Code of Conduct; (5) Violation of Transparency; (6) Omission of Designated Action.

in Spain are measured, we use the levels of actual median residential property prices from (Mitrakos et al., 2014) which are expressed in euros per square meter.

For Spain, housing prices were extracted from the website of the Spanish Ministry of Public Works and Transport. They represent property values of new housing units, are expressed in euros per square meter, and cover2000 through 2008 in quarterly frequency.

Besides housing prices, and based on the findings of the literature, other factors can potentially influence the incentives of zoning officials towards corruption in within country analyses. Following the previous literature on the determinants of corruption as control variables we introduce in the regressions unemployment rates, population density, and enrollment rate in tertiary education. All control variables are obtained from Eurostat's regional statistics portal.

Explaining the control variables in more detail, education attainment is measured via enrollment rates in tertiary education. Bias from the use of tertiary education could potentially come from the fact that large metropolitan areas feature more tertiary educational institutions, skewing enrollment rates higher more populous regions. However, this concern is mitigated by the fact that public tertiary education is uniformly provided across regions of Greece and Spain, a feature that is quite common across continental European education systems. Literacy rates are an alternative measure commonly found in past empirical research but would have yielded negligible variation across regions given the EMU context.

Population density measures the number of inhabitants in a region (all ages, both sexes) per square kilometer. More scarcely populated regions could have fewer corruption counts simply because there is more land available to develop. Alternatively, in more dense regions more people compete for land which produces more checks on the performance of the zoning officials and, subsequently, less corruption. As a matter of fact, most audits in Greece were initiated when adjacent residential property owners extended an informal complaint or filed a zoning appeal that later revealed the official's misconduct.

Finally, we use the unemployment rates of individuals aged 15 years or over, both sexes, as a predictor of housing demand. GDP could have alternatively been used to proxy housing demand. However, there are reasons to expect that GDP is correlated with housing prices which could have attenuated our coefficient of interest.[8]

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[8]Indeed, housing prices are more collinear with GDP (ρ= 0.29 for Greece; ρ= 0.68 for Spain) than unemployment (ρ=-0.28 for Greece; ρ= -0.14 for Spain).

Tables A.1a and A.1b in the Appendix provide summary statistics; Tables A.2a and A.2b contain a short description of the variables used as well as their source; Tables A.3a and A.3b report correlation coefficients between all of the study variables for Greece and Spain, respectively.

4.2 Empirical Approach

By refraining from carrying out estimations using pooled data from Greece and Spain we avoid introducing national fixed effects that would capture a large fraction of the overall variation. Instead, as described above our empirical approach focuses on the regions of a single country at a time. Therefore, institutional homogeneity is implicitly assumed since institutional quality controls are available only at the national level. Nevertheless, it is plausible that within a country major differences in the quality of public administration across regions may still exist. Our paper attempts to capture these discrepancies through the education control which is often regarded as a proxy of overall development and has been found to correlate with enhanced government performance.

Formally, the analysis posits that the incidence of corruption is a function of housing prices (HPI) controlling for educational attainment, unemployment, and population density:

$$Y_{it} \sim f(HPI_{it}, \boldsymbol{X_{it}}, \alpha_i, \delta_t) \quad (1)$$

where Y_{it} represents corruption measured by counts of legal indictments of zoning officials in region i at year t;HPI_{it} denotes housing prices and is our key independent variable of interest; $\boldsymbol{X_{it}}$is the vector of controls which includes population density, the unemployment rate and the enrollment rate in tertiary education in region i at year t. Finally, we include region- and year-specific effects, $\alpha_i$and δ_t, respectively, to account for other systematic unobservable effects.

Graphs A.1 and A.2 in the Appendix show that the Greece and Spain samples are dominated by zeros and highlight the need for a modeling strategy that takes this phenomenon into account. The coexistence of a high proportion of zeros along with very large values of counts makes it difficult for a linear specification to appropriately model corruption. The Poisson and the negative binomial are the primary specifications used in the literature under these conditions (Cameron & Trivedi, 2005).

Let Y_{it} be the count for the i^{th} region in the t^{th} year. Then, the Poisson fixed effects model is given by:

$$Y_{it} \sim Poisson[\alpha_i \exp(\boldsymbol{X'_{it}\beta})] \; (2)$$

A Poisson data generating process assumes the rate parameter $\alpha_i \exp(\boldsymbol{X'_{it}\beta})$is known when, in fact, it is a random variable itself. Further, Poisson models require that the conditional mean is equal to the conditional variance. However, we observe a count data process where the latter exceeds the former (overdispersed dataset). In the presence of overdispersion, fixed effects negative binomial models are preferred to Poisson ones because they allow for flexibility modeling the moments of the observed distribution of corruption; namely, that the conditional mean may differ from the conditional variance. The superiority of the negative binomial to the Poisson models in fitting observed corruption in Greece and Spain is clearly illustrated by Appendix Graphs A.3 and A.4, respectively.

From(2), let

$$\alpha_i \exp\left(\boldsymbol{X'_{it}\beta}\right) \sim gamma(\lambda_{it}, \delta_i)$$

$$\lambda_{it} = \exp\left(\boldsymbol{X'_{it}\beta} + offset_{it}\right)$$

where δ_i denotes the dispersion parameter. This results into the following density function

$$f\left(Y_{it} \middle| \boldsymbol{X_{it}}, \delta_i\right) = \frac{\Gamma(\lambda_{it} + y_{it})}{\Gamma(\lambda_{it})\Gamma(y_{it} + 1)} \left(\frac{1}{1 + \delta_i}\right)^{\lambda_{it}} \left(\frac{\delta_i}{1 + \delta_i}\right)^{Y_{it}} \quad (7)$$

For the fixed-effects overdispersion model, the joint density of the counts is conditioned on the sum of the counts for the region, $\sum_{t=1}^{T} y_{it}$. Therefore,

$$f\left(\boldsymbol{Y_i} \middle| \boldsymbol{X_i}, \textstyle\sum_{t=1}^{T} Y_{it}\right) = \frac{\Gamma(\sum_{t=1}^{T} \lambda_{it})\Gamma(\sum_{t=1}^{T} Y_{it} + 1)}{\Gamma(\lambda_{it} + \sum_{t=1}^{T} Y_{it})} \prod_{t=1}^{T} \frac{\Gamma(\lambda_{it} + y_{it})}{\Gamma(\lambda_{it})\Gamma(y_{it} + 1)} \quad (8)$$

Following Hausman, Hall and Griliches (1984), we use the Andersen's conditional ML methodology to estimate the coefficient of the HPIs. The conditional log likelihood that we estimate for the fixed-effects negative binomial models is given by

$$\begin{aligned} lnL = w_i \Bigg[& ln\Gamma\left(\sum_{t=1}^{T} \lambda_{it}\right) + ln\Gamma\left(\sum_{t=1}^{T} Y_{it} + 1\right) - ln\Gamma\left(\sum_{t=1}^{T} \lambda_{it} + \sum_{t=1}^{T} Y_{it}\right) \\ & + \sum_{t=1}^{T} \left\{ ln\Gamma\left(\sum_{t=1}^{T} \lambda_{it} + \sum_{t=1}^{T} Y_{it}\right) - ln\Gamma(\lambda_{it}) - ln\Gamma(y_{it} + 1) \right\} \Bigg] \quad (9) \end{aligned}$$

where w_i is the weight of the i^{th} region in the estimation.

Despite our best efforts for modeling accuracy, causality cannot be vigorously established. Data availability is a source of minor concern as negative binomial models perform well for sample size of at least 500 observations. This requirement is met by both study states but not very comfortably. In addition, the regional geographical disaggregation does not generate ideal cross-sectional variation for the panels methods employed. We specify 13 and 17 regional fixed effects for Greece and Spain, respectively.

4.3 Results: The Case of Greece

Table 2 presents the estimates of the effect of housing prices on zoning corruption in Greece. Columns (1) and (2) show unadjusted coefficient estimates of the housing price effect. Columns (3) and (4) adjust for our study's controls: the unemployment rate, population density, and the share of the population with tertiary education.

Table 2: Housing Prices and Corruption – Greece, 2003-2008 in months

VARIABLES	(1) Contemporaneous	(2) Lagged	(3) Contemporaneous	(4) Lagged
Housing Prices	$4.901\times10^{-4**}$		0.086×10^{-4}	
	(2.418×10^{-4})		(0.074×10^{-4})	
Housing Prices, 18m lag		$6.942\times10^{-4**}$	3.686×10^{-4}	$22.33\times10^{-4***}$
		(2.753×10^{-4})	(4.98×10^{-4})	(5.363×10^{-4})
Unemployment Rate			0.721	2.587
			(0.970)	(1.299
Population Density			$-20.2\times10^{-4*}$	-1.181×10^{-4}
			(11.99×10^{-4})	(1.077×10^{-4})
Tertiary Education			1.383	-2.499
			(0.965)	(1.193)
Observations	936	702	936	702

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The column (1) presents the association between corruption and contemporaneous housing prices. The coefficient of the HPI is positive and statistically significant at the 5% level. A monthly increase in current housing prices by five percentage points (€96.11 per square meter) increases the likelihood of an extra corruption count in that month approximately by 4.8%.[9]Column (2) shows evidence of the correlation between corruption and housing prices 18 months ago, the average time to completion of a dwelling in Greece. Similarly, the HPI coefficient indicates that an increase in 18-month lagged housing prices by five percent increases the probability of an extra corruption count in that month by about 6.8%. Columns (3) and (4) adjust for the full set of controls. Column (3) contains the only estimate that relates

[9]Note that negative binomial regression models the log of the expected corruption count as a function of the predictors. The estimated coefficients represent the difference in the logs of expected counts of corruption where positive values denote increases in the arrival rate of corruption. They could also be interpreted as incidence rate ratios after exponentiation of the coefficients. The effects are computed throughout the paper according to the formula $\%\Delta y = (\exp\{\beta^*\Delta x\} - 1)*100$ where β denotes the estimated coefficient and Δx changes in housing prices.

housing prices and zoning corruption in a non-significant manner; yet still positive. A five percentage point monthly increase in contemporaneous housing prices yields 1% higher probability of a zoning official's legal indictment. A year and half years later, the effect is much stronger; a five percent increase in lagged housing prices is linked with a 23.9% higher incidence of zoning corruption. Finally, we find

Unemployment is positively correlated with corruption, and significantly in the specification using lagged HPI in column (8). Population density is negatively associated with corruption. This finding is in line with the practice of the audit process in Greece which is initiated and augmented by adjacent property owners' reports. It provides evidence that zoning corruption is more prevalent in scarcely-populated regions. Education, our measure of a region's overall development, has a negative and statistically significant association with zoning corruption according to the results of our primary specification presented in column (8).

4.4 Results: The Case of Spain

Table 3 presents the estimates of the effect the housing bubbles on zoning corruption scandals in Spain. As before, columns (1) and (2) show unadjusted coefficient estimates whereas columns (3) and (4) adjust for the study's controls.

Table 3: Housing Prices and Corruption – Spain, 2000-2008 in quarters

	(1)	(2)	(3)	(4)
VARIABLES	Contemporaneous	Lagged	Contemporaneous	Lagged
Housing Prices	$46.06\times10^{-4***}$		$47.79\times10^{-4***}$	
	(3.501×10^{-4})		(3.964×10^{-4})	
Housing Prices,		$38.85\times10^{-4***}$		$40.11\times10^{-4***}$
18m lag		(2.878×10^{-4})		(3.279×10^{-4})
Unemployment			0.496	-0.947^{**}
Rate			(0.97)	(0.473)
			$-82.54\times10^{-4***}$	$-65.40\times10^{-4***}$
Population			(16.21×10^{-4})	(14.12×10^{-4})
Density			0.376	-0.317
			(0.253)	(0.215)
Tertiary	-16.09^{***}	-14.44^{***}	-12.64^{***}	-11.37^{***}
Education	(0.536)	(0.414)	1.518	1.313
Observations	612	510	612	510

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Column (1) presents the relationship between corruption and contemporaneous housing prices. As hypothesized, the coefficient of the HPI is positive and statistically significant at the 1% level. A quarterly increase in current housing prices by five percent or €68.71 per square meter increases the probability of an extra corruption count in that month by 37.2%. Column (2) provides evidence of the correlation between corruption and housing prices 18 months ago. Again, the coefficient of the HPI is very precisely estimated (significant at the 1% level), positive and slightly smaller in magnitude. A five percentage point increase in housing prices six quarters ago increases the likelihood of an extra corruption count in that quarter by about 30.5%. The findings for Spain are robust to the inclusion of the controls. An increase in contemporaneous housing prices by €68.71 per square meter increases the arrival rate of another zoning scandal by 38.8%. A year and half years later, the same housing price increase is linked with a higher incidence of zoning corruption.

There is mixed evidence on the effect of unemployment on zoning corruption; the precisely estimated coefficient hints towards a negative relationship. At first blush, this result might seem counterintuitive. Recall that unemployment explains demand-sided sources of corruption variation. Since zoning officials themselves enjoy tenured positions, less unemployment could translate into stronger pro-corruption incentives in the presence of investment plans that decreased unemployment in the first place. Therefore, more regional unemployment could be understood as a predictor of weaker economic activity, less construction and fewer potentially illegal re-zoning, as a by-product. In Spain, there is very strong and robust evidence that zoning corruption is more scarcely in more sparse regions as the negative and very precisely estimated density coefficient indicates which conforms to conventional wisdom. The opportunity for illegal re-zoning and other onerous urban planning is expected to be greater in scarcely populated regions, where the potential capture of the regulator seems to be easier (Stigler, 1971). No meaningful inference can be made about the effect of education on zoning corruption. The coefficient is not estimated with precision, taking both positive and negative values, and alternating signs across columns (7) and (8).

4.5 Robustness Checks

Here we present the results from a set of robustness checks that employ zero-inflated Negative Binomial regression models. This approach is desirable for modeling count data with a significant number of zeros. In essence, we check whether the presence of a zero was actually true or is due to misspecification. The theory suggests that the excess zeros are generated by a separate process from the count values and models them independently using a logit model for predicting excess zeros. We choose regional population as the direct predictor of the number of corruption cases in a region. The window of opportunity to engage in corrupt acts should be greater in regions with larger population simply by virtue of size. Therefore, a negative coefficient would sufficiently control for the inflation of zeros in zoning corruption in less populated regions. This is further justified after inspecting the cross-correlations tables

A.3a-b.In both samples, population is the most positively correlated variable with corruption, other than the HPIs[10]. Also, since population and density are highly collinear, we drop density from the robustness check specification. It should be noted that zero-inflated models are not recommended for small samples. Table 5 presents regression results of zero-inflated negative binomial variants for Greece. Columns (1) and (3) correspond to results specifying the Vuong option which provides a test of the validity of the zero-inflated model versus the standard negative binomial one. Columns (2) and (4) account for heteroscedasticity with the use of robust standard errors.

Table 5: Housing Prices and Corruption – Robustness Checks, Greece

	(1) Vuong Test	(2) Robust SEs	(3) Vuong Test	(4) Robust SEs
COUNT MODEL				
Housing Prices	-3.905×10^{-4}	-3.905×10^{-4}		
	(4.396×10^{-4})	(4.51×10^{-4})		
Housing Prices, 18m lag			$9.885\times10^{-4***}$	$9.885\times10^{-4***}$
			(5.454×10^{-4})	(4.825×10^{-4})
Unemployment Rate	1.811	1.811	1.507	1.507
	(1.048)	(1.116)	(1.337)	(1.423)
Tertiary Education	3.718^{***}	3.718^{***}	-1.394	-1.394
	(0.94)	(0.872)	(1.336)	(1.439)
LOGIT MODEL				
Population	$-0.224\times10^{-4*}$	$-0.224\times10^{-4*}$	-0.453×10^{-4}	$-0.453\times10^{-4**}$
	(0.119×10^{-4})	(0.125×10^{-4})	(0.865×10^{-4})	(0.182×10^{-4})
Observations	936	936	702	702

Standard errors in parentheses
$^{*}p< 0.1$, $^{**}p< 0.05$, $^{***}p< 0.01$

For the specification in column (1), the test statistic of the Vuong test is z = 0.65 and not significant at traditional levels (Pr>z = 0.2568). Therefore, we can formally discard the findings presented in columns (1) and (2). We fail to obtain a test statistic for the Vuong test in the specification using lagged housing prices for the samples of 702 observations. Still, we recover a positive and statistically significant relation between zoning corruption. Overall, the robustness checks favor the results of our main specifications for Greece in 4.3, Table 3.

Table 6 presents regression results of zero-inflated negative binomial models for Spain. Given that a lengthy time is required for a zoning scandal to be uncovered, prosecuted and reported in the media following conviction, we are more comfortable with the results using the lagged HPI among the two. There is mixed evidence about the relationship between housing prices (contemporaneous and lagged)

[10] For the sample on Greece, density is the second most highly correlated variable with corruption; conditioning the logit model on density instead of population does not change the results of the robustness check.

and zoning corruption. However, in both (1) and (3) the Vuong test statistics fail to reject the validity of the standard negative binomial models versus the zero-inflated ones (z = 0.67, Pr>z = 0.2525; z = 0.01, Pr>z = 1). On this formal basis, we discard the estimates in Table 6 and maintain the standard negative binomial models' results in 4.4, Table 4 as our primary findings for Spain.

Table 6: Housing Prices and Corruption – Robustness Checks, Spain

	(1) Vuong Test	(2) Robust SEs	(3) Vuong Test	(4) Robust SEs
COUNT MODEL				
Housing Prices	$-59.83\times10^{-4***}$	$-59.83\times10^{-4***}$		
	(5.95×10^{-4})	(7.225×10^{-4})		
Housing Prices, 18m lag			$46.18\times10^{-4***}$	$46.18\times10^{-4***}$
			(5.342×10^{-4})	(5.407×10^{-4})
Unemployment Rate	-1.198^{*}	-1.198^{**}	-1.422^{**}	-1.422^{***}
	(0.672)	(0.542)	(0.665)	(0.518)
Tertiary Education	-0.144	-0.144	1.035	1.035
	(0.814)	(0.872)	(0.909)	(0.917)
LOGIT MODEL				
Population	$-0.016\times10^{-4**}$	$-0.016\times10^{-4***}$	$-0.019\times10^{-4**}$	$-0.019\times10^{-4**}$
	(0.001×10^{-4})	(0.005×10^{-4})	(0.07×10^{-4})	(0.008×10^{-4})
Observations	612	612	510	510

Standard errors in parentheses
$^{*}p< 0.1$, $^{**}p< 0.05$, $^{***}p< 0.01$

5. Concluding remarks

In this paper we have examined the effect of the housing market boom in Greece and Spain on zoning corruption. The understanding of the determinants of corruption and its effects on the economy is a fast-growing field of study in Public and Urban Economics. However, the literature lacks an empirical strategy that uses objective measures of corruption and exogenous shocks to study the sources and effects of corruption. We shed light on this issue by examining how exogenous variation in the housing prices affected zoning officials' corruption motives following the adoption of the euro in Greece and Spain.

We estimated negative binomial models and tested the robustness of our findings using zero-inflated models. As hypothesized, increased housing prices are linked with higher corruption of zoning officials both in Greece and in Spain. Further, we find that the influence of a housing boom on a zoning official's conduit can be long-lasting as the housing price signals not only show persistence after a year and a half but appear to have an even greater impact. This finding is intuitively valid since audits of zoning audits occur after building completion, which averages 18 months. Our primary specifications (Table 2, column (4) for Greece and Table 3, column (4) for Spain) suggest that a five percent increase in housing prices a year and a half ago result to a higher incidence of zoning corruption by 23.9% for Greece and by 31.7% for Spain. These magnitudes are fairly comparable to what relevant corruption literature (exploiting instances of exogenous variation of corruption incentives) finds. IV estimates in Maldonado (2010) show that a unit change in the log of local revenues from natural resource windfalls increases the probability of being asked a bribe from a local public official by 80%. Caselli and Michaels (2013) find that an increase in oil output per mayor translates to increased probability of another municipality corruption scandal reported in the news. Vicente (2013) finds that, following oil discovery, Sao Tome experienced a rise in perceived corruption with respect to vote buying, scholarship allocation, customs, courts, healthcare, the allocation of state procument/subsidies and state jobs ranging from 31% to 40% relative to Cape Verde.

From a policy standpoint, an important takeaway is the long-lasting and time-lagged nature of zoning corruption. Surveillance units should map housing bubbles onto future zoning corruption incidences instead of monitoring according to current housing price fluctuations. Moreover, the negative association between zoning corruption and population density hints towards a behavioral policy prescription: the engagement of the citizenry in combatting zoning corruption through the accommodation of corruption audits. Finally, increased participation rate in tertiary education is found to be a significant negative predictor of corruption arrivals in Greece.

The main limitation of the study is reliance on a non-random sample. Given the observational nature of our study, selection bias could be present if, for example, one region might record more zoning corruption simply because it attracts inspectors' attention more than others for factors our study fails to adjust for. Such administrative constraints mask unobservable heterogeneity leading to inference from a nonrandom sample. A potential remedy is to exploit exogenous variation of housing prices across space and time. This is the strategy we adopt in the paper and thus we believe that our housing price coefficients are not driven entirely by bias. To test the significance of our findings, we also consider zero-inflated models which independently model excessive zeros.

Expanding on this study, there exist several avenues for future research. One could attempt to narrow down the level of geographical disaggregation to introduce more cross-sectional variation; namely, NUTS level 3. Another extension would be broadening the geographical scope of the analysis by considering zoning corruption in other EMU member states that also experienced a housing bubble following the adoption of the euro such as Ireland.

APPENDIX

Table A.1a: Summary Statistics Greece

VARIABLES	N	Mean	Standard Deviations	Minimal Value	Maximal Value
Corruption Counts	936	0.2361111	0.6160244	0	6
Housing Prices (in € per square meter)	936	1,922.25	405.29	1,228	3,071
Unemployment Rate (%)	936	9.66	2.35	4.4	18.54
Tertiary Education Enrollment Rate (%)	936	17.23	4.11	10.5	28.1
Population	936	851,855.5	996,541.6	201,796	4,000,000
Population Density	936	133	265	31.4	1,058.2

Table A.1b: Summary Statistics Spain

VARIABLES	N	Mean	Standard Deviations	Minimal Value	Maximal Value
Corruption Counts	612	0.6405229	1.889291	0	23
Housing Prices (in € per square meter)	612	1,374.22	545.97	476.7	3,078.16
Unemployment Rate (%)	612	8.13	3.51	1.73	20.26
Tertiary Education Enrollment Rate (%)	612	51.76	12.41	24.4	77.6
Population	612	2,535,311	2,215,638	267,911	8,046,131
Population Density	612	150	164	21	789

Table A.2: Data Notes

VARIABLES	Source	Description
Corruption, Greece	Inspectors-Controllers Body for Public Administration	Legal Indictments of Inspection Verdicts by Independent Public Auditors
Corruption, Spain	University of La Laguna, Spain and FundacionAlternativas	Corruption counts is based on media appearance
Housing Prices, Greece	Bank of Greece	4-part Housing price index compiled by the Regional Economic Conditions Service of the Bank of Greece's Economic Research Department; base year is 2007
Housing Prices, Spain	Spanish Ministry of Public Works and Transport	Quarterly Average Housing Price Index
Population Density	Eurostat	Inhabitants per square kilometer, all ages, both sexes
Unemployment	Eurostat	Unemployment Rate, aged 15 years or over, both sexes
Educational Level	Eurostat	share of the population aged 30-34 years who have successfully completed university or university-like education with an education level ISCED 1997 (International Standard Classification of Education) of 5-6

Computation Note: Derivation of Housing Prices for Greece:

Greek housing prices are taken from the Housing Price Index (HPI) compiled by the Real Estate Market Analysis Section of the Bank of Greece. Four regional HPIs are available taking values from 24.18 to 102.6, overall, 2006 being the base year. There is a HPI for the cities of Athens and Thessaloniki that precisely maps onto the Attica and the Central Macedonia regions of analysis, respectively. The third HPI is representative of housing prices of the "other cities "and computed as an average of all prefecture' (smaller administrative unit than regions) of the country – excluding Athens and Thessaloniki – and otherwise cities with populations larger than the capital of each prefecture. The fourth HPI is computed as the average of "other areas" which are not capitals of the prefecture they are located in. Then, we determine whether a region is rural or urban according to the 2010 OECD typology classification. In particular, regions with a greater percentage of their population living in urban areas are assigned the third housing price ("Rest Large Cities") while more rural regions are assigned the fourth housing price index ("Smaller Urban Areas"). Out of the remaining 11 regions of Greece, excluding Attica and Central Macedonia, 2 rural regions; namely, Epirus and Thessaly, are assigned the fourth housing price index. Next, we use the median price in 2013 for each prefecture from a study by Bank of Greece's Real Estate Market Analysis Section [Mitrakos et al. (2014)] to aggregate to the regional level and derive the population-weighted average residential property value in each region. Lastly, we interact these latter values with the four HPIs to introduce cross-sectional variation in the third and fourth HPI. As a result, housing prices are measured in euros per dwelling.

Appendix Table A.3a: Correlation Coefficients, Greece

	Corruption	HPI	HPI lag	Population	Density	Unemployment	Education
Corruption	1						
HPI	0.333*	1					
HPI lag	0.335*	0.941*	1				
Population	0.490*	0.565*	0.597*	1			
Density	0.528*	0.509*	0.524*	0.922*	1		
Unemployment	-0.118*	-0.538*	-0.576*	-0.194*	-0.183*	1	
Education	0.408*	0.524*	0.437*	0.635*	0.7514*	-0.2434*	1

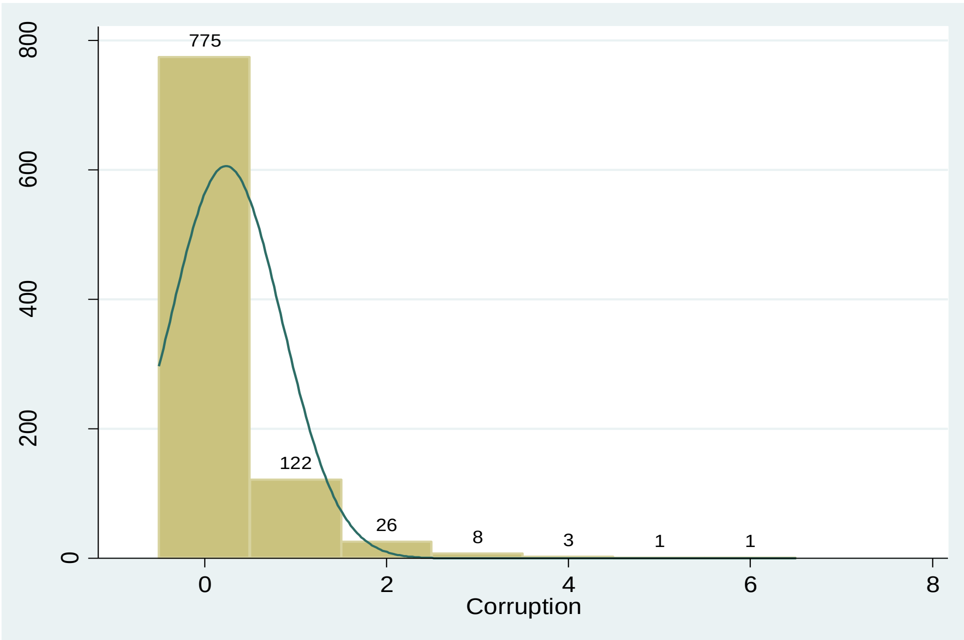
Bonferroni adjustment; * p<0.05

Appendix Table A.3b: Correlation Coefficients, Spain

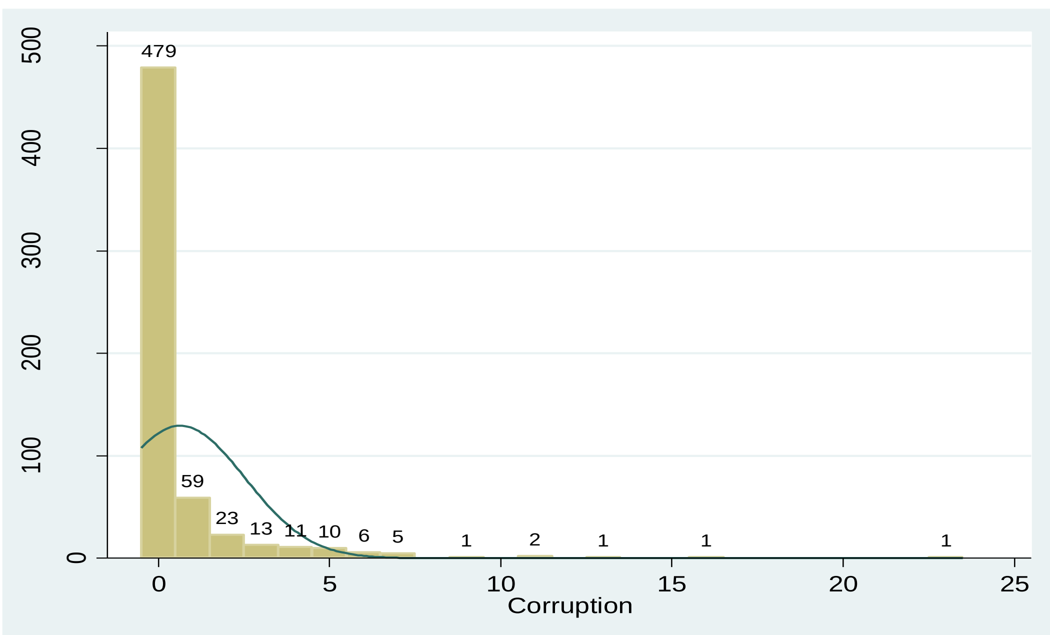
	Corruption	HPI	HPI lag	Population	Density	Unemployment	Education
Corruption	1						
HPI	0.261*	1					
HPI lag	0.244*	0.971*	1				
Population	0.238*	0.210*	0.187*	1			
Density	0.048	0.583*	0.592*	0.922*	1		
Unemployment	0.081	-0.142*	-0.388*	0.261*	-0.112	1	
Education	0.063	0.327*	0.335*	0.286*	0.364*	-0.135*	1

Bonferroni adjustment; * p<0.05

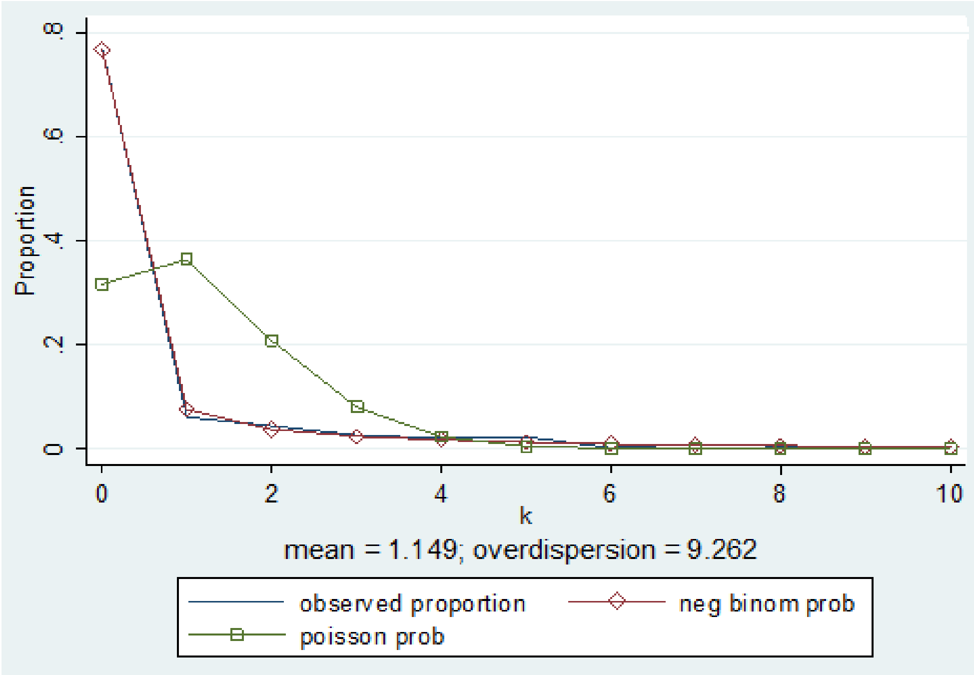
Appendix Graph A.1: Corruption Counts, Greece 2003– 2008, monthly frequency:



Appendix Graph A.2: Corruption Counts, Spain 2000 - 2008, quarterly frequency:



Appendix Graph A.3: Poisson and Negative Binomial Fits of Zoning Corruption, Greece:



Appendix Graph A.3: Poisson and Negative Binomial Fits of Zoning Corruption, Spain:

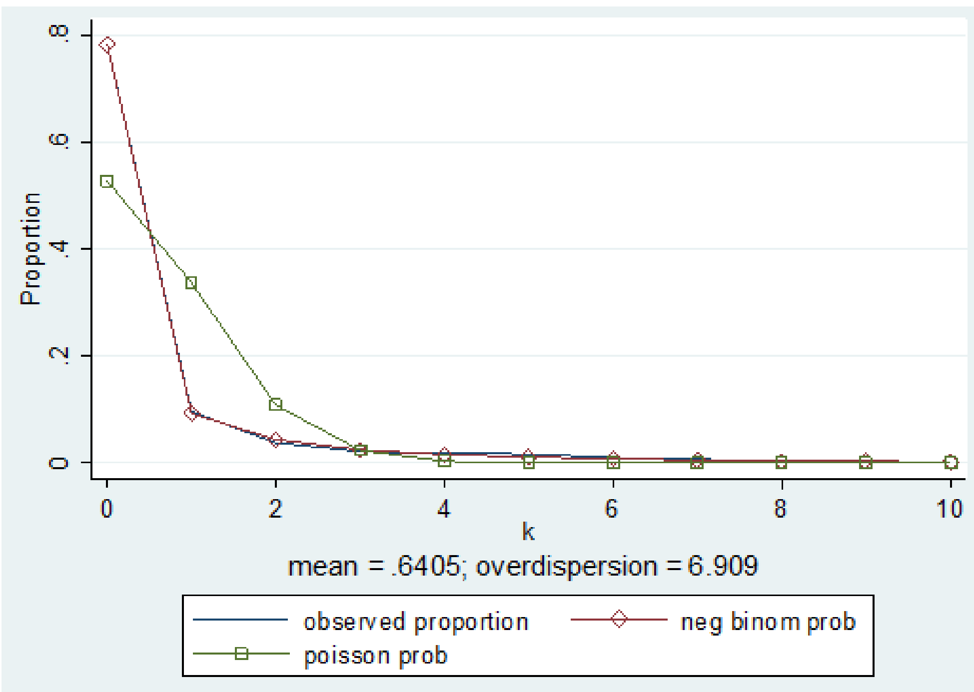


Figure 7a: Aggregate Corruption Counts from January 2003 to December 2008 – Map of Greece:

Legend: # zoning corruption counts

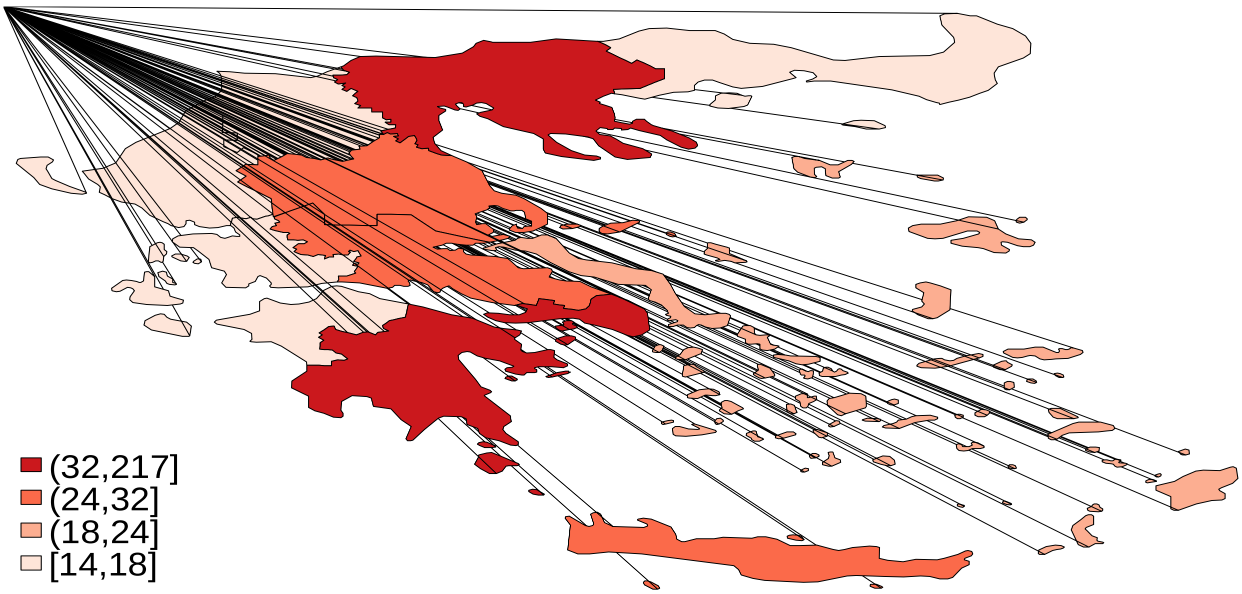


Figure 8b: Average Regional Population from 2000Q1 to 2008Q4 – Map of Spain:

Legend: number of inhabitants in the region, in thousands

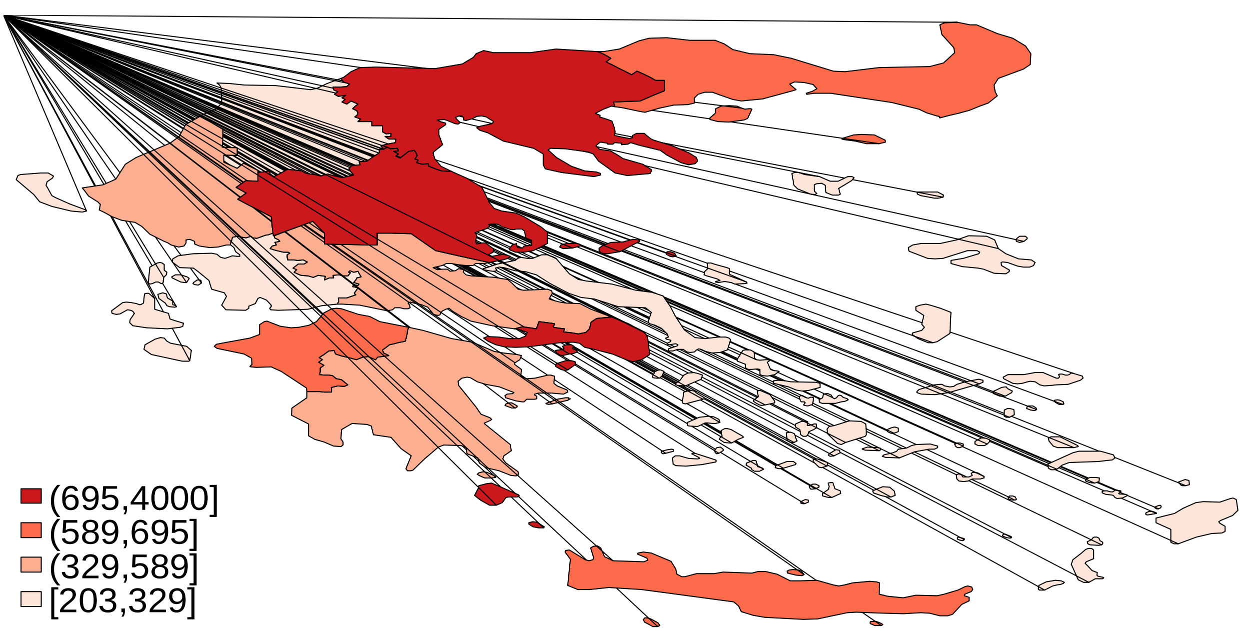


Figure 8a: Aggregate Corruption Counts from 2000Q1 to 2008Q4 – Map of Spain:

Legend: number of zoning corruption counts

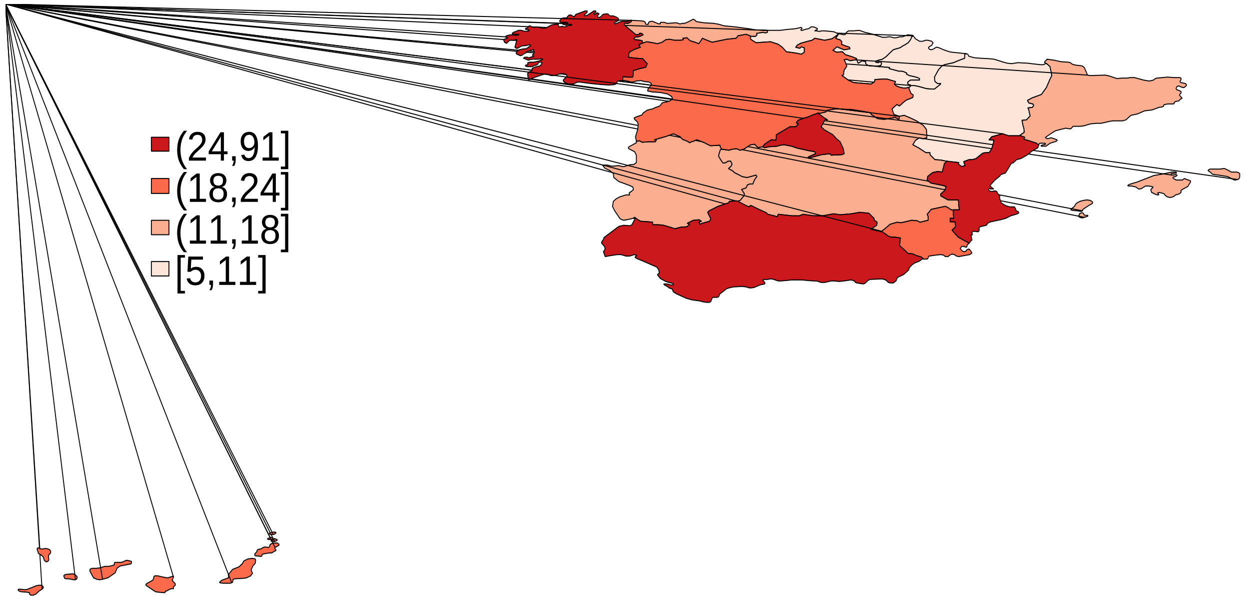
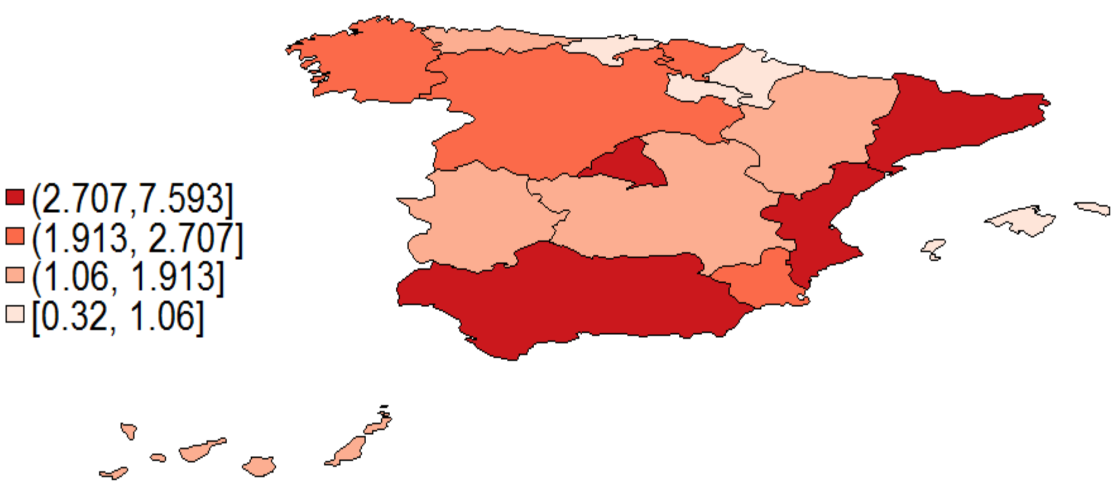


Figure 8b: Average Regional Population from 2000Q1 to 2008Q4 – Map of Spain:

Legend: number of inhabitants in the region, in millions



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