The Economic Effect of Corruption in Italy: A Regional Panel Analysis

Lisciandra, Maurizio and Millemaci, Emanuele

University of Messina

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Maurizio Lisciandra and Emanuele Millemaci*

ABSTRACT

This paper provides a within-country analysis of the impact of corruption on economic growth using a panel of Italian regions from 1968 to 2011 through a robust measure of corruption. This measure is averaged over 5-year periods to reduce short-run fluctuations and to reduce probable delayed effects, which are typical for latent phenomena such as corruption. The results show a significant negative impact of corruption on long-term growth in all specifications, both on average and for each Italian region. As a consequence, a zero-level of corruption is growth maximizing. This effect is non-linear such that the negative impact of corruption on growth becomes less intense as corruption increases.

Keywords: corruption, economic growth, cross-regional analysis, dynamic panel data.

JEL: D73; K4; O10; R11.

* University of Messina. Department of Economics, Business, Environmental and Quantitative Methods (SEAM), Piazza Pugliatti 1, 98122 Messina, Italy. Email: mlisciandra@unime.it (corresponding author), emillemaci@unime.it. We thank the seminar participants at the STOREP 2014 in Bergamo and WINIR 2014 in London for their comments. The usual disclaimer applies.

1. INTRODUCTION

Corruption is a very latent phenomenon. Both the theoretical understanding and empirical evidence show that the effects of corruption can be multidimensional, persistent and uncertain. [1] This paper attempts to contribute to the already established - although contrasting - empirical literature on the impact of corruption on economic growth. A large number of the previously published empirical investigations on this topic focused on cross-country data. These investigations use perception indices as proxies for corruption and attempt to control for the diverse array of institutional variables that helps explain the differences in economic growth rates. We deviate from these analyses by using an 'objective' proxy for corruption, i.e., the number of reported crimes of corruption. In addition, we adopt a within-country empirical approach, in which the institutional factors that influence economic growth do not severely undermine the causal investigation between corruption and growth.

Within-country empirical investigations appear more reliable than cross-country investigations because differences among countries in terms of criminal laws, investigative departments, administrative controls, subsidies, transfers, and publicly owned enterprises may explain most of the variability in corruption. The case of Italy is particularly suitable for this type of investigation. *First*, there are large differences in income levels and growth rates across regions. The Southern regions have always lagged behind the regions in the Centre-North of the country, and this difference has become more severe in recent years. *Second*, an objective or direct measure of corruption is available, i.e., the number of crimes reported to the prosecution departments that were actually prosecuted. *Third*, no significant differences in the institutional systems can be detected among the 20 Italian regions. This plays in favour of a better specification in our empirical strategy.

This study expands upon the scanty literature concerning within-country investigations of the impact of corruption on economic growth.[2] *First*, we make use of a panel data set with a longer time interval (i.e., 1968-2011) than any other similar study. This allows for capturing the long-term dynamics of the causal relationship that could not otherwise be recognized using shorter time intervals. In particular, economic growth models require long time-series, *a fortiori* as the variable of interest, such as corruption, reverberates its effects over several years. In addition, it is worth noting that the anti-corruption laws were not changed in any significant way that would affect the behaviour of agents over this time span. *Second*, we use an original specification strategy to address the estimation issues of

[1] Andvig (1991), Rose-Ackerman (1999), Bowles (2000), Jain (2001), Tanzi (2002), and Aidt (2003) provide detailed surveys on the economics of corruption.

[2] Previous empirical analyses on cross-regional data were conducted by Glaeser and Saks (2006) in the US, Cole *et al*. (2009), Dong (2011), Dong and Torgler (2013) in China, Del Monte and Papagni (2001) in Italy.

a latent and long-run phenomenon such as corruption, and to evaluate the sensitivity of the results. In particular, we compare the results by performing three different estimators: the pooled OLS estimator, the static (fixed effects) estimator, and the dynamic (GMM Arellano-Bond) estimator. This last estimator has been used in the context of annual observations in similar studies; whereas, in an original fashion, we apply this estimator to 5-year averages in order to better separate the long-run from the short-run relationship. *Third*, we test for the potential non-linear effects of corruption on growth. This issue has been extensively debated in the literature of cross-country studies, but found poor attention in within-country analyses. On the contrary, given the heterogeneity in corruption levels across regions and the rather centralized governmental system, Italy is a unique case study to test for non-linear relationships.

The paper is organized as follows. The next section presents the relevant studies on the effects of corruption on economic growth. The third section presents the proxy for corruption and the descriptive statistics of the other variables. The fourth section includes the econometric framework and empirical results. The fifth section discusses the results. The final section concludes the study.

2. LITERATURE REVIEW

In this section, we present a literature survey on the impact of corruption on growth without presuming to be exhaustive with respect to the extensive research performed in this field that still interests many scholars. Although the nexus between corruption and economic growth has been widely analysed, there is still contrasting evidence both in the causal relationship and in the sign and magnitude of the impact between the two variables. The difficulty in disentangling this thorny issue has been remarkably described by Paldman (2002), who emphasized the seesaw dynamics in which corruption and economic growth appear to feed on each other without a clear cause-effect relationship. This mainly empirical dilemma has been commonly handled using various econometric approaches, which strive to cope with the endogeneity problem. We explain the way we address this problem in the empirical section and focus on the impact of corruption on economic growth, which has substantial research behind it. Therefore, we skip the analysis of the determinants of corruption and economic development.

In this perspective, the main research question is whether corruption is sand or grease in the wheels of economic development, which is a rather controversial and mainly empirical question, which has no definitive answer. As a matter of fact, crimes, such as corruption, albeit sanctioned by the law, may in principle help transactions to be smoother and faster, whereas bureaucracy is observed as sand in the mechanisms of exchange and production. In the past, the "grease" argument has been endorsed by several scholars using however theoretical or qualitative investigations, such as Leff (1964), Huntington (1968), Myrdal (1968), and Leys

(1970). They explained that inefficient bureaucracy hampers economic growth, and corrupt practices, by operating as grease in the wheels, reduce friction. According to this viewpoint, corruption would eventually promote economic growth, especially in the early stages of economic development. In more detail, Rose-Ackerman (1978) and Lui (1985) found that corrupt practices minimize the waiting costs for those who placed more value to time.[3] Similarly, Beck and Maher (1986) and Lien (1986) showed that the most efficient firms can afford the largest bribes, thereby minimizing their red-tape costs. In the history of Europe and the US, Bardhan (1997) showed that corruption favours development. More recently, Dreher and Gassebner (2013) provided evidence that corrupt practices could facilitate firms' entry into highly regulated economies. This evidence characterizes corruption as a second-best solution *vis-à-vis* the inefficient bureaucracy that constitutes an impediment to investments.

The "sand" argument appears to be supported by more substantial empirical evidence. According to this view, corruption acts as an uncertainty and cost-increasing factor. This argument was pioneered by Mauro (1995), who performed a very detailed cross-country analysis, assessing the impact of corruption on economic growth and finding a significant negative causal relationship. His findings were confirmed by Mo (2001) and Pellegrini and Gerlagh (2004), among many others. However, it appears important to understand the channels through which corruption has an impact on economic growth.

The private investment channel is one of the most widely investigated because public officials focus on rent-seeking activities in their often discretionary supply of public services, which would eventually induce a misallocation of resources in financial and human capital.[4] More specifically, corruption undermines investments in education, inducing either the recruitment of unsuitable human resources (Mauro 1995, 1997; Mo 2001; Gupta *et al.* 2002) or the adoption of rent-seeking activities rather than production activities (Baumol 1990; Murphy *et al.* 1991; Lui 1996; Lambsdorff 1998). Murphy *et al.* (1993) found that corruption discourages investments in innovation because ruling oligarchies favour established firms in exchange for bribes, raising barriers to entry for potential innovators. Wei (2000), Habib and Zurawicki (2002), Lambsdorff (2003), and Egger and Winner (2005) focused on FDI and found evidence that corruption acts as a tax and, consequently, reduces country attractiveness.

Public investments are also an important channel through which corruption operates and affects economic growth. Tanzi and Davoodi (1997) and Mauro (1997, 1998)

[3] However, Kaufmann and Wei (2000) confute this argument and empirically show that companies paying more bribes are those which lose more time on paperwork as a result of negotiation with public officials.

[4] For general analyses on this topic see, among many, Shleifer and Vishny (1993), Bardhan (1997), and Ehrlich and Lui (1999).

provided evidence that politicians tend to divert public resources toward activities that are more vulnerable to corruption through distortive interventions in public procurements, which is the case for instance of high-cost and large-scale construction projects rather than high-return-value or small-scale decentralized projects. As noted by Shleifer and Vishny (1993), corrupt officials distort public investment projects, awarding the producers who offer the largest bribes instead of the deserving producers.

Bureaucracy is in a way the *raison d'être* of corruption and can be placed at the bottom of all other channels. Corruption induces bureaucrats to expand regulatory practices and slow down bureaucratic processes to persuade governmental clients to pay bribes (Myrdal 1968; Rose-Ackerman 1978). Kurer (1993) argued that corrupt officials have two distortive incentives: *1)* to ration the provision of a public service to decide to whom to allocate that service in exchange for a bribe; *2)* to limit the access of competent officials to key positions to preserve their rent from corruption. In this perspective, Méon and Sekkat (2005) provided cross-country evidence that a poor quality of governance makes corruption a depressing factor for economic growth.

In contrast to various theoretical analyses and wide empirical cross-country evidence supporting the "sand" argument, Assiotis (2012) recently found that, after country-specific fixed effects are taken into account, no significant causal relationship between corruption and income exists.

However, the debate is far from over. The "grease" and "sand" arguments may not necessarily contradict each other. Méndez and Sepulveda (2006) showed that low levels of corruption positively affect economic growth, while high levels are detrimental, although this non-linearity argument is valid only for democratic countries. Similarly, Aidt *et al.* (2008) found that in countries with high quality institutions, corruption has a large, negative impact on growth; however, in countries with low quality institutions, corruption has no impact on growth. Although rejecting the grease argument, Méon and Sekkat (2005) suggested a quadratic relationship between corruption and growth that depends on the degree of political freedom: a weak rule of law, an inefficient government and political violence tend to worsen the negative impact of corruption on growth.

Therefore, the empirical analyses provided here explored the causal relationship under scrutiny using only cross-country investigations. However, the empirical analyses can be performed in another way: a within-country investigation, which is adopted in our study. As mentioned in the introduction, within-country investigations have the advantage of reducing or even eliminating the institutional differences existing across countries, thereby moderating the omitted variable bias, resulting in a beneficial effect on our estimates. Additionally, within-country investigations do not need to make the controversial and implicit assumption of cross-country investigations, i.e., that corruption and economic growth levels of each country are in a steady state. Unfortunately, there are few within-country studies.

Within-country data on corruption have been used by Goel and Nelson (1998) to relate corruption and government size, by Fisman and Gatti (2002) to understand corruption and decentralization, by Svensson (2003) to examine bribery and firms, and by McMillan and Zoido (2004) to study bribery and politicians. However, these studies did not focus on corruption and development. Glaeser and Saks (2006) performed a cross-regional analysis for the 50 States in the U.S. They actually scrutinized the impact of corruption on economic development but found weakly significant negative values. China provides another important example. Both the centralized legal and administrative systems and the wide variability in economic conditions allow for a robust cross-regional analysis. Dong (2011) provided evidence for both the "sand" and "grease" arguments, and consequently, the causal relationship does not appear robust. In a more recent study, Dong and Torgler (2013) identified a positive relationship between corruption and economic development in China, which is mainly driven by the transition to a market economy. In China, Cole *et al.* (2009) found that the regions that exert greater anti-corruption efforts are also able to attract more FDI. However, the latter result was refuted by Dong (2011), who found identification problems and inappropriate measures of anti-corruption efforts. Finally, Del Monte and Papagni (2001) performed a cross-regional investigation in Italy using an old dataset (i.e., 1963-1991). They focused on the effects of corruption, specifically arising from purchases made by government officials, on the efficiency of public expenditure. They found that the most corrupt Italian regions suffer from inefficient public spending, particularly investment in infrastructure, which results in lower growth rates.

3. A MEASURE OF CORRUPTION

As previously stated, measuring corruption is complex, and no complete understanding has been achieved to date. Different proxies are used depending on the dimension of interest, i.e., a country or regional level. Perception indices are often considered the only consistent measure in the absence of more direct or objective proxies, which is typically the case in cross-country surveys. However, perception indices may heavily depend on the momentary public opinion and the media coverage of specific criminal cases. When we consider within-country data, more objective measures of corruption can be used.[5]

In our investigation, we consider the number of crimes reported to prosecution departments for which prosecution has started as a proxy for corruption. This proxy includes all corruption-related crimes reported by region over the period from 1968

[5] For the pros and cons of objective vs. subjective measurements of corruption see Jahedi and Méndez (2014).

to 2011.[6] It differs from the indicators adopted by other cross-regional analyses. Glaeser and Saks (2006) used the number of public officials convicted for corrupt practices by the federal justice department in the U.S.. In China, similar to our measurement, Dong (2011) and Dong and Torgler (2013) derived corruption data from the number of annual registered cases on corruption in procurator's office by region. In Italy, Del Monte and Papagni (2001) used an indistinct proxy of corruption that they define as the official number of crimes against the public administration divided by the total number of employees.

Our proxy for corruption is not exempt from criticisms. It can be considered a measurement of crime detection, which is due to the effort of prosecution departments to investigate and impose criminal charges on new cases of corruption. As a consequence, it may underestimate the underlying phenomenon, but in a dynamic cross-regional analysis, this shortcoming is barely relevant. Another related criticism refers to the fact that the number of detected crimes by region may be affected by the different quality of the prosecution agencies across the country rather than the actual level of corruption (Treisman, 2007). However, in our case, there is no evidence that Italian prosecution agencies differ in terms of anti-corruption efforts among regions, which is mainly due to two factors: 1) a centralized judiciary at a national level, including both judges and prosecutors, and 2) prosecutors only comply with the law and are not accountable to political power.

Furthermore, underreporting or reduced investigations could occur or become more severe as the amount of corruption increases. This behaviour could be due to the lack of trust towards the judiciary or the time constraints facing the investigation and prosecution departments that become more binding as corruption increases. However, this conjecture may not be supported when we take into account the spillover effects of the investigative and prosecution activity in crime reporting and discovery. These effects actually act in the opposite direction, reducing the difference between the measured and the actual corruption. As a consequence, this issue still remains debatable.

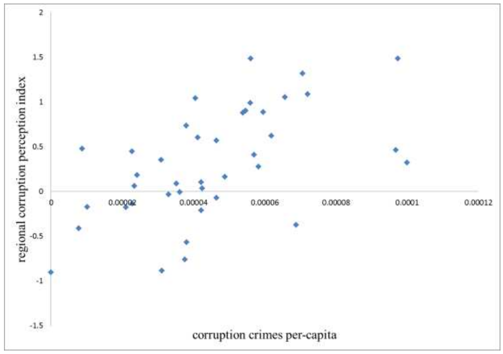
We provide evidence of the robustness of this proxy. We compare our "objective" measure with a regional perception index of corruption that is available for only two years (2010 and 2013).[7] Charron *et al.* (2013, 2014a, 2014b) provided these two measurements for most European regions and, consequently, also for the 20 Italian regions. The correlation results are encouraging as indicated in the scatterplot shown in Figure 1. The correlation between our proxy in 2009 and the perception

[6] The source is the Annals of Criminal Statistics, National Institute of Statistics (Istat), various years, statutes no. 286 through 294. More recent data have not yet been published and have been provided by Istat.

[7] The perception index is equal to the average of five scores regarding the corruption perception in the education system, health care system, law enforcement, public services, and if the respondents were forced to pay bribes to obtain health care.

index in 2010 is equal to 0.70 and the correlation between our proxy in 2011 and the perception index in 2013 is equal to 0.53.[8]

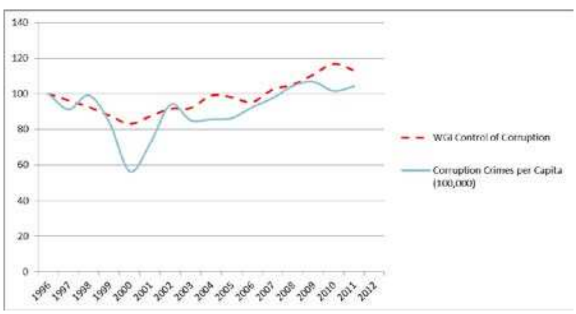
Figure 1. Scatterplot of corruption crimes and regional perception index



SOURCE: Charron *et al.* (2013, 2014a, 2014b) and the Italian Institute of Statistics (Istat).
NOTES: the horizontal axis includes corruption crimes per capita (100,000) in 2009 and in 2011; the vertical axis includes the regional corruption perception index reporting years 2010 and 2013. The score of the regional corruption perception index was originally negative; it has been transformed to positive.

Furthermore, we compare a time series of the worldwide governance indicator (WGI) for the control of corruption, which captures the perceptions of the extent to which public power is exercised for private gain, with our proxy at a national level. We cannot perform a correlation analysis due to the limited number of observations, but Figure 2 clearly shows that the medium-long run tendencies of both measurements are very similar.

Figure 2. WGI-control of corruption and corruption crimes



SOURCE: The World Bank Group and the Italian Institute of Statistics (Istat).

[8] The 2010 survey was carried out between 15 December 2009 and 1 February 2010; therefore, we considered the 2009 indicator more appropriate. The 2013 survey was conducted between February and April of the same year; the last available year for our indicator was 2011. The score of the regional corruption perception index was originally negative; it has been transformed to positive.

NOTES: Corruption crimes are per capita (100,000). Both measures are normalized to 100 in 1996. Data are at the national level. We used smooth connecting lines. The yearly data from the WGI Control of Corruption for 1997, 1999, and 2001 were missing; therefore, we used averages of the adjacent years. In 2000, the corruption crimes per capita indicator suffered from severe underreporting, as discussed further below.

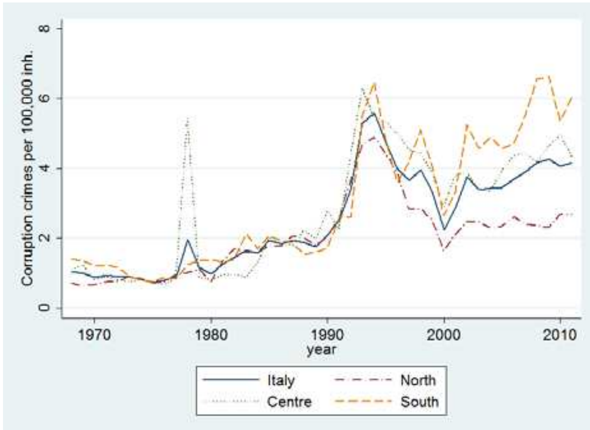
In an investigation on the determinants of corruption in Italy, Del Monte and Papagni (2007) provided further evidence on the robustness of the same proxy. They compared it to the CPI score for Italy and to an index of regional judicial efficiency.[9] The analyses showed that the proxy is correlated with the CPI score and is not significantly related to regional judicial efficiency. Therefore, all of the checks performed in this and in previous studies confirm the robustness of our proxy in capturing the complex phenomenon of corruption.

Figure 3 illustrates the trends of corruption in Italy and in the macro-areas of North, Centre, and South. There are no substantial differences in the trends among the macro-areas: a steady increase until 1991 and, in 1992, the so-called "*clean hands operation*" changed the overall attitude toward corruption both within the society and in investigative and prosecution departments, which very likely generated a spike in the reported crimes, reaching a peak in 1994. The increased rates indicate that some important change had occurred: from 9.09% in 1990 to 15.95% in 1991, the increase rate of corruption crimes per capita rose from 26.97% in 1992 to 67.39% in 1993 and declined to 26.03% in 1994, and finally, it became negative. We have no reason to believe that the amount of actual corruption severely increased as the number of crimes detected per capita between 1992 and 1994 suggests; we at least believe that the actual corruption did not increase by that magnitude. It is likely that, after 1992, the clean hands operation reduced the underestimation of the phenomenon rather than causing an increase in the actual levels of corruption. Di Nicola (2003) confirms this hypothesis and adds that, starting from 1995 with the end of the clean hands operation, a reduction in the moral tension against corruption occurred with a resulting increase in the amount of unobserved corruption. However, we cannot exclude the fact that, starting from 1992, a long-term structural change also occurred.[10] In particular, after this period, there is a divergence in the corruption levels between the sluggish economic area of the South and the more economically advanced regions of the North. After 1992, the Southern regions had increasing levels of corruption compared with the North, which seems related to the slightly increasing trend experienced before the nineties.

[9] CPI is the Transparency International's annual index of perceived corruption.

[10] During the period under scrutiny, the laws on corruption did not undergo any important changes besides the introduction of a new criminal procedure code at the end of 1989 and an increase in the penalties for corruption-related crimes in 1990.

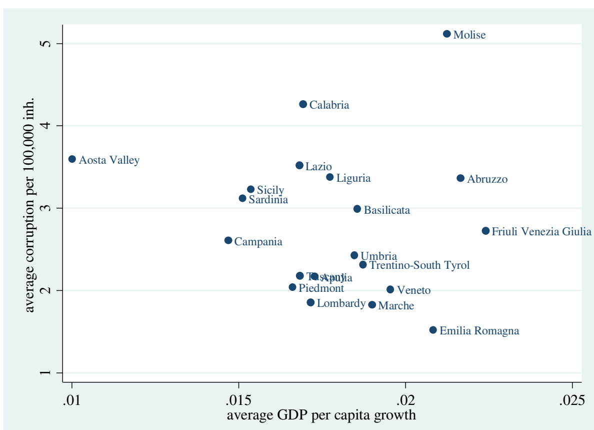
Figure 3. Reported crimes of corruption - 1968-2011



SOURCE: The Italian Institute of Statistics (Istat).
NOTES: Corruption crimes are per capita (100,000). The spike in 1978 in the Centre is due to an anomaly existing in Rome during that year of which we have no accounts.

Finally, Figure 4 shows an apparently negative correlation between the average number of corruption crimes per capita and the average real GDP growth rate per capita. The heterogeneity in the corruption crimes per capita and in the economic growth rates across the Italian regions makes empirical analysis plausible as well as feasible.

Figure 4. Scatterplot of corruption crimes and growth rates (1968-2011)



SOURCE: The Italian Institute of Statistics (Istat) and Crenos.
NOTES: Corruption crimes are per capita (100,000). Note that the Aosta Valley and Molise are the smallest regions of Italy.

4. Empirical Analysis

4.1 Dataset and Methodology

In this section, we test the hypothesis that corruption affects economic growth. We make use of a panel data set consisting of the Italian regions over the period from 1968 to 2011. Following other studies on this subject, we consider 5-year averages of the variables of interest.[11] Multi-year averages allow us to reduce the short-run fluctuations and alleviate concerns about endogeneity. Furthermore, for this type of crime, registered cases of corruption in one year could reflect crimes committed in previous years but detected in that year. Averaging reduces this lag effect.

The dependent variable is the growth of real Gross Domestic Product (GDP) per capita, while the independent variable of interest is the number of detected corruption crimes per 100,000 inhabitants. We control for other long-run determinants of economic growth, such as physical and human capital growth per capita, population growth and the initial real GDP per capita. As an alternative estimate of the physical capital growth, we consider the private investment-GDP ratio. Human capital is proxied by the number of years of education per employee, while physical capital is obtained using the procedure described by, for example, Caselli (2005).[12]

Table 1 shows the sources and summary statistics of the variables used in the empirical analysis.

Table 1. Summary statistics

Variables	Source	Mean	St. dev.	Min	Max	Obs.
Corruption per 100,000 inh.	Istat	2.809	2.565	0.0	26.5	880
GDP per capita	Crenos + Istat	18.854	6.593	7.0	33.5	880
GDP growth per capita	Crenos + Istat	0.018	0.029	-0.1	0.1	860
Private Investments/GDP	Crenos + Istat	0.230	0.054	0.1	0.5	880
Physical capital growth	Crenos + Istat	0.022	0.017	-0.0	0.1	860
Human capital	Istat	9.129	1.732	6.0	13.8	840
Human capital growth	Istat	0.014	0.028	-0.2	0.2	820
Public expenditure/GDP	Crenos + Istat	0.210	0.049	0.1	0.3	880

NOTES: Annual values. All monetary variables are expressed in real terms (constant euros of 2005). GDP per capita is expressed in thousands of euros. The variables reporting *Crenos + Istat* as a source were provided by CRENoS (1999) for the earlier years (i.e., 1968-1994), where we use the dataset *Regio IT 60-96*. In subsequent years (i.e., 1995-2011), we use the regional accounts data provided by ISTAT. As a proxy for human capital, we use the average number of years of schooling per employee. Human capital data until 2004 are elaborated by Tornatore *et al.* (2004) from Istat data, whereas most recent years are directly obtained by Istat.

[11] See, for instance, Méndez and Sepulveda (1996), Deininger and Squire (1996), Li *et al.* (2000), and Paldam (2002).

[12] Starting from the hypothesis that regions are at the steady state, the initial stock of capital K_0 is $I_0/(g+d)$, where g is the geometric mean of the investment growth over a specific time interval, and d represents the capital depreciation rate (set to 6%). The capital stock in the subsequent years is $K_t = K_{t-1} + I_t - dK_{t-1}$.

In the following analysis, we will present different estimation strategies that attempt to address several econometric problems that such an analysis can encounter. We used three different estimators, i.e., the pooled cross-section OLS (POLS) estimator, the fixed effects (FE) estimator, and the generalized method of moments Arellano-Bond (GMM A-B) estimator.

Pooled OLS model

As a baseline model, we consider the pooled OLS with cluster-robust standard errors. This model relies on the assumption that the intercepts are the same for all regions or that the errors are uncorrelated with the regressors. The inference needs to control for the likely correlation between the error term over time for a given region (*within* correlation) and a possible correlation between regions (*between* correlation). To address the *within* correlation problem, we rely on cluster-robust standard errors to check the statistical significance of the parameters. However, the POLS estimator may be inconsistent for at least a couple of reasons. First, it is possible that the relationship between the two variables under investigation is driven by a third omitted variable, which is correlated with both of them. For instance, this behaviour could be due to a different cultural disposition towards morality across Italian regions. Second, economic growth may affect corruption, rather than just being the effect. For instance, fast-growing regions may present a less friendly environment for corrupt practices.

Static panel data model

An alternative approach consists of using the fixed effects estimator with a static panel data model to control for endogeneity due to unobserved regional characteristics that the POLS estimator cannot successfully address. However, the FE approach does not solve the possible endogeneity due to the reverse impact of economic growth on corruption; it also does not allow for control of the endogeneity due to time-variant factors (Méndez and Sepulveda 2006).

Dynamic panel data model

Finally, to account for the weaknesses of the previous estimators, we consider the following Autoregressive Distributed Lag (ARDL) model:

$$\dot{y}_{i,t} = \alpha_i + \sum_{q=1}^{Q} \rho_{iq} \dot{y}_{i,t-5q} + \sum_{j=0}^{J} \beta_{ij} X_{i,t-5j} + u_{it} \quad (1)$$

where $\dot{y}$ is the 5-year average growth of the real GDP per capita, α_i is a time invariant region specific component, ρ_{iq} is the parameter of the autoregressive component of order q for region i, and $X_{i,t-5j}$ contains 5-year averages of the explanatory variables, including the corruption indicator. The presence of lags of the dependent variable ($\dot{y}_{i,t-5q}$) on the right-hand side is required because $\dot{y}$ follows an AR(Q) process.

Estimating such a model using the *within estimator* would give inconsistent results because the lags of the dependent variable are correlated with the error component. In the context of dynamic panel models, we can rely on a first-differenced (FD) specification. However, the lagged dependent variables in the FD model have to be treated with IV estimators that use appropriate lags of $\dot{y}_{i,t}$ as instruments to lead to consistent parameter estimates. The endogenous components of the matrix $X_{i,t-j}$ can be instrumented with their corresponding lagged terms (Anderson and Hsiao 1981; Holtz-Eakin 1988; Arellano and Bond 1991; Blundell and Bond 1998). Moreover, we treat all variables in the matrix *X* as endogenous. This specification allows us to account for the possible existence of a reverse causality nexus between economic growth and corruption - or any other variable in *X* - to correctly identify only the effect of the latter on the former. To the best of our knowledge, this is the first time in the corruption literature that the GMM Arellano-Bond estimator has been applied using variables that were averaged over 5-year periods.

4.2 Estimation Results

To expand the number of observations, we use up to seven 5-year averages for each of the 20 Italian regions. To calculate non-overlapping 5-year averages, we initially consider the following seven time intervals: 1970-1975, 1976-1981, 1982-1987, 1988-1993, 1994-1999, 2000-2005, 2006-2011.[13] At a later stage, we will discuss whether the results are sensitive to shifting intervals.

Table 2 reports the main results obtained using the POLS estimator with cluster-robust standard errors.[14] In all specifications, the dependent variable is the growth of the real GDP per capita. Growth of physical and human capital stock per capita (*physical* and *human*, hereafter), population growth (*pop*) and log of real GDP per capita of the first year within each interval (*ingdp*) are all regressors of specification I and are, constantly, included in all specifications except for specification IV in which *physical* is replaced by the investment-GDP ratio (*inv)*. In addition to these variables, specifications II-V include the number of detected corruption crimes per 100,000 inhabitants (*corr*), and specifications III-V include *corr* squared (*corr2*) to check for non-linearities. Specifications V and VI add the public expenditure-GDP ratio (*pexp*) to the set of independent variables of specification III. Specification VI replaces *corr* and *corr2* with the log of *corr* (*lcorr*) and adds the interaction term (*pexp*lcorr*) between *pexp* and *lcorr*. All variables are averaged over 5-year periods except for *ingdp*.

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[13] Each interval consists of six years. To calculate the 5-year average of the growth rates, we need to consider one additional year for the variables expressed in levels.

[14] Similar results are obtained when using another robust estimator available in STATA 11 (*rreg*) to deal with the presence of possible outliers in either the space of regressors or the space of residuals (Li 1985; Hamilton 1991).

Table 2. Pooled OLS estimates

	(I)	(II)	(III)	(IV)	(V)	(VI)
Corruption per capita (*corr*)		-.00222*** (0.001)	-.00469*** (0.001)	-.00682*** (0.001)	-.0043*** (0.001)	
Corruption per capita squared (*corr2*)			.000248*** (0.0001)	.000377*** (0.0001)	.000194** (0.0001)	
Log Corruption per capita (*lcorr*)						-.0134*** (0.004)
Population growth (*pop*)	-.935*** (0.177)	-1.3*** (0.181)	-1.33*** (0.175)	-1.38*** (0.219)	-1.18*** (0.169)	-1.11*** (0.145)
Human capital growth per capita (*human*)	.827*** (0.158)	.731*** (0.137)	.724*** (0.142)	.841*** (0.154)	.726*** (0.143)	.743*** (0.157)
Log real GDP per capita (t-5) (*ingdp*)	-.0627*** (0.024)	-0.00382 (0.024)	0.0117 (0.024)	0.00938 (0.028)	0.000875 (0.023)	-0.0123 (0.017)
Physical capital growth per capita (*physical*)	.438*** (0.069)	.369*** (0.057)	.327*** (0.056)		.338*** (0.048)	.312*** (0.044)
Private Investment/GDP (*inv*)				.0315* (0.017)		
Public Expenditure/GDP (*pexp*)					.0399*** (0.008)	-0.1 (0.099)
*pexp*lcorr*						0.0252 (0.019)
N	140	140	140	140	140	140

NOTES: The dependent variable is the growth of the real GDP per capita. All variables are averaged over 5-year periods except for *ingdp*, which is the logarithm of the real GDP per capita of the first year within each interval. The figures in parenthesis are the cluster-robust standard errors. * denotes significance at a 10 percent level, ** at a 5 percent level, and *** at a 1 percent level.

We find that the coefficient of *corr* is statistically significant and negative with specifications II-V. In specification II, in which the variable enters linearly, the parameter value is -0.00222. In the non-linear specifications III-V, the coefficient of *corr* ranges between -0.0043 and -0.0068, whereas quadratic term *corr2* is also significant but positive with a parameter value ranging between 0.00019 and 0.00038. This evidence presents three issues: *1)* The marginal effect of corruption is negative with respect to economic growth both on average and for each Italian region. As a consequence, a zero-level of corruption is growth-maximizing, which is in line with previous evidence for Italian regions (Del Monte and Papagni 2001) but differs with respect to some cross-country evidence that shows growth-maximizing levels of corruption (e.g., Méndez and Sepúlveda 2006). *2)* Due to the positive sign of the coefficient of *corr2*, the negative effect of corruption on growth becomes less intense as corruption increases. At some point, the detrimental effects of corruption are so high that additional levels of corruption may not be increasingly harmful. This evidence is compatible with a fixed cost of corruption that impairs the economic attractiveness of the region. *3)* If we assume that the actual levels of corruption only change smoothly over time, the observed peak in our proxy may be – at least in part – due to a reduction in the underestimation of the actual phenomenon. This may be responsible for the estimated nonlinearity at high levels of corruption because an increase in the observed corruption does not correspond to a similar increase in the actual levels and, therefore, does not have an impact on economic growth as the results seem to suggest.

By comparing specifications I, II, and III, we note that the addition of *corr* and *corr2* does not affect the coefficients of the other variables. We can also notice that the magnitude of the coefficient of *corr* increases when the squared term for corruption is included. The size of the coefficients allows us to conclude that the negative impact of corruption on economic growth appears larger when the specification includes a quadratic form. The coefficients of all control variables have the expected sign. The coefficient of the variable *pop* is always negative and statistically significant, while those of *physical* and *human* are always positive and significant. The coefficient of the term *ingdp* is negative but not significant at conventional levels. This result is not surprising because the Italian regions did not actually experienced convergence in recent decades. Thus, the results may also suggest that the lack of convergence in GDP per capita across Italian regions can be partially explained by the corruption levels impairing economic performance. The coefficient of private investments (*inv*) is positive and significant at a 10% significance level. In specification V, the coefficient of the public expenditure term (*pexp*) is significant and positive. Finally, specification VI shows that the coefficient of the interaction term (*pexp**lcorr*) is not significant, suggesting that public expenditure does not cause corruption to be more detrimental to economic growth, or likewise, it also suggests that corruption does not impair the likely growth-enhancing effect of public expenditure.

Table 3 shows the results obtained from using the FE estimator on the same specifications (I-VI) introduced above. The coefficients of *corr* are very similar to those obtained with the POLS estimator. In the linear specification (II), the parameter value is -0.0027. In the non-linear specifications (III-V), the parameter value increases in absolute terms and ranges between -0.00516 and -0.0081. The coefficients of the squared corruption term (*corr2*) are also significant and positive with values ranging between 0.00024 and 0.00041. The coefficients for *physical*, *human*, *pop*, and *ingdp* are also very similar to those obtained from the POLS estimator. The coefficient of the variable *inv* becomes non-significant and that of *pexp* is only significant at the 10% confidence level, which is most likely due to the quasi-time-invariant nature of these variables. Finally, the coefficient of the interaction term (*pexp**lcorr*) is again non-significant.

Table 3. Fixed Effects Estimates

	(I)	(II)	(III)	(IV)	(V)	(VI)
Corruption per capita (*corr*)		-.00274*** (0.001)	-.00553*** (0.001)	-.00807*** (0.001)	-.00516*** (0.001)	
Corruption per capita squared (*corr2*)			.000265** (0.0001)	.000411*** (0.0001)	.000239** (0.0001)	
Log Corruption per capita (*lcorr*)						-.0149* (0.008)
Population growth (*pop*)	-1*** (0.239)	-1.4*** (0.238)	-1.51*** (0.207)	-1.76*** (0.233)	-1.46*** (0.215)	-1.31*** (0.267)
Human capital growth per capita (*human*)	.833*** (0.163)	.724*** (0.137)	.706*** (0.134)	.738*** (0.143)	.703*** (0.135)	.753*** (0.163)
Log real GDP per capita (t-5) (*ingdp*)	-2.36 (1.655)	-0.351 (0.947)	-0.372 (1.053)	-0.186 (1.726)	0.79 (1.376)	-0.227 (2.181)
Physical capital growth per capita (*physical*)	.587*** (0.062)	.387*** (0.066)	.315*** (0.064)		.313*** (0.064)	.352*** (0.086)
Private Investment/GDP (*inv*)				0.0227 (0.022)		
Public Expenditure/GDP (*pexp*)					.0923* (0.049)	-0.111 (0.27)
*pexp**lcorr*						0.0333 (0.043)
N	140	140	140	140	140	140

NOTES: The dependent variable is the growth of the real GDP per capita. All variables are averaged over 5-year periods except for *ingdp*, which is the logarithm of the real GDP per capita of the first year within each interval. The figures in parenthesis are the standard errors. * denotes significance at a 10 percent level, ** at a 5 percent level, and *** at a 1 percent level.

Finally, Table 4 reports results obtained by estimating specifications I-VI using the GMM A-B estimator.[15] In this model, we include a lagged term for the dependent variable after we determined, using the A-R test, that one lagged term (*gdp-5*) is sufficient to avoid serial correlation of the errors. Moreover, we drop the variable *ingdp* because it is collinear with respect to the variables that are used by the GMM A-B method to instrument the lagged value of the dependent variable. Again, the corruption estimate appears significantly negatively correlated with economic growth. The parameter values of *corr* are very similar to those previously obtained using POLS and FE estimators, ranging between -0.0037 (in the linear specification) and -0.0068. The coefficients of *pop* and *human* also confirm the previous results. The coefficients of the variables *inv* and *pexp* are not significant as in the previous estimates, while the coefficient of *physical* becomes non-significant. Finally, in specification VI, the coefficient of the interaction term (*pexp**lcorr*) is weakly significant and positive. This result confirms the previous evidence against

[15] Regressions, which rely on the one-step GMM Arellano-Bond estimator, were performed with the econometric software STATA 11. Serial correlation of errors is checked by means of the Arellano-Bond test. The Sargan test is used to check whether the overidentifying restrictions are valid. Standard errors are corrected following the suggestions by Windmeijer (2005).

the hypothesis that public expenditure amplifies the negative effect of corruption on growth.

Table 4. GMM Arellano-Bond estimates

	(I)	(II)	(III)	(IV)	(V)	(VI)
Real GDP per capita (t-5) (*gdp-5*)	0.147 (0.1046)	0.0966 (0.116)	0.0376 (0.0912)	0.0613 (0.0849)	0.0634 (0.0857)	0.0838 (0.084)
Corruption per capita (*corr*)		-.00372*** (0.001)	-.00611*** (0.002)	-.00681*** (0.001)	-.00597*** (0.001)	
Corruption per capita squared (*corr2*)			0.000225 (0.0002)	.000279* (0.0002)	.000246** (0.0001)	
Log Corruption per capita (*lcorr*)						-.0284*** (0.009)
Population growth (*pop*)	-.586** (0.242)	-1.26*** (0.174)	-1.4*** (0.155)	-1.45*** (0.235)	-1.42*** (0.155)	-1.13*** (0.204)
Human capital growth per capita (*human*)	1.57*** (0.26)	1.27*** (0.225)	1.04*** (0.182)	1.09*** (0.143)	.99*** (0.154)	1.11*** (0.219)
Physical capital growth per capita (*capital*)	.383** (0.158)	0.0423 (0.17)	0.123 (0.126)		0.139 (0.136)	0.193 (0.142)
Private Investment/GDP (*inv*)				0.0092 (0.068)		
Public Expenditure/GDP (*pexp*)					-0.0058 (0.055)	-.493* (0.27)
*pexp**lcorr*						.0882* (0.047)
N	100	100	100	100	100	100

NOTES: The dependent variable is the growth of the real GDP per capita. All variables are averaged over 5-year periods. The figures in parenthesis are the standard errors. * denotes significance at a 10 percent level, ** at a 5 percent level, and *** at a 1 percent level.

4.3 ROBUSTNESS CHECKS

To check the consistency of these results, we consider different sets of time intervals with respect to the one proposed above. In particular, we consider 5-year non-overlapped and adjacent time intervals (as above) that are shifted back in time, such that the ending years for each set are 2007, 2008, 2009 and 2010. In the cases of the sets ending in 2007 and 2008, the time intervals are restricted to 6, whereas time intervals are 7 when the sets end in 2009 and 2010. We find that the parameter values of *corr* and *corr2* are very stable across all considered groups of data.

In the year 2000, the data collection suffered from problems of underreporting of tribunals and prosecution agencies caused by some changes encountered by the judiciary, which affected data for all criminal offences. Moreover, the observation from 1978 for the Lazio region is anomalously high. We expect that these problems do not significantly affect our estimates because we use 5-year averages. However, to determine whether these anomalies in the data recording had an effect on our estimated coefficients, we replaced the suspected data with the averages of the data from the adjacent years. The results are very similar in both cases.

Because the corruption data for the small regions Molise and the Aosta Valley are likely to be more imprecise, we treat them as outliers. Therefore, we eliminate them from the sample and re-run regressions for all specifications and estimators. The results are again similar to those previously reported.

Finally, we wonder whether the legislative, social, and political shocks of the first half of the 1990s in Italy, such as the enactment of some changes in the criminal law of corruption in 1990 that stiffened penalties, the so-called clean-hands operation in 1992-1993, the bomb attacks on the anti-mafia judges Falcone and Borsellino in 1992, and the end of the "institutional" Christian democrats governments in Italy in 1992-1994, could have affected the estimates of corruption on economic growth. To verify this hypothesis, we consider two different datasets: in one dataset, we exclude the observations from the time interval 1994-1999, and in the other one, we exclude the time intervals 1988-1993 and 1994-1999. Then, we estimate the same specifications as before (I-VI) using all three estimators. We find confirming results.[16]

5. Discussion

To understand the intensity of the phenomenon under examination, we measured the average magnitude of the impact of corruption on economic growth according to the estimated parameters for corruption reported in the previous section. An increase of a standard deviation in the corruption levels results in a reduction in the growth of GDP per capita by between 0.78 and 1.49 percentage points, depending on the specification and estimator. To compare the Italian case with other two prominent cases such as U.S. and China, we also measure the impact in terms of standard deviations of growth of GDP per capita of a change in a standard deviation in the corruption levels. In particular, an increase of a standard deviation in the corruption levels in Italy results in a reduction between 25.6% and 51.3% of a standard deviation of growth of GDP per capita, depending on the specification and estimator. We collected regional data of the U.S. and China to elaborate the standard deviations of growth of GDP per capita. Glaeser and Saks (2006) for the U.S. and Dong (2011) for China provided the data for corruption and the estimates of the impact of corruption on economic growth. Our estimation upon these data reveals that an increase of a standard deviation in the corruption levels results in a reduction of 19% and 78% of a standard deviation of growth of GDP per capita in the U.S. and China, respectively. This comparison suggests that reducing corruption levels in developing economies such as China has higher growth-enhancing effects than other developed countries such as Italy and the U.S..

[16] All results of robustness checks can be provided upon request.

Regional heterogeneity in corruption can contribute to understand regional differentials in economic growth. For instance, Emilia Romagna is the Italian region with the smallest number of detected corruption crimes over the entire timespan. It has on average one-third of the corruption level of Calabria, one of the most corrupt regions in Italy.[17] In Table 5 we show, using a simple simulation, the average growth rate that a region would achieve if it had the same corruption level as Emilia Romagna. It emerges, for instance, that while Lombardy would grow by an additional 0.27 percentage points per year, Lazio and Calabria would increase by an additional 1.45 and 1.91 percentage points per year, respectively.

Table 5. Simulations of the impact of corruption on yearly growth by region

Region	**Corruption**	**%GDP**	**Δ%GDP (min)**	**Δ%GDP (max)**
Emilia Romagna	*1.5*	*2.08*	*0*	*0*
Marche	1.8	1.90	0.13	0.24
Lombardy	1.9	1.72	0.14	0.27
Veneto	2.0	1.96	0.21	0.39
Piedmont	2.0	1.66	0.22	0.41
Apulia	2.2	1.73	0.27	0.51
Tuscany	2.2	1.68	0.27	0.51
Trentino-South Tyrol	2.3	1.87	0.33	0.62
Umbria	2.4	1.85	0.37	0.70
Campania	2.6	1.47	0.44	0.83
Friuli Venezia Giulia	2.7	2.24	0.49	0.91
Basilicata	3.0	1.86	0.59	1.10
Sardinia	3.1	1.51	0.64	1.18
Sicily	3.2	1.54	0.68	1.26
Abruzzo	3.4	2.17	0.73	1.35
Liguria	3.4	1.77	0.73	1.36
Lazio	3.5	1.68	0.78	1.45
Aosta Valley	3.6	1.00	0.81	1.50
Calabria	4.3	1.69	1.03	1.91
Molise	5.1	2.12	1.29	2.37

NOTES: The column *Corruption* reports the number of detected corruption crimes per 100,000 inhabitants. The column %GDP shows the average growth of the GDP per capita in the interval 1968-2011. The last two columns describe the yearly increase in percentage points of the GDP per capita if all of the regions had the same corruption level as the least corrupt region, which is Emilia Romagna. In particular, in these two columns we distinguish between the yearly minimum and maximum percentage increase of GDP per capita, depending on the overall effect of the estimated coefficients of corruption for all estimators and specifications, including the quadratic form.

The regions that can profit from control of corruption are mostly in the Centre and South of Italy, e.g., Calabria, Lazio, Sicily, Sardinia, Campania, etc. These are also the regions that experienced the lowest growth rates over the entire timespan. Thus,

[17] The Molise and Abruzzo regions in South Italy and the Aosta Valley and Friuli Venezia Giulia regions in North Italy are small regions and can be considered outliers.

a reduction in the differentials between the corruption levels could reduce the regional disparity in GDP per capita between South and North Italy.

6. CONCLUSIONS

This empirical investigation aimed at expanding the understanding over the existence and size of the impact of corruption on economic growth at a regional level. Italy appeared as a privileged corner to perform this type of analysis for three main reasons: *1)* the homogeneity of the law and enforcement system across regions; *2)* the regional heterogeneity of the variables involved in the analysis; *3)* the availability of a long panel data set. In particular, the long panel (i.e., 44 years) allowed us to address the latency characterizing corruption by means of a set of estimators applied to multi-year averages. This helped to separate the long-run tendencies from the short-run occurrences.

We found evidence that the presence of corruption is detrimental to long-run growth. In addition, corruption enters the relation with economic growth in a non-linear form. This evidence is robust and persistent throughout different models and specifications. Accordingly, we can draw a few considerations. The impact of corruption is always negative with respect to economic growth both on average and for each Italian region. The levels of corruption in the Italian regions lie along the negative slope of the relation between corruption and economic growth, which might be U-shaped. The zero-level of corruption is growth maximizing. Moreover, the value of the quadratic term of corruption is positive. Thus, the negative effect of corruption on growth becomes less intense as corruption increases. A possible interpretation could be that corruption entails a fixed cost and a variable cost in terms economic attractiveness of the region such that, as corruption increases, the fixed cost is watered down and, eventually, corruption may not be increasingly harmful.

We do not find any evidence that public expenditure increases the detrimental effects of corruption on economic growth, or read differently, no evidence suggests that corruption makes public expenditure inefficient in its growth-enhancing effect. Instead, corruption itself may reduce the levels of public spending rather than its effectiveness. This can be mainly due to inefficient public servants, non-credible politicians, and the increasingly stricter requirements and procedures to capture public money when corruption levels are high. For example, consider the low percentages of EU structural funds spent by Southern Italian regions, where corruption is highly pervasive, with respect to those spent by other Italian regions.[18]

[18] In the 2007-2013 structural funds agenda, the Southern Italian regions have been able to spend by April 2014 about 45% of the funds compared to 59% of the remaining Italian regions (*source*: Italian Department of Development and Social Cohesion).

Finally, the results also suggest that the corruption levels help explain the lack of convergence in GDP per capita across Italian regions in recent decades. The Central and Southern regions of Italy could achieve a significant increase in GDP per capita up to approximately 2 percentage points per year by reducing their corruption levels to the same level as the most virtuous Italian region. Hence, corruption appears a strong impediment to economic performance, and its reduction would unleash the economic energies of the most sluggish regions, thereby reducing the persistent gap between the two areas of the country.

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