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

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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 an original and robust measure of corruption. The investigation is carried out by means of different specification strategies that attempt to reduce short run fluctuations and to alleviate concerns about endogeneity. The results show a significant effect of corruption on regional economic growth in all specifications. Likewise, no evidence of a non-linear relationship between corruption and growth emerges. Finally, the evidence suggests that corruption does not make public expenditure inefficient.

Keywords: corruption, growth, cross-regional analysis.

JEL: K14; O43; R11.

1. Introduction

Corruption is a very latent phenomenon. The large economic literature on this topic provides both theoretical understanding and empirical evidence explaining that the effects of corruption can be multidimensional, persistent, but also uncertain.[1] This paper wants to remain in the wake of an already established - although contrasting - empirical literature on the impact of corruption on economic growth. A large amount of previous empirical investigations on this topic focused on cross-country data. These used perception indices as proxies for corruption, and attempt to control for the several institutional variables that contribute to explain the differences in economic growth rates. We make a deviation from these analyses by choosing an 'objective' proxy of corruption, such as the number of reported crimes of

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

corruption. Although the literature is scanty, we prefer within-country investigations, in which institutional factors influencing economic growth do not severely undermine the causal investigation between corruption and growth.

Within-country empirical investigations appear more reliable than cross-country investigations to explain the relationship between corruption and economic growth because differences among countries in terms of criminal laws, investigative departments, administrative controls, subsidies and transfers, public-owned enterprises may explain most of the variability of corruption. The case of Italy is particularly suitable for this type of investigation. *First*, there are wide differences in income levels but also in growth rates across its regions. The Southern regions have always lagged behind the regions of the Centre-North of the country, and this diverging pattern has become more severe over the last years. *Second*, an objective or direct measure of corruption is available, this is the number of reported crimes to the prosecution departments for which they have started their prosecution actions. *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.

The only two recent studies focusing on the effect of corruption on economic growth in Italy are those by Del Monte and Papagni (2001) and Fiorino *et al.* (2012). With respect to these contributions, this study expands the investigation of the impact of corruption on economic growth in the following way. *First*, we make use of a different proxy on corruption, which we consider more reliable.[2] *Second*, the time interval (i.e., 1968-2011) is larger than previous studies and allows for capturing long-term dynamics of the causal relationship that - especially for these types of investigations - could not otherwise be recognized with shorter time intervals[3] Importantly, anti-corruption laws did not experience any significant modification so as to affect agents' behaviour over this time span. *Third*, we use a different specification strategy to address the estimation issues of a latent and long-run phenomenon such as corruption, and to evaluate the sensitivity of the results. In particular, we compare the results obtained by performing the pooled OLS estimator with those obtained by using the static (fixed effects) and the dynamic (GMM Arellano-Bond) panel data models.

The paper is organised as follows. The next section presents the main contributions of the literature on the effects of corruption on economic growth. The third section introduces the dataset, the variables, in particular the proxy used, and their

[2] This proxy has been used by Del Monte and Papagni (2007) only for the investigation of the determinants of corruption. Further, as will be discussed at length below, Del Monte and Papagni (*ibid.*) provide evidence of the robustness and reliability of this measure.

[3] Del Monte and Papagni (2001) consider the years from 1963 to 1991, whereas Fiorino *et al.* (2012) from 1980 to 2004.

descriptive statistics. The fourth section includes the econometric framework and empirical results. The final section concludes.

2. Literature Review

In this section we provide a literature survey on the impact of corruption on growth without presuming to be exhaustive with respect to the extensive research carried out in this field that still gathers the interest of 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 to disentangle this thorny issue has been remarkably described by Paldman (2002), emphasising the seesaw dynamics in which corruption and economic growth appears to feed on each other without a clear cause-effect relationship. This mainly empirical dilemma has been commonly faced through various econometric approaches, which strive for coping with the endogeneity problem. We postpone to the empirical section the way we face this problem and focus this survey on the impact of corruption on economic growth, which has a substantial research behind it. Therefore, we skip the analysis of the determinants of corruption, and among them economic development.

In this perspective, the main research question is whether corruption is sand or grease in the wheels of economic development. This is rather controversial and, again, this is mainly an empirical question to which no definitive answer can be provided. 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 seen 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, thereby corrupt practices by operating as grease in the wheels reduce frictions. This 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 put more value to time.[4] Similarly, Beck and Maher (1986) and Lien (1986) show that the most efficient firms can afford highest bribes thereby minimising their red-tape costs. Another supportive investigation of the "grease" argument is due to Dreher and Gassebner (2011), who provide evidence that corrupt practices could facilitate firms' entry in highly regulated economies. In a nutshell, this evidence characterizes corruption as a second-best solution vis-à-vis the inefficient bureaucracy that constitutes an impediment to investments.

[4] 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.

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, among many, by Mo (2001) and Pellegrini and Gerlagh (2004). However, it appears important to understand through which channel corruption acts in order to impact on economic growth.

The channel of private investments is one of the most widely investigated, since public officials focus on rent-seeking activities in their often discretionary supply of public services. This would eventually induce a misallocation of resources, in particular financial and human capital.[5] More specifically, corruption undermines the investments in education by 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) find that corruption discourages investments in innovation because ruling oligarchies in exchange of bribes favour established firms raising barriers to potential innovators entrance. Wei (2000), Habib and Zurawicki (2002), Lambsdorff (2003), and Egger and Winner (2005) focus on FDI and find 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) provide evidence that politicians tend to divert public resources towards activities more vulnerable to corruption through distortive interventions in public procurements. This 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 it is at the bottom of all other channels. Corruption attitudes induce bureaucrats to expand regulatory practices and slow down bureaucratic processes in order to persuade government's clients to pay bribes (Myrdal 1968; Rose-Ackerman *ibid.*). In this perspective, Méon and Sekkat (2005) provide evidence that poor quality of governance makes corruption a depressing factor for economic growth. In a cross-country analysis, Aidt *et al.* (2008) find that corruption exerts a significant negative impact on

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

economic growth in countries with good governance, while no effect can be detected in regimes with poor governance.

Contrarily to various theoretical analyses and a wide empirical cross-country evidence supporting the “sand” argument, Assiotis (2012) recently finds that once country-specific fixed effects are taken into account no significant causal relationship between corruption and income exists.

However, the debate is far to be over, both the “grease” and the “sand” arguments may not necessarily contradict each other. Treisman (2000) supports this view and provides evidence of an inverted U relationship between corruption and economic development: at early stages of development corruption increases and then, when the economies become robust, corruption starts to decrease. A non-linear relationship between corruption and growth is ascertain by Klitgaard (1988) and Acemoglu and Verdier (1998), who show that low levels of corruption positively affect economic growth whereas high levels are detrimental. Further, by distinguishing democratic and non-democratic countries Méndez and Sepulveda (2006) corroborate this argument and more specifically provide evidence that non-linearity is valid only for democratic countries.

So far, the empirical analyses here provided has explored the causal relationship under scrutiny only with cross-country investigations. However, the empirical analyses can be carried out along another direction, a within-country investigation, which is adopted in our study. As mentioned in the introduction, within-country investigations have the advantage to reduce or even eliminate the institutional differences existing across countries, thereby moderating the omitted variable bias and with an ultimate beneficial effect on our estimates. Unfortunately, within-country studies do not abound.

Within-country data on corruption have been used by Goel and Nelson (1998) about corruption and government size, Fisman and Gatti (2002) about corruption and decentralization, Svensson (2003) about bribery and firms, and McMillan and Zoido (2004) about bribery and politicians. However, these studies do not focus on corruption and development. Glaeser and Saks (2006) perform a cross-regional analysis for the 50 States in U.S.. They actually scrutinize the impact of corruption on economic development, but find weakly significant negative values. China provides an important example. Both the centralised legal and administrative systems, and the wide variability in economic conditions allow for a robust cross-regional analysis. Dong (2011) provides evidence of both “sand” and “grease” arguments, and consequently the causal relationship does not appear robust. In a more updated study, Dong and Torgler (2013) identify a positive relationship between corruption and economic development in China, which is mainly driven by the transition to a market economy. Again in China, Cole *et al.* (2009) find that those regions which exerts a higher anti-corruption effort are able to attract more

FDI. However, the latter result is confuted by Dong (2011), who finds identification problems and inappropriate measures of anti-corruption efforts.

As mentioned above, Fiorino *et al.* (2012), using a dataset covering the period 1980-2004, performed a cross-regional investigation in Italy and confirm a negative impact of corruption on economic growth. They also provide evidence that the presence of corruption hampers the positive impact of public expenditure on economic growth. Del Monte and Papagni (2001) carried out a similar investigation on an older dataset (i.e., 1963-1991). They focus on the effects of corruption on the efficiency of public expenditure, and corruption is specifically that arising from purchases made by government officials. They find that the most corrupted Italian regions suffer from inefficient public spending, particularly investment in infrastructures, which in turn entails lower growth rates.

3. Dataset and Variables

As previously stated, the measurement of corruption is complex and yet no conclusive remark has been made. Different proxies are used according to the dimension to capture: at a country or regional level. Perception indices are often considered the only consistent measure in the absence of more direct or objective proxies. This is typically the case of cross-country surveys. However, perception indices are not exempt from criticisms since perception may heavily depend on the momentary feelings of the public opinion and the media coverage about specific criminal cases. When we consider within-country data, more objective measures of corruption can be adopted.

In our investigation, we consider as a proxy for corruption the number of crimes reported to prosecution departments for which prosecution has started. It involves all corruption-related crimes reported by region and it covers from 1968 to 2011.[6] This proxy can also be seen as a measurement of crime detection due to the effort of prosecution departments to investigate and impose criminal charges to new cases of corruption. It differs from the indicators adopted by other cross-regional analysis in Italy on the impact of corruption on economic growth.[7] In particular, both Del Monte and Papagni (2001), and Fiorino *et al.* (2012) considered the entire group of crimes against the public administration, which however hides crimes not directly or indirectly related to corruption such as assault, resisting and insulting public officer, dereliction of duty, etc.. Consider that the subset of corruption crimes is

[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 been published yet and have been provided by Istat.

[7] In a similar cross-regional investigation in U.S., Glaeser and Saks (2006) use the number of public officials convicted for corrupt practices by the federal justice department. In China, similarly to our measure, 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.

considerably small with respect to the overall number of crimes against the public administration: in general, less than 10%. Further, this percentage is increasing over time, by less than 2% until the middle of '70s, up to 8% at the beginning of the nineties, and roughly 5% at the beginning of years 2000.

Del Monte and Papagni (2007) have however already used our proxy but only for identifying the determinants of corruption. As correctly mentioned by this last contribution, this proxy may underestimate the underlying phenomenon, but in a dynamic cross-regional analysis this shortcoming is barely relevant. Another 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. This is mainly due to two factors: 1) a centralized judiciary at a national level including both judges and prosecutors, 2) prosecutors comply only to law and are not accountable to political power. Thus, we are confident that differences across regions in the magnitude of the proxy are mainly due to the differences in the incidence of actual corruption. Del Monte and Papagni (2007) also discards this possible systematic bias.

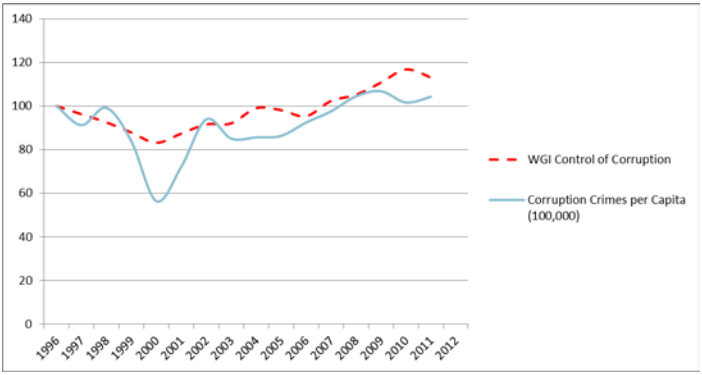
We provide further robustness checks regarding this proxy. First, we compare our "objective" measure with a regional perception index of corruption that is available only for two years (2010 and 2013).[8] Charron *et al.* (2013, 2014a, 2014b) provide these two measurements for most of the European regions and, consequently, also for the 20 Italian regions. The correlation results are encouraging. The correlation between our proxy in 2009 and the perception 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.[9] Second, we compare the time series of the worldwide governance indicator (WGI) of 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 1 clearly shows that the medium-long run tendency of both measures are very similar.

[8] The perception index is equal to the average of five scores regading the corruption perception in the education system, health care system, law enforcement, and public services, and finally whether the respondents were force to pay bribes to obtain any health care.

[9] 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.

FIGURE 1

WGI-control of corruption and corruption crimes per-capita (100,000)



SOURCE: the World Bank Group and the Italian Institute of Statistics (Istat).
NOTES: both measures are normalized to 100 in 1996. Data are at a national level. We considered smooth connecting lines. Yearly data of WGI Control of Corruption in 1997, 1999, and 2001 were missing, therefore we considered the average of the adjacent years. In 2000, the corruption crimes per capita indicator suffered from a severe underreporting, as discussed further below.

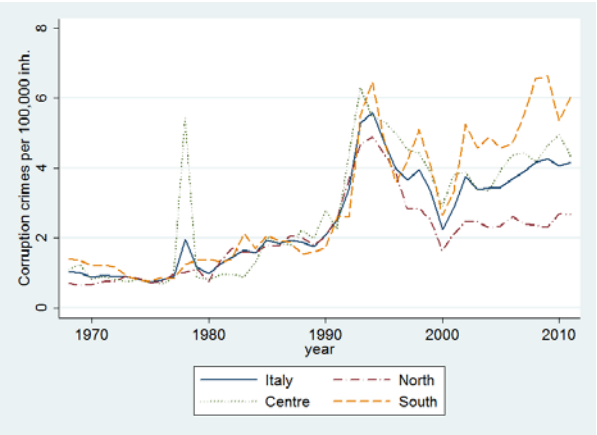
All the checks carried out in this and in previous studies confirm the robustness of our proxy in capturing the complex phenomenon of corruption.

Figure 2 illustrates the trends of corruption in Italy and in the macro-areas North, Centre, and South. There are no substantial differences in the trends among the macro-areas: a steady increase until 1991, then in 1992 the so-called "*clean hand operation*" changed the overall attitude against corruption both within the society but also in the investigative and prosecution departments, which very likely generated a spike in the reported crimes, reaching its utmost in 1994. The increase rates witness that some important change has occurred: from 9.09% in 1990 and 15.95% in 1991, the increase rate of the per-capita detected corruption rises to 26.97% in 1992, 67.39% in 1993 and decline to 26.03% in 1994, and finally it becomes negative. We have no reason to believe that the amount of actual corruption has also severely increased as the number of detected crimes per-capita between 1992-1994 tends to suggest, or at least we believe that actual corruption has not increased by that magnitude. It is likely that after 1992 the clean hand operation could have 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 wave of the clean hand operation, a reduction in the moral tension against corruption has occurred with a resulting increase in the number of unobserved crimes of corruption. However, we cannot exclude that starting from 1992 a long-term

structural change has also occurred.[10] In particular, we can notice that after this period there is a certain divergence in the levels between the sluggish economic area of the South and the more economically advanced regions of the North. After 1992, the Southern regions come across increasing levels of corruption with respect to the North, which seems to continue with the soft increasing trend experienced before the nineties.

FIGURE 2

Number of reported crimes of corruption per capita (100,000) - 1968-2011



SOURCE: the Italian Institute of Statistics (Istat).
NOTES: The spike in 1978 in the Centre is due to an anomaly existing in Rome during that year for which we have no accounts.

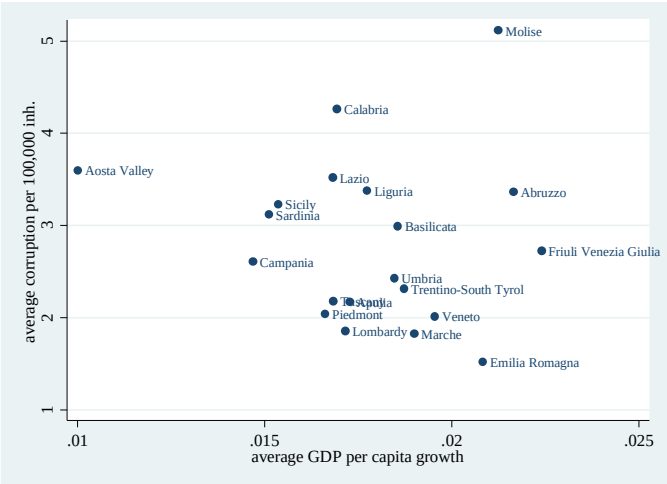
Figure 3 shows an apparently negative correlation between the average corruption crimes and the average growth rates of real GDP per capita.[11] The heterogeneity in the corruption crimes per capita and in the economic growth rates across the Italian regions makes the empirical analysis feasible.

[10] It is worthwhile mentioning that during the period under scrutiny, the law on corruption did not come across important changes, apart from the introduction of a new criminal procedure code at the end of 1989 and an increase in the penalties of corruption-related crimes after 1990.

[11] Aosta Valley and Molise are the smallest regions of Italy.

FIGURE 3

Scatterplot corruption crimes and growth rates (1968-2011)



SOURCE: Italian Institute of Statistics (Istat).

Finally, we show in Table 1 the sources and the summary statistics of the variables used in the subsequent 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: All monetary variables are expressed in real terms (constant euros of 2005). GDP per capita in thousand euros. The variables reporting Crenos + Istat as a source are elaborated by CRENoS (1999) for the earlier years (1968-1994), in which we used a dataset (*Regio IT 60-96*), whereas for the subsequent years (1995-2011) we used the regional accounts data elaborated by ISTAT. As a proxy for human capital we use the average number of years of schooling per employee. Until 2004, human capital data are elaborated by Tornatore *et al.* (2004) from Istat, the recent years are directly obtained by Istat.

4. Empirical Analysis

4.1 Methodology

In what follows, we test the hypothesis that corruption affects economic growth. We make use of a panel data set consisting of the Italian regions in the period between 1968 and 2011. Following other studies on this subject, we consider the five-year averages of the variables of interest.[13] Multi-year averages allow us to reduce short-run fluctuations and to alleviate concerns about endogeneity. Further, for this type of crime, registered cases of corruption in one year could reflect crimes committed in previous years but detected in that year. The averages reduce 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 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 also consider the private investment-GDP ratio. Human capital is proxied by the number of years of education per employee, while physical capital is obtained by following the procedure described, for instance, by Caselli (2005).[14]

In the following, we will present different estimation strategies that attempt to address the several econometric problems that such an analysis can encounter. We will adopt three different estimators such as the pooled cross-section model, the fixed effects model, and the generalized method of moments Arellano-Bond model.

<u>Pooled cross-section model</u>

As a baseline estimator, we consider the pooled cross-section OLS (POLS) with cluster-robust standard errors. This model relies on the assumption that intercepts are the same for all regions, or, at least, that errors are uncorrelated with regressors. Inference needs to control for a likely correlation of the error term over time for a given region (*within* correlation) and a possible correlation over regions (*between* correlation). To address the *within* correlation problem, we rely on cluster-robust standard errors to check statistically significance of 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

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

[14] 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 investment growth over a determined time interval and d represents the capital depreciation rate (defined as 6 %). The capital stock in the subsequent years is $K_t = K_{t-1} + I_t - dK_{t-1}$.

driven by a third omitted variable, which is correlated with both of them. Second, economic growth may affect corruption, rather than just being the effect.

Static panel data model

An alternative approach consists in using the fixed effects (FE) estimator with a static panel data model to control for the endogeneity due to unobserved regional characteristics that the POLS estimator cannot address successfully. However, the FE approach does not solve the possible endogeneity due to the reverse impact of economic growth on corruption. Neither, it allows us to control for the endogeneity due to time-variant factors (Mendez and Sepulveda, 2006).

Dynamic panel data model

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

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

where $\dot{y}$ is the five-year average growth of 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, $X_{i,t-5j}$ contains five-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 by the fact that $\dot{y}$ follows an AR(Q) process.

Estimating such a model with 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, 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 in order to lead to consistent parameter estimates. Endogenous components of the matrix $X_{i,t-j}$ can be instrumented with lagged terms of $X_{i,t-5j}$ (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 the corruption proxy - or any other variable in X - so as to correctly identify the only effect of the latter on the former.

4.2 Estimation results

Table 2 reports the main results obtained by using the POLS estimator with cluster-robust standard errors.[15] To expand the number of observations, we use up to 7 five-year observations for each of the 20 Italian regions. To calculate non-overlapping 5-year averages, we initially consider the following 7 time intervals: 1970-1975, 1976-1981, 1982-1987, 1988-1993, 1994-1999, 2000-2005, 2006-2011.[16] At a later stage, we will discuss on whether results are sensitive with respect to shifting intervals.

In all specifications, the dependent variable is the growth of real GDP per capita. The growth of the physical and human capital stock per capita (*physical* and *human*, hereafter), population growth (*pop*) and the log of real GDP per capita of the first year within each interval (*ingdp*) are the regressors of specification I, and are constantly included in all specifications apart from specification III, in which the *physical* term is replaced by the investment-GDP ratio (*igdp)*. In addition to these variables, specifications II-VI include the number of detected crimes of corruption per 100,000 inhabitants (*corr*). Specification IV and V adds the public expenditure-GDP ratio (*pgdp*) to the set of independent variables of specification II. Specification V also adds the interaction term (*pgdp*corr*) between *pgdp* and *corr*. Finally, specification VI differs from specification II because it includes the square of corruption per 100,000 inhabitants (*corr2*). The 5-year average is considered for all variables except for *ingdp*.

TABLE 2

POLS estimates of the impact of corruption on economic growth

	(I)	(II)	(III)	(IV)	(V)	(VI)
Corruption per capita (*corr*)		-.00759*** (-6.14)	-.0103*** (-5.83)	-.00781*** (-6.13)	-.0134*** (-3.15)	0.000828 (0.04)
Corruption per capita squared (*corr2*)						-0.00079 (-0.47)
Population growth (*pop*)	-.935*** (-5.29)	-1.28*** (-8.19)	-1.29*** (-5.95)	-1.12*** (-7.47)	-1.11*** (-7.66)	-1.3*** (-8.12)
Human capital growth per capital (*human*)	.827*** (5.25)	.721*** (4.97)	.848*** (5.44)	.721*** (4.88)	.743*** (4.74)	.717*** (5.01)
Log real GDP per capita (t-5) (*ingdp*)	-.0627*** (-2.62)	-0.00897 (-0.5)	-0.0198 (-0.87)	-0.0179 (-1.05)	-0.0123 (-0.71)	-0.00802 (-0.43)
Physical capital growth per capita (*physical*)	.438*** (6.34)	.313*** (6.53)		.317*** (7.81)	.312*** (7.07)	.316*** (6.72)

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

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

Private Inv./GDP (*igdp*)			0.0289 (1.63)			
Public Expenditure/GDP (*pgdp*)				.0355*** (4.8)	-0.1 (-1.01)	
*pgdp*corr*					0.0252 (1.36)	
N	140	140	140	140	140	140

NOTES: Dependent variable: growth of real GDP per capita. The 5-year average is considered for all variables except for *ingdp*, which is the value of real gdp per capita of the first year within each interval. The figures in parenthesis are p-values. * 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, and shows a coefficient ranging between -0.008 and -0.013. By comparing specifications I and II, we note that the addition of *corr* does not affect the other variables' coefficients. All control variables have the expected sign. Variable *pop* is always negative and statistically significant, while *physical* and *human* are always positive and significant. The term *ingdp* is negative but non-significant at conventional levels. Private investments are not significant but positive. The public expenditure term is significant and positive in specification IV, while the interaction term is not significant (*pgdp*corr*), suggesting that public expenditure does not make corruption more detrimental for economic growth, or likewise, it also suggests that corruption does not make public expenditure inefficient. Finally, as the results of specification VI suggest, we do not find evidence of a non-linear relationship between corruption and growth. This is not surprising as we usually observe less heterogeneity in variables in within-country contexts than in cross-country ones.

Table 3 shows the results obtained from using the FE estimator on the same specifications (I-VI) introduced above. The coefficients on *corr* are very similar to those obtained with the POLS estimator, ranging between -0.008 and -0.015. Coefficients on *physical*, *human* and *pop* are also very similar. Other than *ingdp* and *igdp*, the variable *pgdp* becomes non-significant, this is most likely due to the low time variability within each region. The interaction term *pgdp*corr* is again non-significant. Finally, confirming results reported in Table 2, we do not find evidence of a non-linear effect of corruption on growth.

TABLE 3

FE estimates of the impact of corruption on economic growth

	(I)	(II)	(III)	(IV)	(V)	(VI)
Corruption per capita (*corr*)		-.00863*** (-4.39)	-.0125*** (-6.16)	-.00812*** (-4.06)	-.0149* (-1.81)	0.0187 (0.88)
Corruption per capita squared (*corr2*)						-0.00258 (-1.36)
Population growth (*pop*)	-1*** (-4.19)	-1.43*** (-6.2)	-1.66*** (-6.85)	-1.38*** (-5.9)	-1.31*** (-4.89)	-1.46*** (-6.59)

Human capital growth per capital (*human*)	.833*** (5.12)	.722*** (5.16)	.758*** (5.15)	.722*** (5.14)	.753*** (4.63)	.704*** (5.35)
Log real GDP per capita (t-5) (*ingdp*)	-2.36 (-1.43)	-0.69 (-0.46)	-0.505 (-0.22)	0.258 (0.15)	-0.227 (-0.1)	-0.117 (-0.11)
Physical capital growth per capita (*physical*)	.587*** (9.5)	.325*** (4.79)		.327*** (4.74)	.352*** (4.1)	.324*** (5.13)
Inv/GDP (*igdp*)			0.0238 (1.02)			
Public Expenditure/GDP (*pgdp*)				0.0789 (1.64)	-0.111 (-0.41)	
*pgdp*corr*					0.0333 (0.77)	
N	140	140	140	140	140	140

NOTES: Dependent variable: growth of real GDP per capita. The 5-year average is considered for all variables except for *ingdp*, which is the value of real gdp per capita of the first year within each interval. The figures in parenthesis are p-values. * 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 through the GMM Arellano-Bond (GMM A-B) estimator.[18] In this model, 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 are very similar to those previously obtained with POLS and FE, ranging between -0.010 and -0.028. Coefficients of *pop* and *human* also confirm previous results. The variables *igdp* and *pgdp* are not significant as in the previous specification, while *physical* becomes non-significant. With specification V, the interaction term *pgdp*corr* is weakly significant and positive confirms previous evidence against the hypothesis that public expenditure amplifies the negative effect of corruption on growth. Finally, the hypothesis of a non-linear relationship between corruption and growth does not find evidence.

TABLE 4

GMM A-B estimates of the impact of corruption on economic growth

	(I)	(II)	(III)	(IV)	(V)	(VI)
Corruption per capita (*corr*)		-.0102*** (-4.53)	-.0114*** (-6.02)	-.0101*** (-3.39)	-.0284*** (-3)	0.0384 (1.07)
Corruption per capita squared (*corr2*)						-0.00448 (-1.35)
Population growth (*pop*)	-.586** (-2.42)	-1.26*** (-7.46)	-1.24*** (-4.56)	-1.34*** (-7.22)	-1.13*** (-5.56)	-1.26*** (-7.81)
Human capital growth per capital (*human*)	1.57*** (6.06)	1.18*** (5.34)	1.26*** (7.93)	1.14*** (5.94)	1.11*** (5.04)	1.18*** (4.7)

[18] 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).

Physical capital growth per capita (*capital*)	.383** (2.43)	0.118 (0.88)		0.0814 (0.5)	0.193 (1.36)	0.0842 (0.57)
Inv/GDP (*igdp*)			0.00232 (0.03)			
Public Expenditure/GDP (*pgdp*)				-0.0336 (-0.35)	-.493* (-1.82)	
*pgdp*corr*					.0882* (1.86)	
N	100	100	100	100	100	100

NOTES: Dependent variable: growth of real GDP per capita. The 5-year average is considered for all variables except for *ingdp*, which is the value of real gdp per capita of the first year within each interval. The figures in parenthesis are p-values. * denotes significance at a 10 percent level, ** at a 5 percent level, and *** at a 1 percent level.

Robustness Checks

To check for consistency of these results, we want to consider different sets of time intervals with respect to the one proposed above. In particular, we consider five-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, time intervals are restricted to 6, whereas time intervals are 7 when the sets end in 2009 and 2010. In Table 5, we show the estimated coefficients on the corruption variable (and their standard deviation) obtained with the specifications II-V by POLS, FE and GMM A-B estimators.[19] We find that the parameter value of *corr* is very stable across all considered groups of data.

TABLE 5

Comparison of POLS, FE, and GMM A-B estimates for different time intervals

from-to	POLS (II)	POLS (III)	POLS (IV)	POLS (V)	FE (II)	FE (III)	FE (IV)	FE (V)	GMM A-B (II)	GMM A-B (III)	GMM A-B (IV)	GMM A-B (V)
1972-2007	-.0081*** (-5.42)	-.01*** (-7.17)	-.0082*** (-5.64)	-.0131** (-2.25)	-.0084*** (-4.07)	-.0103*** (-6.09)	-.0079*** (-4.33)	-.016** (-2.1)	-.0108*** (-4.31)	-.0111*** (-7.13)	-.0112*** (-5.96)	-0.0105 (-1.14)
1973-2008	-.0064*** (-4.47)	-.0081*** (-5.62)	-.0064*** (-4.45)	-0.00546 (-0.96)	-.0067*** (-4.84)	-.0094*** (-7.44)	-.0066*** (-4.14)	-0.00638 (-0.85)	-.00445** (-1.99)	-.0062*** (-3.22)	-.00366* (-1.66)	0.00116 (0.11)
1968-2009	-.0084*** (-6.17)	-.0112*** (-7.71)	-.0083*** (-6.17)	-.0119** (-2.04)	-.0086*** (-5.34)	-.013*** (-9.23)	-.0086*** (-5.09)	-.0144* (-1.95)	-.0091*** (-5.22)	-.0132*** (-8.73)	-.0103*** (-5.02)	-.0204* (-1.92)
1969-2010	-.0103*** (-6.38)	-.0143*** (-8.62)	-.0102*** (-6.35)	-.0252*** (-3.61)	-.0113*** (-4.98)	-.0152*** (-9.34)	-.0108*** (-4.56)	-.0303*** (-3.03)	-.0127*** (-4.77)	-.0175*** (-8.19)	-.0134*** (-5.96)	-.0532*** (-4.13)

[19] Since all the results suggest to reject the hypothesis of non-linearity in the relationship between corruption and GDP growth, for the sake of brevity, we do not report the results concerning specification VI.

1970-2011	-.0076*** (-6.14)	-.0103*** (-5.83)	-.0078*** (-6.13)	-.0134*** (-3.15)	-.0086*** (-4.39)	-.0125*** (-6.16)	-.0081*** (-4.06)	-.0149* (-1.81)	-.0102*** (-4.53)	-.0114*** (-6.02)	-.0101*** (-3.39)	-.0284*** (-3)

NOTES: The coefficients of the corruption per capita variable (*corr*) are estimated according to different estimators as reported in the first row. The figures in parenthesis are p-values. Each set of 5-year time intervals is shown in a row. * denotes significance at a 10 percent level, ** at a 5 percent level, and *** at a 1 percent level.

In year 2000, data collection suffered from problems of underreporting of tribunals and prosecution agencies caused by some changes encountered by the judiciary that affected all data from criminal offences. We expect that this problem does not affect significantly our estimates because it was ubiquitous to all regions and also because we use the 5-year averages. However, to check whether this anomaly in recording data has an effect on our estimated coefficients, we replace data of corruption of year 2000 with the average between data on corruption of year 1999 and 2001. As expected, results (not reported in tables but available upon request) are very similar.

Finally, we wonder whether the legislative, social, and political shocks of the Italian nineties, such as respectively 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, and the end of the "institutional" Christian democrats governments in Italy in 1992-1994, could drive the estimated effects of corruption on economic growth. To verify this hypothesis, we eliminate observations within the time interval 1988-1999 and estimate the same specifications (I-VI) using all three estimators. While we find confirming results with the POLS and FE estimators, results become more unstable with the GMM A-B estimator (not reported in tables but available upon request). This can be attributed to the fact that the number of observations decreases from 100 to 40, by determining a loss of efficiency of the estimator.

5. Conclusion

This investigation has used an original proxy of corruption, consisting in the number of reported crimes to the prosecution departments and for which prosecution action has started. A long time interval, from 1968 to 2011, has allowed for a more comprehensive analysis of the impact of corruption on regional economic growth in Italy. We find robust evidence that the presence of corruption undermines economic growth. This result corroborates previous findings by Del Monte and Papagni (2001), and Fiorino *et al.* (2012), and complements other within-country studies such as Glaeser and Saks (2006) for the U.S. and Dong (2011) for China.

Results are robust and persistent through different models and specifications. In particular, the results suggest that public expenditure does not make corruption more detrimental for economic growth, or put differently, it also suggests that

corruption does not make public expenditure inefficient. Therefore, there must be other channels through which corruption affects economic growth. Finally, there is no evidence of a non-linear relationship between corruption and growth. This is not surprising as we usually observe less heterogeneity in variables in within-country contexts than in cross-country ones.

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