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Abstract

The construction sector, whether privately or publically financed, is characterized by potentially large rents and government intervention. Not surprisingly then, both case-study and survey evidence has been provided highlighting the problem of corruption in this sector. In this article, we test the proposition that a bigger construction sector is likely to be inimical to clean government based on a panel of 42 countries over the period 1995 to 2011. We control for a range of potentially counfounding variables and the expectation that corrupt public officials may favor the development of this sector because it increases the volume of rents available to them. Our empirical evidence shows that a larger construction sector will tend to worsen perceptions of the extent to which public power is exercised for private gain.

JEL Classification: D73, L74

Key words: Corruption, Construction Sector, Empirical Estimates, Reverse Causality

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1. Introduction

Corruption or the abuse of public office for public gain is bad for society. Among its mainy ills, economists have reported that corruption tends to reduce economic growth (Knack and Keefer 1995; Mauro 1997; Tanzi and Davoodi 2001), increase income and educational inequalities (Gupta et al. 2002), reduce spending on health and education (Mauro 1998; Gupta, Davoodi and Tiongson 2001) and enlarge the underground economy thus reducing government revenues (Johnson et al. 1998).

Because of the negative impact of corruption on desirable socio-economic objectives, social scientists have attempted to identify those factors which drive corruption. These include economic conditions such as the level of economic development (Treisman 2000) and inter-personal income inequalities (You and Khagram 2005), political factors such as the level of democracy (Bäck and Hadenius 2008) and electoral rules (Persson et al. 2003), and cultural factors (Fisman and Miguel 2007) which have been linked to religion (La Porta et al. 1999).[1]

Several authors have identified the pernicious effect of natural resources on governance. The natural resource sector is one characterized by state regulation and large rents and profits which result in part due to limited competition (Ades and Di Tella 1999). This combination of rents and regulation creates opportunities for corrupt behavior by public officials leading to a "resource curse" such that natural resources, by increasing corruption tend to reduce rather than increase economic growth (Leite and Weidmann 2002; Busse and Gröning 2013; Sala-i-Martin and Subramanian 2013).

Inspired by this literature, in this article we turn to another sector of the economy – the construction sector – which is similarly characterized by relatively high value investments and significant government interactions and regulation thus providing opportunities for corrupt public officials (Transparency International 2011). The construction market in most countries is split between a competitive segment composed of large number of small contractors and an oligopolistic, often cartelized tranche, made up of a limited number of firms handling the larger construction projects (OECD 2008; Kenny 2009). The sector includes construction projects, both public and privately financed, and government intervention can take several forms the most obvious being public tenders to undertake public investment projects and local government zoning or town planning decisions which affect the construction of private housing.

In line with empirical work exploring the impact of natural resources on governance, we posit that countries with larger construction sectors, both in terms of volume and as a percentage of Gross Value Added (GVA), are likely to suffer from more corruption. We explore this by way of an unbalanced panel of 42 mostly middle and high income

[1] See Lambsdorff (2007) for an extensive – book length – review of both the causes and consequences of corruption.

countries over the period 1995 to 2011. We find that the greater importance of the construction sector tends to worsen corruption even after controlling for a range of potentially confounding variables and the real possibility that corrupt officials may promote the development of the construction sector since it increases the resources appropriable by them.

This article is structured as follows. In the next section we review that work which has considered the relationship between the construction industry and corruption. We then present how we measure our key variables and explain our empirical approach. Finally, we report and discuss our main empirical findings before concluding the article.

2. Construction and corruption: existing evidence

According to one estimate, corruption in the construction industry accounts for an estimated $340 billion of worldwide construction costs each year, representing 10% of the global construction market value (ASCE 2004). Corruption in the industry leads to cost overuns, poor quality construction, inefficient project selection and deficient maintainence (Kenny 2006 and 2009). Corruption in public construction projects is particularly damaging for developing countries with important infraestructural deficiencies and scarce resources (Transparency International 2011).

The structure of the construction industry across countries speaks to the availability of large rents which can fuel corruption. National construction sectors are mainly characterized by the presence of a limited number of large firms which have the capacity to undertake large construction projects. Perhaps not surprisingly then, competition in the construction industry tends to be limited with anti-competitive practices occurring frequently mostly in the guise of collusive agreements between firms. The OECD (2008) documents a series of high profile examples of collusion which were brought to light in the period 1997-2007 in several countries including, Turkey, South Korea, Japan, the United Kingdom, the Netherlands and Germany. This collusion takes several forms including bid rigging, sales restrictions, price fixing and market allocation deals.

A range of qualitative, mostly, country case studies have considered the nature of corruption in the construction industry (see, Le et al. 2014 for a survey). Corruption can occur at any stage of a construction project, from planning and design, bidding and construction and operation and maintenance. It can manifest itself in many related forms including bribing public officials involved in key decisions affecting private and public construction projects, bid rigging by public administrators to ensure that a favored tenderor wins the project, or even the extortion of construction companies to extract bribes. And several factors have been identified as contributing towards corruption in the contstruction sector including, ethical preferences related to culture, innefective legal systems, insufficient transparency in tenders, asymmetric information among tenderees, difficulties in benchmarking for cost and time given the uniqueness of many construction projects, the practice of sub-contracting which makes the tracing of payments and the diffusion of standards of practice more complex and, finally, the major role of government as “clients, regulators, and owners” of construction companies (see also, Sohail and Cavill 2008 and Kenny 2009).

The positive association of the construction sector and corruption (both that involving public officials and that between private agents) has been picked up by several surveys. Since 1999, Transparency International’s Bribe Payer’s Index (BPI) has reported company executives’ perceptions of the likelihood that companies from twenty eight leading countries (the G-20 plus eight) to win business abroad by paying bribes (Transparency International 2011). The executives surveyed by Transparency International consider that companies working in the public works and construction sector are the ones most likely to bribe to obtain contracts. Moreover, the BPI finds that those countries whose companies are more likely to pay bribes abroad are also the ones with higher levels of perceived corruption at home. The positive association between the construction sector and corruption abroad has been reported by the OECD based on actual corruption cases brought to light (OECD 2014). Of the 427 cases of corruption of public officials between 1999 and 2014, the OECD found that companies from the extractive industries were most likely to corrupt followed closely by those in the construction and transportation and storage sectors.[2]

Despite the existence of numerous country case-studies and survey evidence indicating the possible adverse effects of the construction industry on corruption, to our knowledge this relationship has not received any systematic empirical attention. Instead, authors have made some attempt to examine the extent to which corruption can affect the development of the construction sector and, more generally, the composition of public expenditures. The point of departure of this line of work is Shleifer and Vishny (1993) who argue that corrupt governments will tend to favor infrastructure and defense projects where corruption opportunities are abundant (compared to spending on say, education and health). The empirical evidence is largely supportive of this since corrupt countries tend to overinvest in public infraestructures which moreover are of lower quality (Tanzi and Davoodi 1997), spend more on defense (Gupta, de Mello and Sharan 2001) and less on education (Mauro 1997 and 1998). More recently, Liu and Mikesell (2014) draw on evidence across U.S. states and report that corruption increases spending in public construction projects and reduces spending on education and health. This work is important in its own right but for our purpose it alerts us to the likelihood that the direction of causality between corruption and construction runs both ways. We describe how we deal with this issue in the next section.

3. Data and empirical method

Our measure of the construction sector is the ratio of gross value added (GVA) of the construction sector on total GVA and comes from the World Input-Output Database (WIOD) Socio-economic Accounts (SEA), a source that provides industry-level time-

[2] Kenny (2009) reports additional survey-based evidence of a strong association between corruption and the construction sector from the Business Environment and Enterprise Performance Survey (BEEPS) which covers over 4,000 firms in 22 transition countries.

series on employment, capital stocks, gross output and value added at current and constant prices using the same industry classification as for the world input-output tables.[3] The WIOD covers 40 countries for the period from 1995 to 2011. Specifically, the WIOD-SEA provides data on gross value added of the economy disaggregated for 35 industries, including the contruction industry. We expand our sample using data from the OECD STAN Database for Structural Analysis and following the same methodology with regards to the elaboration of the construction variable. Our final sample comprises 27 EU countries (Croatia is not inluded), 3 other European countries (Iceland, Norway and Switzerland), also Russia, Turkey and 4 Asian countries (India, Indonesia South Korea and Japan), 4 American countries (Brazil, Canada, Mexico and USA) and Australia and New Zealand (see Table A.1 in the appendix).

Additionally, we propose to measure the importance of construction by multiplying the previous variable by country GDP (in logs). The reason for this is to take into account not just the weight or relative size of the sector in the economy but also to reflect upon the amount of resources involved. Doing so can capture the possibility that during an economic expansion (contraction), the weight of contruction in the economy may remain stable but the amount of resources and thus rents generated by the sector may experience a significant increase (decrease) something which may have a bearing on corruption.[4] For instance, Slovenia (1997), Portugal (1998), the Netherlands (1999) and Sweden (2000) grew almost 5 per cent (during the specified year) while the ratio of construction remained very stable. Alternatively, the Baltic countries experienced a very strong economic crisis in 2009 (with GDP reductions above 10%), but at the same time the share of construction in GVA remained constant. Consequently, just considereding the relative size of the construction sector would not necessarily capture the volume of resources employed, something which is likely to have an incidence on the extent of corruption in this sector. Using this alternative measure of the construction industry is also a useful robustness test since the simple correlation between it and construction as a percentage of GVA is a mere -0.021 (see Table A.2 in the appendix for the summary statistics and Table A.3 for the correlation matrix).

To measure corruption we rely on the World Governance Indicators (WGI). Specifically we employ the Control of Corruption measure from this source which measures “perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests” (Kaufmann et al. 2010). This indicator has been widely used in research empirically calibrating the causes and consequences of corruption. Like all the other governance dimensions it varies between -2.5 and 2.5 and higher values reflect

[3] These tables are constructed on the basis of officially published input-output tables in conjunction with national accounts and international trade statistics. Timmer (2012) provides an overview of the contents, sources and methods used in compiling the World Input-Output Database.

[4] In this relation, Jiménez (2009) describes how the building boom in Spain fuelled political corruption there.

less perceived corruption. In our sample of countries perceived corruption is highest in Russia, Indonesia and India while it is lowest in Scandinavia and New Zealand.

As a first step in empirically examining the relationship between the construction sector and corruption we plot the Control of Corruption measure against our two construction sector indicators. To simplify the figures we use average values for each variable over the sample period (1995-2011). The figures are suggestive of a negative association between Control of Corruption and the construction sector or, in other words, a larger sector is associated with greater corruption. Figure 1 shows that the construction sector is relatively small (compared to other sectors) in countries like Malta, New Zealand, Hungary and Norway while it accounts for a larger part of gross value added in Spain, Iceland, Cyprus and South Korea. A slightly different picture emerges from figure 2 which plots the corruption measure against the indicator aimed at capturing the volume of resources employed in the construction sector. Now Spain, South Korea, Japan and India have larger construction sectors. The size of the U.S construction sector also looks larger from this perspective. While the two figures are suggestive of a negative association between clean government and construction, they are of course silent on both the counfounding influence of other factors as well as the direction of causality. In what remains in this section we explain how we address these two important concerns.

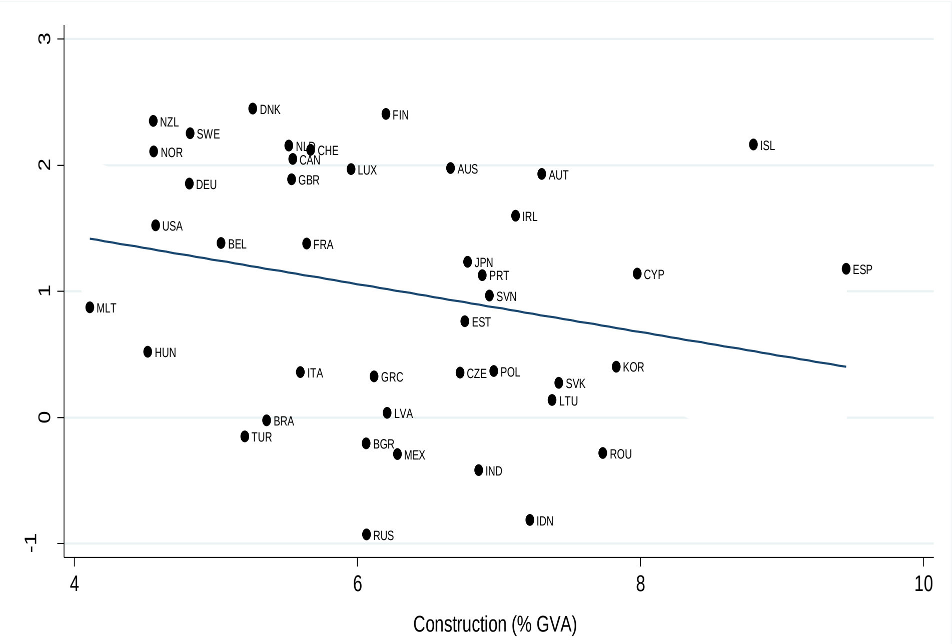

Figure 1. Control of Corruption and Construction as a % of GVA (average values over the period 1995-2011).

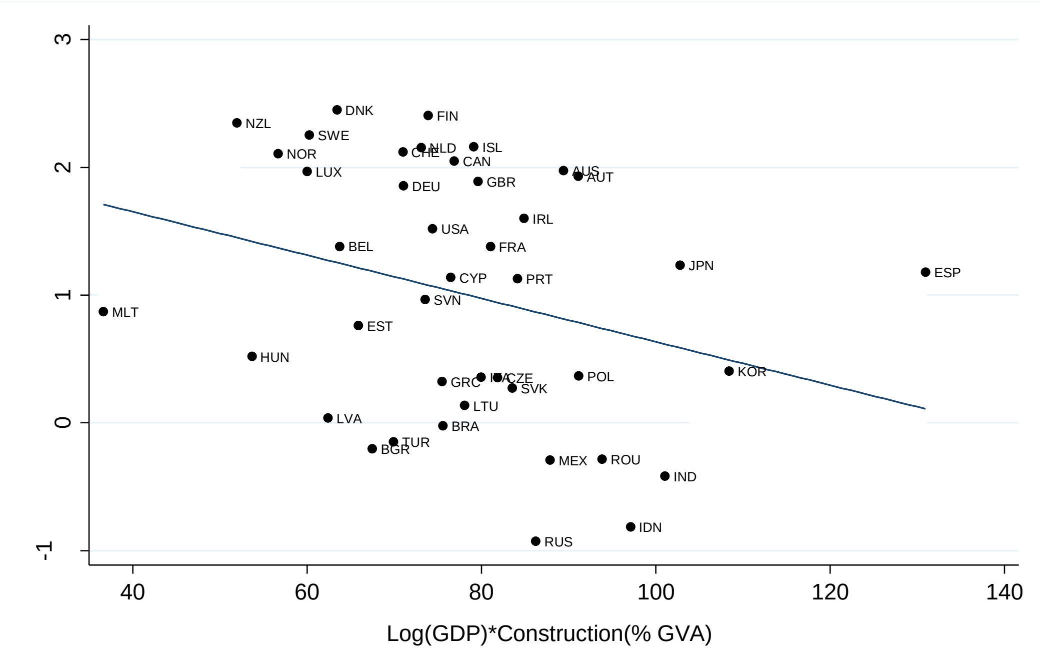

Figure 2. Control of Corruption and Construction Sector Volume (average values over the period 1995-2011).

We estimate the following model:

$$Control\ of\ Corruption_{it} = \alpha_i + \alpha_1\ Construction_{it} + \alpha_2\ X_{it} + \varepsilon_{it} \qquad (1)$$

where *i* refers to countries and *t* to years, α_i is a constant, X_{it} is the vector of control variables and ε_{it} is the error term. Given our previous discussion we expect $\alpha_1<0$. Since we have substantially more cross-section units than time periods, we follow Beck and Katz (1995) and estimate the model using OLS with panel corrected standard errors (PCSE) employing cross-section clustering or a covariance structure which computes standard errors that are robust to heteroskedasticity and serial correlation between the residuals for a given cross-section (Period SUR). Because the limited within country variation of the Control of Corruption measure in our sample (see, Table A.2 in the appendix) we do not apply cross-section fixed effects (see, Baltagi 2013). Alternatively, we do introduce period fixed effects to account for the influence of unknown or unobservable time variant factors affecting all our cross-section units.

Our set of control variables is chosen so as to minimize omitted variable bias and as such is potentially associated with both corruption and the size of the construction sector. In particular we control for the logarithm of real GDP per capita, a country's population (in logs), public sector size, the openness of the economy, the importance of the oil and mining sectors (all as a percentage of GDP), a measure of inter-personal inequalities (Gini based on disposable income), the extent to which local governments have fiscal and political autonomy and legal origins.

The link between economic development and corruption has been argued from both the supply and demand sides of the political market place: wealthier countries may be able to afford better quality public institutions and the citizens of these countries countries may – by virtue of higher education levels – be more demanding with respect to clean and efficient government (Islam and Montenegro 2002; Treisman 2007). Accounting for the level of development also allows us to control for the possibility that the relative importance of different economic sectors may vary with income (Imbs and Wacziarg 2003) as well as the expectation that the demand for both private and public construction may increase with income. We moreover, contol for population since more populous countries may be more difficult to govern (Treisman 2002) or may enjoy economies of scale in the fight against corruption (Knack and Azfar 2003). Like the case of income, the evolution of population over time is likely to have an incidence on the demand for private and public construction. The need to control for the size of the public sector is due to the fact that a bigger public sector offers greater opportunities for rents and thus corruption (Tanzi 1998) and because the resources available to the state may determine its capacity to undertake public construction projects.

Given our previous discussion we also account for the importance of natural resources in a country's gross domestic product since this determines the availability of rents which may be captured by corrupt officials. The availability of rents also depends on the degree of openness of the economy since competition from foreign firms will tend to reduce the rents enjoyed by domestic firms and hence the rewards from corruption (Ades and di Tella 1999). Controlling for the natural resource industry and country openness is also justified because both are likely to affect the sectoral specialization of the economy and thus, the relative size of the construction sector.

Because inter-personal income inequalities have been identified as potential determinants of corruption we also control for them (You and Khagram 2005; Uslaner 2010). Income inequalities may, moreover, have an incidence on the size of the construction sector either because they affect the capacity of individuals to purchase housing in the private sector or because they impact on the demand for public services which may imply public construction. We moreover control for the independence of local governments from higher level governments control. Specifically, we control for the degree of fiscal and political autonomy enjoyed by local governments (Ivanyna and Shah 2014). Previous work has reported that a greater dependence on ones own fiscal resources tends to reduce corruption because inter-jurisdictional competition for tax base disciplines subnational governments while the election rather than appointment of local politicians has been related to greater corruption possibly because the proximity of public officials increases the likelihood of their capture by special interests (Kyriacou and Roca-Sagalés 2011a and 2011b). Controlling for local government's autonomy is also warranted by the fact that local government decisions – for example the classification of land as subject to building or not and the concession of building permits – affect the construction of new housing (see, for example, Wollman 2008 and Jimenez 2009).

Finally, we control for legal origins since scholars have associated them with both corruption and a set of variables capturing the nature of financial institutions and which, as a result, can potentially have an incidence on the development of the construction sector. In particular, it has been argued that the depth and scope of state intervention – and thus possibilities for corruption – will tend to be greatest in countries with a Soviet legal tradition, lower in ones with a tradition of civil law (represented by the French, German and Scandinavian civil codes) and lowest in countries with common law systems (La Porta el al. 1999). Moreover, legal traditions have been linked to the key features of financial institutions including the degree of shareholder and creditor protection, the efficiency of debt enforcement and government ownership of banks (for a summary of the findings, La Porta el al. 2008). Legal origins have also been linked to the regulation of entry of new firms to the economy and from there to the size of unofficial economies (Djankov et al. 2002). To the extent that either of these variables may affect the relationship between corruption and the construction sector, then legal origin helps us to control for their confounding effect. [5]

A major concern when trying to identify the relationship between construction and corruption is the presence of reverse causality. While the construction sector may worsen corruption, it could also be the case that officials in more corrupt countries may adopt policies which will tend to favor the construction sector to the detriment of other economic sectors which do not provide similar opportunities for appropriating rents. Not accounting for this feedback effect is likely to generate point estimates of the impact of construction on corruption which are downward biased (since a greater control of corruption is likely to be associated with a smaller construction sector).

To deal with this issue we resort to two stage least squares estimation where we instrument our measures of the construction industry with the percentage of population between 25 and 49 years of age because individuals within this age range are more likely to demand housing while those below this range may still be living with their parents or renting while those above this age group may have already bought a house. We would argue that this demographic based variable satisfies the conditions expected of a good instrument (Murray 2006). First, there is no apriori reason why the level of corruption in a country should affect its demographic structure in general or this age cohort in particular. Second, we think it is reasonable to argue that the impact of this particular age cohort on corruption be transmitted through our measures of construction or, at least, that the possibility of any other indirect impact be reduced by our chosen set of control variables (the exclusion restriction). To this effect, the link between age cohorts and housing demand has been explored by work studying the impact of the baby boom on the housing market (Jafee et al. 1979; Mankiw and Weil 1989). Finally, our instrument is a strong one as attested by the F-statistics from the first stage of the two-step procedure which are always above the critical value of 10 recommended by Staiger and Stock (1997).

[5] Unfortunately data on the importance of the informal economy (Schneider et al. 2010 and Schneider and Buehn 2013) is not available for our sample of countries and years.

4. Empirical Results

Table 1 presents our OLS regressions of control of corruption on the measures of the construction sector and the control variables. Columns 1 to 3 employ the share of construction in GVA while the last three columns show the results when using the alternative measure of the construction sector taking into account the volume of resources. We employ both contemporaneous values of construction (columns 1 and 4) and values taking one and two period lags based on the expectation that corruption in this sector may take some time to affect perceptions (columns 2, 3, 5 and 6). The results indicate that construction is negatively associated with control of corruption at statistically significant levels. Both the estimated impact of construction and its statistical significance improve when using lagged valued lending some support to the idea that corruption in this sector in any year may be better captured by corruption perceptions corresponding to later years.

The estimated impact of the control variables is in line with that found in previous studies. Focusing on the statistically significant findings, the results indicates that the level of income and the degree of fiscal autonomy of municipal governments are positively associated with control of corruption, while the latter is negatively related to the political autonomy of local governments, the relative importance of natural resources and french and soviet legal origins (compared to having a British common law tradition). The results also indicate that a larger population tends to be associated with more corruption lending some support to the suggestion that smaller countries are better goverened, although this finding is not robust across all specifications.

In table 2 we report the same regressions but based on TSLS and employing our chosen demographic instrumental variable namely, the percentage of population between 25 and 49 years of age. Compared to the OLS regressions, both the estimated impact and statistical significance of the construction sector on corruption are higher. This is consistent with the presence of reverse causality in the OLS estimates – recall that this effect, if present, should reduce the point estimate on construction. In table 2 we, moreover, report the F-statistics of the first stage regressions which, again, are always above the critical value of 10 thus pointing to the strength of the instrument. The estimated impact of construction on corruption is economically significant. Focusing on the results in the first column of table 2, a one standard deviation increase in construction as a share of GVA, reduces the control of corruption measure by 0.306 points or around 32 per cent of a standard deviation in the control of corruption index. By way of illustration, consider South Korea and Belgium. Focusing on average values over the sample period, Korea's and Belgium's construction sectors represent, respectively, 7.828 and 5.037 per cent of total Gross Value Added while the corresponding Control of Corruption scores are 0.403 and 1.382 respectively. Our empirical analysis implies that almost 31 per cent of the corruption gap between South Korea and Belgium can be explained by the larger weight of the construction sector in the former.

Table 1. The impact of Construction on Control of Corruption (OLS)

	(1)	(2) One lag	(3) Two lags	(4)	(5) One lag	(6) Two lags
Construction (% GVA)	-0.048* (0.026)	-0.054** (0.026)	-0.061*** (0.027)	--	--	--
(Log of GDP) *Construction	--	--	--	-0.004** (0.002)	-0.005** (0.002)	-0.005** (0.002)
Log of GDP per Capita	0.670*** (0.115)	0.675*** (0.115)	0.674*** (0.114)	0.689*** (0.116)	0.698*** (0.115)	0.701*** (0.115)
Log of Population	-0.094** (0.047)	-0.096** (0.046)	-0.103** (0.046)	-0.069 (0.046)	-0.068 (0.045)	-0.071 (0.045)
Public Sector Size (% GDP)	-0.000 (0.004)	0.000 (0.004)	-0.000 (0.004)	-0.000 (0.004)	0.000 (0.004)	-0.000 (0.004)
Natural Resources (% GDP)	-0.039*** (0.016)	-0.039*** (0.016)	-0.040*** (0.016)	-0.038*** (0.016)	-0.039** (0.016)	-0.040*** (0.016)
Openness (% GDP)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)
Inequality	-0.012 (0.013)	-0.011 (0.013)	-0.009 (0.013)	-0.012 (0.013)	-0.012 (0.013)	-0.010 (0.013)
Fiscal Decentralization	0.824*** (0.302)	0.826*** (0.299)	0.849*** (0.004)	0.829*** (0.301)	0.830*** (0.298)	0.854*** (0.295)
Political Decentralization	-1.207*** (0.446)	-1.214*** (0.441)	-1.254*** (0.436)	-1.243*** (0.448)	-1.254*** (0.443)	-1.294*** (0.438)
Legal French	-0.668*** (0.142)	-0.670*** (0.141)	-0.657*** (0.141)	-0.664*** (0.141)	-0.666*** (0.140)	-0.652*** (0.140)
Legal German	-0.322* (0.195)	-0.312* (0.193)	-0.283 (0.191)	-0.318* (0.194)	-0.306 (0.193)	-0.276 (0.191)
Legal Scandinavian	-0.074 (0.227)	-0.076 (0.226)	-0.060 (0.224)	-0.083 (0.227)	-0.086 (0.225)	-0.071 (0.223)
Legal Soviet	-1.025*** (0.173)	-1.025*** (0.172)	-1.005*** (0.170)	-1.030*** (0.172)	-1.029*** (0.171)	-1.008*** (0.170)
Adjusted R^2	*0.869*	*0.870*	*0.875*	*0.869*	*0.870*	*0.875*
Observations	479	479	479	479	479	479

Notes: *** p < 0.01, ** p < 0.05, * p < 0.1. All regressions report Period SUR panel corrected standard errors and include period fixed effects.

Table 2. The impact of Construction on Control of Corruption (TSLS)

	(1)	(2) One lag	(3) Two lags	(4)	(5) One lag	(6) Two lags
Construction (% GVA)	-0.189*** (0.077)	-0.175*** (0.069)	-0.187*** (0.065)	--	--	--
(Log of GDP) *Construction	--	--	--	-0.015*** (0.006)	-0.014*** (0.005)	-0.015*** (0.005)
Log of GDP per Capita	0.646*** (0.119)	0.668*** (0.117)	0.667*** (0.116)	0.716*** (0.119)	0.737*** (0.118)	0.746*** (0.118)
Log of Population	-0.154*** (0.057)	-0.146*** (0.053)	-0.153** (0.052)	-0.059 (0.047)	-0.057 (0.046)	-0.058 (0.046)
Public Sector Size (% GDP)	-0.006 (0.005)	-0.004 (0.004)	-0.004 (0.004)	-0.005 (0.005)	-0.003 (0.004)	-0.004 (0.004)
Natural Resources (% GDP)	-0.052*** (0.018)	-0.050*** (0.017)	-0.051*** (0.017)	-0.050*** (0.018)	-0.048*** (0.017)	-0.050*** (0.017)
Openness (% GDP)	-0.003* (0.002)	-0.003* (0.002)	-0.003* (0.002)	-0.003* (0.002)	-0.003* (0.002)	-0.003* (0.001)
Inequality	-0.012 (0.014)	-0.010 (0.013)	-0.007 (0.013)	-0.013 (0.014)	-0.011 (0.014)	-0.008 (0.013)
Fiscal Decentralization	0.709** (0.315)	0.742*** (0.306)	0.765*** (0.304)	0.738*** (0.312)	0.762*** (0.303)	0.783*** (0.302)
Political Decentralization	-1.638*** (0.518)	-1.559*** (0.490)	-1.576*** (0.477)	-1.722*** (0.532)	-1.641*** (0.502)	-1.671*** (0.487)
Legal French	-0.689*** (0.147)	-0.689*** (0.144)	-0.676*** (0.144)	-0.673*** (0.145)	-0.674*** (0.142)	-0.660*** (0.142)
Legal German	-0.328* (0.200)	-0.294 (0.196)	-0.264 (0.195)	-0.313 (0.199)	-0.278 (0.195)	-0.245 (0.194)
Legal Scandinavian	-0.226 (0.251)	-0.198 (0.241)	-0.164 (0.236)	-0.243 (0.251)	-0.215 (0.241)	-0.188 (0.236)
Legal Soviet	-1.022*** (0.179)	-1.023*** (0.175)	-1.004*** (0.174)	-1.041*** (0.178)	-1.035*** (0.174)	-1.014*** (0.173)
Adjusted R^2	*0.826*	*0.839*	*0.841*	*0.832*	*0.843*	*0.845*
F-statistic from first stage	*11.374*	*11.091*	*11.574*	*15.335*	*15.508*	*15.635*
Observations	479	479	479	479	479	479

Notes: *** p < 0.01, ** p < 0.05, * p < 0.1. All regressions report Period SUR panel corrected standard errors and include period fixed effects. Construction is instrumented using the percentage of population between 25 and 49 years old.

Table 3. Robustness Analysis (TSLS)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Construction (% GVA)	-0.179** (0.087)	--	-0.202*** (0.082)	--	-0.436*** (0.176)	--	-0.206** (0.098)	--
(Log of GDP) *construction	--	-0.014** (0.007)	--	-0.016*** (0.006)	--	-0.034*** (0.0136)	--	-0.016** (0.007)
Log of GDP per Capita	0.651*** (0.127)	0.711*** (0.128)	0.525*** (0.130)	0.586*** (0.128)	0.321 (0.262)	0.484* (0.258)	0.607*** (0.147)	0.682*** (0.143)
Log of Population	-0.106* (0.060)	-0.016 (0.059)	-0.151*** (0.057)	-0.050 (0.049)	-0.315*** (0.132)	-0.095 (0.106)	-0.144** (0.067)	-0.042 (0.055)
Public Sector Size (% GDP)	-0.011** (0.005)	-0.011** (0.005)	-0.009 (0.005)	-0.008 (0.005)	-0.009 (0.011)	-0.009 (0.011)	-0.006 (0.007)	-0.006 (0.007)
Natural Resources (% GDP)	-0.055*** (0.021)	-0.052*** (0.021)	-0.049*** (0.018)	-0.045*** (0.017)	-0.043 (0.042)	-0.037 (0.040)	-0.054*** (0.022)	-0.051*** (0.021)
Openness (% GDP)	-0.001 (0.002)	-0.001 (0.002)	-0.003* (0.002)	-0.003* (0.002)	-0.006 (0.004)	-0.006 (0.004)	-0.003 (0.002)	-0.003 (0.002)
Inequality	-0.025* (0.015)	-0.027* (0.015)	-0.020 (0.014)	-0.023* (0.014)	-0.022 (0.031)	-0.025 (0.030)	-0.021 (0.017)	-0.022 (0.017)
Fiscal Decentralization	--	--	0.491 (0.332)	0.505 (0.327)	1.452** (0.697)	1.516** (0.684)	0.697** (0.357)	0.731** (0.351)
Political Decentralization	--	--	-1.759*** (0.607)	-1.852*** (0.622)	-2.242** (1.177)	-2.431** (1.202)	-1.704*** (0.601)	-1.787*** (0.617)
Decentralization Index	-0.009 (0.017)	-0.008 (0.017)	--	--	--	--	--	--
Legal French	-0.624*** (0.164)	-0.605*** (0.165)	-0.749*** (0.191)	-0.733*** (0.185)	-0.768*** (0.317)	-0.731*** (0.311)	-0.684*** (0.162)	-0.663*** (0.160)
Legal German	-0.439* (0.234)	-0.441* (0.236)	-0.329* (0.194)	-0.314* (0.191)	-0.837** (0.440)	-0.800* (0.434)	-0.347 (0.231)	-0.327 (0.228)
Legal Scandinavian	0.189 (0.366)	0.157 (0.366)	-0.388 (0.311)	-0.405 (0.305)	-0.340 (0.562)	-0.373 (0.559)	-0.319 (0.305)	-0.318 (0.301)
Legal Soviet	-1.045*** (0.205)	-1.067*** (0.207)	-1.134*** (0.191)	-1.167*** (0.191)	-1.361*** (0.395)	-1.404*** (0.389)	-1.048*** (0.208)	-1.062*** (0.206)
Catholic	--	--	0.420 (0.334)	0.433 (0.331)	--	--	--	--
Protestant	--	--	0.479 (0.507)	0.472 (0.500)	--	--	--	--
Muslim	--	--	-0.207 (0.486)	-0.299 (0.479)	--	--	--	--
Orthodox	--	--	0.127 (0.401)	0.108 (0.392)	--	--	--	--
Adjusted R^2	*0.793*	*0.794*	*0.825*	*0.833*	*0.514*	*0.529*	*0.792*	*0.800*
F-statistic from first stage	*12.478*	*15.501*	*15.274*	*20.686*	*11.669*	*15.249*	*4.703*	*6.776*
Observations	479	479	479	479	473	473	137	137

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. All regressions report Period SUR panel corrected standard errors and include period fixed effects. Construction is instrumented using the percentage of population between 25 and 49 years old. Regressions 7 and 8 employ five year means of all variables and all the time variant control variables are instrumented using initial period values.

We further pursue the robustness of our results in table 3 where, again, we employ TSLS. In columns 1 and 2 of this table we replace the measures of local fiscal and political decentralization with a more aggregate indicator also proposed by Ivanyna and Shah (2014). In addition to incorporating information on the degree of fiscal and political autonomy enjoyed by local governments, this more aggregate measure also includes information on their administrative autonomy (the share of local government employment in general government employment and the extent to which local governments can decide on human resources policy) and the security of existence of local governments (as measured by the constitutional and legal restraints on their arbitrary dismissal by higher level governments). This more aggregate measure, called Decentralization Index, is not associated with corruption at statistically significant levels which, perhaps, is as expected since it incorportates the notions of fiscal and political autonomy which relate to corruption in opposite ways. More importantly for our purposes here, our substantive results remain unchanged: we continue to find a negative and statistically significant impact of the construction sector on corruption.

In columns 3 and 4 of the table we further control for the confounding influence of culture as captured by the size of different religions in a country. Several authors have related Protestantism with less corruption and Catholicsm, Islam and the Eastern Orthodox tradition with more corruption perhaps because the latter three are more hierarchical and, as such, inculcate values which make people less likely to challenge public office holders (La Porta et al. 1999; Treisman 2000; North et al. 2013). Moreover, Guiso et al. (2003) report systematic differences between individuals from different religions across a range of economic attitudes on issues like tax evasion, public versus private ownership, the importance of luck and chance versus hard work for success, the importance of thrift and whether competition is good or harmful. These attitudes could potentially have some incidence on both the demand and supply sides of the private and public construction markets thus justifying the need to control for different types of religions in our estimates. As shown in the table, these variables do not have a statistically significant impact in our sample while the estimated impact of construction is robust to their introduction.[6]

Columns 5 and 6 of table 3 show the results when we employ an alternative measure of corruption namely, that provided by the Political Risk Services group in the context of their International Country Risk Guide. In our sample, this indicator varies between 1 and 6, and higher values reflect a lower risk of corruption. The use of this indicator as the dependent variable does not change our results. Finally, in columns 7 and 8 we report the results of employing 5 year averages of the data. The significant change in the sample size acts as a further robustness check. Moreover, because our decentralization and legal origin indicators are constant over time, adopting this approach goes some way to account for the possibility that our panel results are being driven by repeated

[6] The measures of religion refer to the percentage of the population that can identified as belonging to a specific religion and come from North et al. (2013).

entries. Five year values also allow us to deal to some extent with the impact of reverse causality on all of our time variant explanatory variables. In particular we instrument these variables with their initial five-year period values. Finally, the use of five year averages also allow us to control somewhat for the business cycle and thus to focus on the structural relationship between the key variables of interest. As can be seen, employing five year averages does not change our substantive results and confirms the magnitude of the estimated coefficients.

5. Conclusion

The construction industry is vital. The construction and maintainance of residential housing and public infraestructures is an indispensable component of any economy. And the construction sector is important in its own right, accounting for a sizeable share of a country's output and employment. According to the European Commission (2013), the sector in Europe account for almost 10% of European Union GDP and 20 million direct jobs with comparable figures reported for OECD countries (OECD 2008). This may be one reason why policymakers aim to promote the development of this industry. A case in point is Construction 2020, an action plan adopted by the European Commission to promote the sector by way of more favourable investment conditions, human capital improvements, better resource efficiency, environmental performance and business opportunities, and strengthening of the internal market for construction and the global competitive position of EU construction enterprises (European Commission 2014).

In this article we have argued that because the construction sector is characterized by potentially large rents and government intervention, it may contribute towards public sector malfeasance. Our empirical evidence, based on a sample of 42 countries over the period 1995 to 2011 and accounting for both the confounding effect of other variables and the possibility that corrupt officials may favor the development of the construction sector, provides robust support for the negative impact of construction on control of corruption. As such it supports calls to adopt anti-corruption measures in this industry at the same time as it recognizes that public officials in corrupt countries may tend to resist policies that reduce their access to rents (see, Transparency International (2011) for a review of initiatives and Le et al. (2014) for anti-corruption strategies).

Our evidence is consistent with that reporting a deleterious effect on governance coming from another economic sector characterized by substantial rents and state involvement – the natural resource sector. That literature has, moreover, reported evidence of a resource curse whereby the abundance of natural resources has a negative impact on economic growth both directly because it makes countries susceptible to the Dutch Disease crowding out other sectors (Sachs and Warner 1995; Leite and Weidmann 2002) but also indirectly, through its negative effect on governance (Isham et al. 2005, Sala-i-Martin and Subramanian 2013). Our analysis is silent on the direct effect of the construction sector on growth rates (see, for example, Wilhemsson and Wigren 2011) but it is suggestive of an indirect negative effect passing through its harmful effect on governance. We leave it for future research efforts to fully explore this important issue.

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APPENDIX

Table A.1 List of countries

Country Code	**Country**
AUS	Australia
AUT	Austria
BEL	Belgium
BRA	Brazil
BGR	Bulgaria
CAN	Canada
CYP	Cyprus
CZE	Czech Republic
DNK	Denmark
EST	Estonia
FIN	Finland
FRA	France
DEU	Germany
GRC	Greece
HUN	Hungary
ISL	Iceland
IND	India
IDN	Indonesia
IRL	Ireland
ITA	Italy
JPN	Japan
KOR	Korea, Republic of
LVA	Latvia
LTU	Lithuania
LUX	Luxembourg
MLT	Malta
MEX	Mexico
NLD	Netherlands
NZL	New Zealand
NOR	Norway
POL	Poland
PRT	Portugal
ROU	Romania
RUS	Russia
SVK	Slovak Republic
SVN	Slovenia
ESP	Spain
SWE	Sweden
CHE	Switzerland
TUR	Turkey
GBR	United Kingdom
USA	United States

Table A.2 Summary statistics

		Mean	Standard deviation	Minimum	Maximum	Observations
Control of Corruption (WDI)	Overall	1.0824	0.9627	-1.1339	2.5856	N = 479
	Between		0.9797	-0.9182	2.4494	n = 42
	Within		0.1610	0.2253	1.8143	T-bar = 11.4048
Corruption (ICRG)	Overall	3.7333	1.3288	1	6	N = 479
	Between		1.2309	1.2692	6	n = 42
	Within		0.5037	2.2813	5.8743	T-bar = 11.4048
Construction	Overall	6.3201	1.6193	3.3935	12.1715	N = 479
	Between		1.3001	3.9888	9.9559	n = 42
	Within		0.9919	2.5417	10.4132	T-bar = 11.4048
Population between 25 and 49 years	Overall	36.3164	1.878572	30.334	42.312	N = 479
	Between		1.759675	31.17833	41.72646	n = 42
	Within		.9172818	33.22331	40.172	T-bar = 11.4048
Log of GDP	Overall	12.5335	1.6923	8.8589	16.3977	N = 479
	Between		1.7331	9.0025	16.3486	n = 42
	Within		0.1354	11.989	12.9787	T-bar = 11.4048
Log of GDP per capita	Overall	9.9592	0.6667	7.4180	11.0484	N = 479
	Between		0.6727	7.7798	10.9679	n = 42
	Within		0.1216	9.4034	10.3150	T-bar = 11.4048
Log of Population	Overall	2.5743	1.8129	1.2888	7.1104	N = 479
	Between		1.8765	1.2051	7.0209	n = 42
	Within		0.0324	2.4435	2.6695	T-bar = 11.4048
Public Sector Size	Overall	34.3938	13.0572	9.9236	99.000	N = 479
	Between		12.4831	12.3065	74.1870	n = 42
	Within		5.8327	0.8256	68.9271	T-bar = 11.4048
Natural Resources	Overall	1.3521	3.2090	0	19.9332	N = 479
	Between		3.3060	0	16.6884	n = 42
	Within		0.6979	1.9322	4.8411	T-bar = 11.4048
Openness	Overall	92.5818	50.4575	15.8650	333.5322	N = 479
	Between		50.9919	24.5443	295.4356	n = 42
	Within		10.6794	45.7050	130.6784	T-bar = 11.4048
Inequality	Overall	31.5879	6.2676	20.7933	53.2056	N = 479
	Between		6.5437	23.5389	49.5488	n = 42
	Within		1.3584	26.0799	36.1348	T-bar = 11.4048
Fiscal Decentralization	Overall	0.5970	0.2149	0.1000	0.9600	N = 42
	Between		0.2178	0.1000	0.9600	n = 42
	Within					T = 1
Political Decentralization	Overall	0.6821	0.1313	0.4200	1	N = 42
	Between		0.1378	0.4200	1	n = 42
	Within					T = 1
Decentralization Index	Overall	6.3940	7.0572	0.0100	34	N = 42
	Between		7.0548	0.0100	34	n = 42
	Within					T = 1
Catholic	Overall	0.3767	0.3526	0	0.9447	N = 42
	Between		0.3613	0	0.9447	n = 42
	Within					T = 1
Protestant	Overall	0.2462	0.2788	0.0017	0.9304	N = 42
	Between		0.2779	0.0017	0.9304	n = 42
	Within					T = 1
Muslim	Overall	0.0392	0.1177	0.0001	0.9713	N = 42
	Between		0.1686	0.0001	0.9713	n = 42
	Within					T = 1
Orthodox	Overall	0.1054	0.2439	0	0.9118	N = 42
	Between		0.2405	0	0.9118	n = 42
	Within					T = 1

Table A.3 Correlation matrix

	Control of Corruption (WDI)	Corruption (ICRG)	Construction as a % GVA	Population 25_49	(Log of GDP) *construction	Log of GDP per capita	Log of population	Public Sector Size	Natural resources	Openness	Inequality	Fiscal decentralization	Political decentralization
Control of Corruption (WDI)	1.000												
Corruption (ICRG)	0.8698	1.000											
Construction as % of GVA	-0.191	-0.203	1.000										
Population 25_49	0.0454	-0.1151	0.2353	1.000									
(Log of GDP) *construction	-0.107	-0.120	-0.021	0.2587	1.000								
Log of GDP per capita	0.792	0.583	-0.158	0.3056	-0.040	1.000							
Log of population	-0.362	-0.295	-0.093	-0.0695	0.929	-0.381	1.000						
Public Sector Size	0.183	0.194	-0.143	-0.0295	-0.478	0.228	-0.498	1.000					
Natural resources	-0.228	-0.113	-0.112	-0.0400	0.229	-0.137	0.273	-0.260	1.000				
Openness	0.116	0.052	-0.024	0.1530	-0.620	0.241	-0.651	0.310	-0.264	1.000			
Inequality	-0.581	-0.458	0.095	-0.2043	0.427	-0.638	0.609	-0.408	0.284	-0.446	1.000		
Fiscal decentralization	0.503	0.462	-0.161	0.1191	0.304	0.394	0.154	-0.353	-0.013	-0.175	-0.185	1.000	
Political decentralization	-0.023	-0.045	-0.160	0.1186	0.266	0.099	0.227	-0.160	-0.039	-0.321	0.191	0.219	1.000

Table A.4 Data definitions and sources

Control of Corruption - WBGI	Assessment of corruption within the political system. Lower values imply a higher level of corruption (World Governance Indicators, World Bank).
Control of Corruption- ICRG	Assessment of corruption within the political system. Lower values imply a higher level of corruption (International Country Risk Guide, Political Risk Services Group).
Construction	Gross value added of the construction sector divided by total gross value added (World Input-Output Database Socio-economic Accounts (WIOD SEA) and OECD STAN Database for Structural Analysis (ISIC Rev. 3)).
GDP	Real GDP in logs Penn World Table 8.0 database (RGDPNA, 2005 PPP$).
GDP per capita	Real GDP per capita in logs Penn World Table 8.0 database (RGDPCNA, 2005 PPP$).
Population	Total population (Word Development Indicators, World Bank).
Population 25-49	Percentage of total population by broad age group, both sexes per 100 total population. (United Nations, Department of Economic and Social Affairs, Population Division (2013). World Population Prospects: The 2012 Revision).
Government Size	Government consumption as a percentage of GDP at current PPPs (Penn World Tables, Version 8.0).
Natural Resources	Sum of Oil and Mineral Rents (World Development Indicators).
Openess	Percentage of exports plus imports divided by Real GDP (World Penn Tables).
Inequality	Gini coefficient based on net income inequality (Solt 2014).
Fiscal Decentralization	Fiscal autonomy of local governments measured by the extent that they are independent from higher level funds, tax, expenditure and borrowing autonomy (Ivanyna and Shah 2014).
Political Decentralization	Election of mayor and local council members and direct democracy provisions for major tax, spending and regulatory decision and the recall of public officials (Ivanyna and Shah 2014).
Decentralization Index	Fiscal and political decentralization plus information on the degree of administrative autonomy and the security of existence of local governments (Ivanyna and Shah 2014).
Legal Origins	Dummy variables which identify the legal origin of the company law or commercial code of each country. There are five dummies: (1) English common law; (2) French commercial code; (3) German commercial code; (4) Scandinavian commercial code; (5) socialist communist laws (La Porta et al. 1999).
Religion	Largest religions (Catholic, Protestants, Muslim and Eastern Orthodox) as a percentage of population in 2000 (North et al. 2013).