Proposal for a New Measure of Corruption, and Tests using Italian Data

Miriam A. Golden
Department of Political Science
University of California at Los Angeles
golden@ucla.edu

and

Lucio Picci
Department of Economics
University of Bologna
l.picci@ei.unibo.it

version 1.1

October 2001

For help assembling data, we thank Massimo Guagnini, Claudio Mazziotta, and Robert Putnam. Golden acknowledges the support of National Science Foundation (SES-0074860) and of the Russell Sage Foundation, New York, N.Y. All opinions expressed are entirely the authors'.
Corresponding author: Professor Miriam Golden, Department of Political Science, University of California at Los Angeles, Box 951742, Los Angeles, CA 90095; golden@ucla.edu.

Abstract

Standard crossnational measures of corruption draw on information collected through surveys. We propose a novel alternative measure based on objective data, namely, the difference between a measure of the physical quantities of public infrastructure and a measure of the value of public capital stocks. Where the difference between the value of existing infrastructure and the actual physical infrastructure is larger, more money is being siphoned off in mismanagement, fraud, bribes, kickbacks, and embezzlement; that is, corruption is greater. We create this measure for Italy's 20 regions as of the mid-1990s, controlling for possible regional differences in the costs of public construction.

We analyze data over the Italian regions to demonstrate the utility of the proposed measure. The analysis shows that corruption is greater in the southern Italian regions, as would be expected. Our proposed measure exhibits a strong statistically significant relationship inverse with Putnam's measure of government performance, suggesting that as corruption increases, government performance deteriorates. Finally, we show that high-level political malfeasance—measured by the number of charges of malfeasance against members of Italy's Chamber of Deputies in the period from 1992 to 1994—is highly and significantly correlated with the more general measure of corruption that we propose.

We offer suggestions for constructing a similar measure of corruption for various other countries.

The emergence of the Transparency International (TI) Corruption Perceptions Index in the 1990s has fundamentally altered comparative research into corruption, typically defined as the misuse of public office for private gain. The TI index, itself based on an aggregation of multiple surveys of public and expert opinion, currently offers scores for nearly 100 of the world's countries on an annual basis.[1] The availability of a comparable index for so many countries has generated a raft of crossnational statistical studies on the causes and the consequences of corruption (including Mauro 1995; Mauro 1997; Sandholtz and Koetzle 2000; Treisman 2000). Results of this line of analysis have been impressive, demonstrating, for instance, that corruption lowers investment and economic growth. It has reinvigorated research into a set of questions that political scientists had temporarily abandoned, in part because of he lack of good data, regarding the quality of government.[2] Finally, research based on the Corruption Perceptions Index has also had significant policy importance

Nonetheless, the measure of corruption commonly used has some intrinsic weaknesses, weaknesses that may have become increasingly problematic over time. These are of two sorts. First, the real degree of reliability of survey information about corruption is largely unknown. Respondents directly involved in corruption may have incentives to underreport such involvement, and those not involved may not have accurate information. This is an intrinsic weakness to measuring corruption with survey information, a weakness that TI attempts to correct by aggregating information from multiple surveys. Second, however, aggregation efforts may be less successful in some cases than

1 For details, see http://www.transparency.org. In 2001, for the first time, the TI index drew on surveys only of businesspeople and on country experts, and did not use any surveys of public opinion (reported in Lambsdorff 2001a).

others. As TI notes, for 2001, the Corruption Perceptions index "is a composite index, drawing on 14 different polls and surveys from seven independent institutions carried out among business people and country analysts, including surveys of residents, both local and expatriate" (TI 2001).[3] For countries where information from as many as 14 surveys is available, the scoring is likely to be more reliable than countries scored on the basis of the minimum number of available surveys (for 2001, this was three). This is likely to generate systematic biases in the TI dataset, for instance making the index more reliable for developed nations than for less developed. In other words, the Corruption Perceptions Index is more reliable precisely where corruption is typically less prevalent.[4]

The reliability of the Corruption Perceptions Index may also deteriorate over time. As the index has become more widely publicized, there is a real danger that survey respondents, rather than reporting how much corruption they have actually observed and/or participated in, are instead responding to the amount of corruption reported by the most recent TI index. This is a specific example of the more general problem that respondents may "not report their personal experiences but rely on media coverage and reports obtained by others" (Lambsdorff 2001a). To the extent that the substantial publicity generated by the index itself actually entails greater enforcement of anticorruption laws, or greater domestic press attention to purportedly corrupt transactions, the index itself may actually generate an increase in the amount of corruption known to the public, as well as to

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[2] Examples of older political science research into corruption, which was seen as especially troublesome in developing nations, include Banfield 1975, Huntington 1968, Nye 1967, and Scott 1972.

[3] The 2001 index drew on surveys from the following sources: Political and Economic Risk Consultancy, Hong Kong; the World Economic Forum; the Institute for Management Development, Lausanne; PricewaterhouseCoopers; the World Bank's World Business Environment Survey; the Economic Intelligence Unit; and Freedom House, Nations in Transit (Lambsdorff 2001a).

[4] For a general discussion of the reliability of the TI index, see Lambsdorff (2001b).

businesspeople and to country experts. The construction of the index, in other words, may well become self-referential, and the measures may become endogenous to the index itself.

In response to some of these concerns, scholars at the World Bank developed an alternate index, one that, like the TI index, aggregates information from multiple surveys but weights each according to its presumed reliability rather than simply standardizing them. The World Bank's weighting procedure is based on the premise that surveys whose values better correlate with others for the same country are of higher quality (see Kaufmann, Kraay, and Zoido-Lobatón 1999a; Kaufmann, Kraay, and Zoido-Lobatón 1999b). The development of an alternate index reveals underlying dissatisfaction with some aspects of using survey data to measure corruption in the first place, as well as specific disagreement with TI's aggregation procedure.

Like scholars at the World Bank, we endorse the attempt to develop multiple measures of the same concept by using different kinds of measurement techniques. Basing a measure of corruption on survey information has inherent limitations, ones recognized even by those involved in their creation and dissemination. Respondents not directly involved in corrupt transactions may be unreliable in the information they report, whereas those involved in such activities may underreport them. Complementary measures using other information are obviously called for.

In this study, we propose an entirely novel, more "objective" measure of corruption: namely, the difference between what government cumulatively spends on public infrastructure and the physical quantities of infrastructure that are available (controlling for local variations in the cost differences in infrastructure construction). The intuition underlying this measure is that, all else equal, governments that don't get what they pay for are those whose bureaucrats and politicians are siphoning off more public monies in corrupt transactions.[5] The rationale for focusing on spending on public infrastructure is that activities surrounding public works construction are a classic locus of illegal monetary activities between public officials (both elected and appointed) and businesses; indeed, as Rose-Ackerman notes, "Corruption in contracting occurs in every country" (1999, p. 28) and as a result, "high levels of corruption are associated with higher levels of public investment as a share of GDP" (ibid., p. 30).

We interpret public infrastructure that costs more than the national average—a level we take as a rough benchmark—as indicating waste, fraud, and mismanagement in the public contracting process. While our measure does not allow us to distinguish mere waste and mismanagement from outright fraud and other illegal monetary transactions that entail corruption in the construction of public works, we subject our measure to some external validity checks that show that it stands up well. We hence conclude that the proposed measure does a good job capturing the varying extent of corruption across the Italian peninsula.

While in principle, it is feasible to collect the relevant data crossnationally—and below, we discuss possible data sources for selected other countries—in what follows, we chose to demonstrate the utility of our proposed proxy with an analysis of Italian regions. The main rationale for focusing initially on a single country is that we know enough about real differences in the costs of constructing public works across Italy's twenty regions to be able to incorporate the appropriate controls into the analysis; moreover, some differences in the costs of constructing public works may not exist within a given national territory but would have to be confronted in building a crossnational database. In

5 Our measure, like that generated by the TI index, is not able to distinguish political from bureaucratic corruption, nor what Rose-Ackerman (1978) has called "high-level" from low-level, or petty

addition, by working within a single country that we know well, we feel confident that we can interpret the results accurately, given the wealth of independent information that exists on the political and economic differences among Italian regions (for instance, Kohn 1999; Putnam 1993). Italy is a country with especially well-known, deeply-rooted, and long-standing regional differences, and we are able to exploit some of the available information on these in order to assess our measure. Indeed, we explicitly compare our measure with other data on Italian regions, as a way to evaluate its validity. Our analysis is in principle easily extended to crossnational analysis, given appropriate data and country expertise.

We proceed in five steps. First, we discuss the measure of corruption that we propose, with details on the data and the method used to construct the measure. Second, we detail the control variables that we have incorporated. Third, we present the results of comparing data on public spending and existing infrastructure over the 20 Italian regions; that is, we present the index that we generate, both numerically and with a map. Fourth, we compare our results with other types of data available for Italy's regions, in order to assess the validity of our measure. In conclusion, we discuss possible extensions of the procedure proposed here to other countries.

The Data and Indicator Construction

Our procedure is to create two sets of measures of public capital stock using two different types of data. The measure of "corruption" that we propose is based on the ratio between the two. The first consists of a measure of existing physical infrastructure, based on an infrastructure census,

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corruption.

whereas the second is a measure of gross capital stock, assembled using what is called the perpetual inventory method (PIM), a standard method for calculating capital assets.[6] The measure of physical infrastructure uses data collection devices devised by the European Union (Biehl 1986; Commission 1986) to assess infrastructure needs across the terrain of its member states (see Ecoter 1999), whereas the second uses standard econometric techniques employed by governments around the world (see OECD 2000). We emphasize that both sets of data are based on commonly accepted measurement techniques. We might think of the first as a measure an engineer would be comfortable with, whereas the second is one familiar to economists. The novelty of our work lies with the idea of comparing them to create an index of "corruption." We now describe each measure and the underlying data.

Physical Public Capital Data

In Ecoter (2000), a computation of Italian provincial public capital stocks is presented. In essence, the authors collect data on the physical amounts of various types of public capital that exist in a given year[7] for the 103 Italian provinces, using a wealth of statistical sources. For example, roads are measured as kilometers of roads; railroads are, likewise, kilometers of railroads; hospitals are the number of beds in public hospitals; and schools are measured by the number of classrooms.

Having collected these disparate measures of physical public infrastructure in obviously

[6] The first uses data from Ecoter (2000), based on earlier studies by Mazziotta (2000) and by Biehl et al. (1990), while the second uses data compiled by Bonaglia and Picci (2000), based on data from Picci (1995), using methods outlined in OECD (2000).

[7] We use data from 1997.

variable units, the authors face aggregation problems. Within each category of goods, they solve this by constructing reasonable weights. For example, freeways are weighted more than country roads. More importantly, across the various categories of goods there is an aggregation problem in order to generate a single overall measure. This is addressed at length in Mazziotta (2000), who shows how the choice of a particular aggregation method, up to a point, does not substantially alter the results. The basic procedure is to standardize the various measures across types of goods, weight them, and then aggregate them.

Normalization is carried out in two different ways. Goods that are "space serving," such as roads and railroads, are normalized by the area of the geographical unit that they refer to, whereas goods that are "people serving," such as public buildings, are normalized by population. The resulting measures are then expressed as ratios to the national average and multiplied by one hundred, so that a measure, say, of 124 means that a given territorial unit has 24 percent more infrastructure than the national average, after having controlled for size and population.

Ecoter (2000) presents provincial and regional indices for the year 1997. The regional data are shown in the leftmost column of Table 1. The data show that northern regions, which are located in the top portion of the list, are more infrastructure-abundant than regions in the south of Italy, which are featured in the bottom half of the list. For instance, the southern region of Calabria has a little more than half the stock of (normalized) infrastructure than the national average, while Emilia-Romagna, located in the north, has over 40 percent more than the average, or almost three times as much as Calabria. At the regional level, there is thus considerable variation in the extent of physical infrastructure that exists in Italy.

Table 1 about here

Public Capital Stocks Computed using the Perpetual Inventory Method

Drawing on Bonaglia and Picci (2000), we now describe the sources and methods for the construction of the measure of capital stocks using the perpetual inventory method. This is the most common way that statistical agencies measure public capital stock. Essentially, it involves adding up past capital formation in constant prices while deducing the value of assets as they reach the end of their service lives.

In order to do that for Italian regions, we tap two main data sources. Rossi, Sorgato, and Toniolo (1993, RST from now on), draw on several statistical sources to create one long time series (covering the years 1890 to 1992) of public investments at the national level for Italy. We have then used data from ISTAT (1999) to extend RST for the years from 1992 to 1998.

Typically, to obtain estimates of current capital stock, one needs estimates of previous capital formation, beginning with an initial benchmark estimate. The latter may draw on information such as that contained in a census or administrative property records. If one is not interested in the early decades of the sample period, the RST data allow computation of the total stock at the national level by means of a perpetual inventory technique even when an initial benchmark is not available. This is possible since after their service lives, goods are retired from the capital stock, so that after a certain number of years, an initial estimate is no longer necessary.

To obtain similar data on capital stocks at the regional level, information contained in ISTAT (1954-1998) has been used. ISTAT collects regional data by means of an annual survey of relevant public officials, in order to record the amount of public investments for geographic area, type of good, and administrative unit responsible for its realization and for its financing. The analysis covers "all public works related to new construction, reconstruction, structural improvements, major repairs, special maintenance, and similar interventions, financed a) with total financing by the State or with its contribution, through Ministries and by means of the Cassa per il Mezzogiorno;[8] b) with total or partial financing by national or territorial branches of the Public Administration (Inail,[9] Inps,[10] Regions, Provinces, Municipalities) or with the contribution of other administrative units (the national State excluded); c) with total financing by the Autonomous Administrations of the State and by other public corporations" (ISTAT (1954-1998)). (For details on the data, see Appendix B.)

There are nine types of goods included in the analysis. These are: roads and airports; railroads and subways; marine (ports, lake and river navigation); water (river planning, etc.) and electrical lines; public buildings and schools; sanitation and public health (hospitals, water filtering, sewers); land reclamation and irrigation; telecommunications; and other types of works (such as pipelines, infrastructure for tourism, etc.).

We first use the survey data from ISTAT (1954-1998) to apportion the aggregate data from RST to regions and types of goods. After doing so, we have 180 long time series—one for each region and one for each type of good—whose reciprocal ratios are the same as the reciprocal ratios

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[8] The Cassa per il Mezzorgiorno, which no longer exists, was a special form of financing, established by the national government, aimed at encouraging economic development in the south of Italy.

[9] Istituto Nazionale per l'Assicurazione Contro gli Infortuni sul Lavoro, a social security body covering certain classes of employees.

[10] Istituto Nazionale di Previdenza Sociale, the main national social security body.

of the ISTAT data, and whose grand sum is equal to the aggregate data in RST.

These long time series can then be used to compute the regional public capital stocks using a perpetual inventory technique that is applied to each of them; that is, to the nine categories of public goods for each of the twenty regions.

Indices for infrastructure can be computed in a way similar to that for the physical data, by normalizing space and people serving goods appropriately. While it is impossible to precisely replicate the methodology used in Ecoter (2000) for the physical data, for the simple reason that the two datasets are characterized by similar but not identical categories of goods, care has been taken to make the two indices as comparable as possible. (Details of the procedure used appear in Appendix B.) The results are shown in the second column of Table 1.

This second measure of public capital generates data that is quite different from the physical data examined above; in particular, southern Italy is, on average, *better* equipped than the north, according to this second measure. This is the opposite of what we found using the physical infrastructure measure, and on the face of it, rather surprising. Our proposed measure of corruption provides an interpretation for why public expenditures for infrastructure in Italy's south are so much higher than one would expect.

A noteworthy exception in the measure presented in Column 2 of Table 1 is the northern region of Liguria, whose infrastructure, after controlling for space and population, is 2.36 times the national average. This makes the region an outlier, especially among the northern regions. However, Liguria is a special case, because the area houses a large population on a very narrow wedge of land running between mountains and sea. In such a situation, public works construction often requires daunting—and expensive—techniques, familiar to anyone who has driven the freeway running along the Ligurian coast. (See below, Figure 1, to visualize the location of the region.) In what follows, we first include controls for regional variations in altitude to try to capture the Ligurian case, and then in our preferred set of results simply exclude Liguria from the sample entirely.

Cost Controls

Several factors may affect the cost of a given public work. Casual observation suggests that in Italy, the costs of infrastructure construction should be largely similar in different parts of the country. First, labor market regulation forces labor costs to be almost identical nationwide. Second, the presence of an extensive and quite efficient transportation network guarantees effective arbitrage of many building materials, and the construction industry, unlike some other industries, is present in all parts of Italy, the fruit of a tradition dating back to the Romans. Hence, we have no reason to believe that public infrastructure should exhibit large cost variations across the country**.**

Notwithstanding these considerations, we developed a measure of regional cost differentials, in order to be as certain as possible that the differences we observe in the regional data on physical infrastructure compared with public capital stocks did not stem from differences in costs at the regional level. We tapped several data sources to create different kinds of cost controls. The July 2001 issue of an Italian journal, *Ponte*, contains provincial data[11] on labor costs in the construction industry, including annual updates with information from the industry's national labor contract, which

[11] Provinces are geographic units smaller than regions; data at the provincial level is easily aggregated into regional data.

sets wage increases for different categories of workers in construction. Such data confirm that labor costs are very similar across the Italian provinces and regions. We have used the data on skilled labor (*primo livello)* to build a regional index of construction wages, whose average we have set at 100.

Second, the regional offices of the Ministry of Infrastructure and Transportation collect a wealth of data on the costs of construction materials at the regional and provincial levels in two month intervals. According to Ministry officials whom we interviewed for the purpose of assessing the quality of these data, their purpose is to record temporal variations more than geographic ones; that is, government officials are mainly concerned with assessing price inflation in the costs of basic materials used in construction. We thus decided to consider the cost only of cement and of sand since, according to the interviews, these goods' prices are better measured, and their tradability is also geographically limited; that is, we would expect the greatest potential geographic cost variation in these components.[12]

We then constructed an aggregate regional cost index, based on data from January 2001, as a geometric average of the labor, sand and cement indices. According to the overall cost index, the least costly region, Lazio, has construction costs around 7 percent below the national average, while Tuscany is the most expensive region, with costs 12 percent above the national average. Such a cost measure was used to scale the perpetual inventory capital stock data from 1997, assuming that, while it refers to only one moment in time, the cost differences across regions were essentially unchanged

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[12] Data on the regional costs of construction materials proved difficult to obtain because the national Ministry in Rome does not collect them (sic), and as a result we had to contact the twenty regional offices individually. We were not able to collect the cost data for Liguria, Abruzzo, Sicily, and Calabria. Neighboring region's data have been used for those cases.

over those years. Such an assumption is obviously strong but unavoidable, given the sheer difficulty in finding comparable cost information for other years.

The cost-corrected perpetual inventory index is shown in the third column of Table 1. As expected, the data are not much different from the raw data displayed in column 2.[13] But controlling for what cost differences may exist across Italy's regions has the obvious advantage of generating a measure with greater validity and reliability.

Other variables in addition to labor and materials could potentially affect the costs of infrastructure development. However, these variables seem to us somewhat less obvious than labor and materials, and as a result, we choose to test their importance rather than assume they were important and fold them into our proposed measure.

Among the additional variables we considered are differences in the altitude at which construction occurs and differences in population density. An example should clarify the possible importance of the former. A freeway crossing a range of mountains is more expensive to build than a freeway across a plain, simply because of the corresponding differences in terrain. To capture this effect, we used a dataset provided by ISTAT containing communal data—communes are a smaller administrative subdivision, below provinces—on surface, population, and highest and lowest altitude. For each commune, we computed the difference between the lowest and highest altitude, excluding altitudes above 1000 meters in order to limit the influence of (relatively unpopulated) mountains, and we aggregated the data at the regional level by weighting the municipal data by their population.

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13 In fact, the correlation coefficient between the two measures is 0.995.

We used the same dataset to compute a measure of population density, to capture any effect that congestion may have on the cost of public works. The underlying intuition is that it is more expensive to build new roads, for instance, in areas that are already densely populated than in areas that are relatively less populated. We experimented with several measure, and in the end we chose the ratio of regional population living in cities with more than 30,000 inhabitants as our control[14].

We also experimented with a measure of seismicity, since government standards for the construction of public works are more stringent in areas of the country more susceptible to earthquakes. We computed this as a population-weighted aggregation of the standard seismicity index (Istituto Sismico Nazionale 2001) at the municipal level. However, results were not very meaningful, so we decided not to include such a measure. In the end, therefore, we adjust our regional measure of public capital stocks with four cost controls:

- construction wages;
- basic construction materials;
- altitude;
- population density.

The first two were folded into our regional index. The second two were used as controls in regressions, the results of which we report below, and proved relatively unimportant substantively.

Results

[14] This measure is obviously sensitive to the particularities of Italian population distribution, and would have to be altered accordingly for other countries.

We first compute the ratio at the regional level between the physical index and the cost-corrected perpetual inventory index. Such a ratio is shown in column 4 of Table 1, and it represents the differences between the two ways of estimating public goods, correcting for the two differences in cost (labor and materials) that we have discussed. A value equal to 1 means that a given region has the same allotment of infrastructure regardless of which of the two measures—physical infrastructure and spending—is used. It also means that that region is as effective in turning money into public works as the national average. A value equal to 1.5 means that a given region has 50 percent more physical capital than the amount of money spent over time would lead one to expect, relative to the national average. For example, Sicily, with a ratio equal to 0.56, has a little over 50 percent of the physical capital that it would have if the financial resources that were spent there had been spent according to the nationally average standard. The data demonstrates impressive differences across Italy's regions.

This ratio is now used as the dependent variable in a regression analysis, whose model also includes the two additional variables that we have considered above: variations in altitude, and population concentration. Table 2 shows the regression output, with a dummy variable included for Liguria.

Table 2 about here

We first note that both the altitude and the population density variables have the expected negative signs: the greater the altitude variation or the greater the density, the more expensive it is to build, and the smaller the difference between the physical and the permanent inventory indices.

However, the differences are not significant. The Liguria dummy variable is not significant either, but its estimated coefficient also has the expected negative sign. Overall, the regression explains only 8 percent of total variation, indicating that the cost variables cannot explain the bulk of the huge differences between the two indices.

In Table 2a we present the same regression with the exclusion of the Liguria dummy variable. The regression now explains 4 percent of total variation; even if the Liguria dummy variable is not significant in the original model, we think it should be retained, since these results suggest that our altitude variation variable is not able to fully capture the extreme nature of Ligurian geography.

Table 2a about here

In Table 3, we take the residuals of the regressions reported in Table 2 and we add 1 to them, in order to obtain a version of the dependent variable, our proposed measure of corruption, from which we have purged possible differences in the costs of construction. This formulation is the measure of corruption that we propose. It is similar to the dependent variable of the regression (reported in the fourth column of Table 1), since the additional control variables for altitude and population have so little explanatory power. In Figure 1, we illustrate our measure of corruption by mapping the variable across Italy's 20 regions.

Figure 1 about here

Our interpretation of the corruption measure is straightforward. Consider Trentino Alto-Adige, whose "corruption index," at 1.69, is the highest in the country. This means that in Trentino, there is 69 percent more public infrastructure than would be the case if the public goods constructed had cost the national average. Consider now Calabria, the most corrupt region by our measure, with an index equal to 0.18. Infrastructure there is only 18 percent of what it would be if resources had been used at the same extent as the national average. These differences are staggeringly large. Note in particular that all the southern regions, with the exception of the island of Sardinia, report numbers below 1, meaning that in every one of Italy's southern regions, public authorities have gotten less than the national average for their spending on public infrastructure. Also note that Calabria, Campania and Sicily, typically regarded as those regions most affected by organized crime, are the three worst performing regions, according to our measure. On the other hand, the northern "civic-minded" regions, those characterized by large amounts of "social capital" (Putnam 1993) are the ones that exhibit the least corruption.

Table 3a, finally, reports the corruption index with Liguria included in the sample. The differences with respect to Table 3 are minor.

Table 3a about here

Tests of Validity

It is commonly believed that corruption is higher in Italy's southern regions compared with their northern counterparts (cf. Banfield 1958). Our proposed method for measuring corruption thus generates values that are intuitively plausible, because our index has lower (more corrupt) numbers for the south of the country. We can go one step further, however, and compare our measure with other variables for which we have regional level data and about which we have relatively secure knowledge.

In this section, we present results of regressions of our proposed measure against Putnam's measure of governmental performance and against newly-available data measuring high-level political malfeasance.

In Putnam (1993), the author presents an index of institutional performance for Italy's 20 regions, for the period 1978-1985. The components of Putnam's index, described in detail there, are as follows:

- reform legislation;
- day care centers;
- housing and urban development;
- statistical and information services;
- legislative innovation;
- cabinet stability;
- family clinics;
- bureaucratic responsiveness;
- industrial policy instruments;
- budget promptness;
- local health unit ing;
- agricultural spending capacity (Putnam 1993: table 3.2, p. 75).

We have itemized the components to verify that Putnam's index of governmental performance does not contain anything like a measure of corruption, and hence is independent of what we seek to measure here. The correlation coefficient between the two indices is 0.795, and it is highly significant, suggesting that where corruption is least—recall that our measure has lower numbers for higher levels of corruption— government performance is best.

The first row of Table 4 reports the estimated correlation coefficients between our proposed measure of corruption and Putnam's index of government performance, together with its significance level. Our hypothesis is that where government is unable to prevent waste, fraud, mismanagement and other aspects of corruption from occurring in the construction of public works, it is likely to be generally less effective in its capacity to govern. The statistical results do not reject this interpretation. Our proposed measure of corruption accounts for 68 percent of the variation in the performance measure, corresponding to a correlation coefficient of 0.824, and is statistically significant well below the 1% level.

Table 4 about here

We next assess the proposed index of corruption against a measure of high-level political malfeasance. This measure counts the number of members of parliament (MPs) charged with malfeasance in Italy's XI Legislature (1992-94) for all crimes excluding those such as libel, slander, and likewise.[15] The count is performed over the twenty regions, and the number of those charged is put in proportion to the number elected from each region.[16] Hence, the measure used is the percent

[15] For other work using this measure, but only examining Christian Democratic members of Parliament, see Golden and Chang (2001).

[16] Italian elections to the Chamber of Deputies in the period considered took place in electoral districts that were smaller than regions. Because our proposed measure of corruption is available only for regions, however, we aggregated the data on charges of malfeasance by electoral district into regions. Note however that no charge was made against the only MP of Valle d'Aosta, so we excluded that region.

of Deputies charged with non-opinion crimes during the life of the legislature.[17] This measure is conceptually different than that proposed here, because it concerns illegal activities of all sorts by legislators, not bribes and kickbacks in public works construction.

The second row of Table 4 reports the correlation coefficients of our proposed measure of corruption with the Golden-Chang measure of charges of political malfeasance. Our hypothesis is that those regions whose national elected representatives are purportedly more involved in illegal activities of various sorts are also likely to be those regions in which national legislators have implicitly permitted or even explicitly encouraged greater numbers of bribes, payoffs, and kickbacks surrounding the procurement process for public works.

The estimated correlation is equal to -0.662, meaning that around 44 percent of total variation in our proposed measure of corruption is accounted for by the extent of purported political malfeasance characteristic of the legislators representing the region.[18] Our proposed measure exhibits the correct sign—it is negatively associated with purported legislative malfeasance, as we would expect given that lower numbers of our measure indicate greater corruption, whereas the reverse is the case for the legislative measure. The coefficient is strongly significantly associated with the outcome.

These correlation analysis results are just what we would expect if our proposed measure

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[17] Because some legislators were charged more than once, the percent could be higher than 100.

[18] For this analysis, data on charges of malfeasance for non-opinion crimes had to be aggregated at the regional level. Part of the region of Lazio comprises provinces from two different electoral districts. The results reported thus reflect this. The number of MPs charged from the electoral district that cuts across two regions is only one, however, so the unavoidable error in the analysis is very small and does not substantially affect the results we report.

were doing a good job capturing the extent of bribes, kickbacks, and payoffs in public works across the Italian regions. Before concluding, we comment on the temporal discrepancies across the various measures. The measure of government performance that we take from Putnam draws on data from the period 1978-1985, whereas the charges of malfeasance against legislators that we examine refers to the 1992-94 period. Our proposed measure of corruption, finally, uses data on physical infrastructure fom 1997. Our justification for the temporal discrepancy between the performance measure and our proposed measure is twofold. First, we do not have comparable data on government performance for a period closer to that for which we have the infrastructure measure. Second, however, we do not believe that the index of government performance across Italy's regions is likely to have altered much in the intervening ten or fifteen years; certainly, the performance of the various regions relative to each other, which is what we care about, is not likely to have changed much.

It is easy to justify the temporal lag between the charges of malfeasance against legislators that we examine and the extent of corruption in public works spending. The XI Legislature was the last under Italy's old electoral system, one that systematically encouraged high-level political corruption (Golden and Chang 2001; Golden forthcoming). After 1994, the institutional conditions systematically promoting corruption declined, and as a result, it does not make sense to use data on purported political malfeasance from subsequent legislatures. Moreover, the proposed measure of corruption that we devise is unlikely to have altered much between the early and the late 1990s, because public infrastructure changes slowly.

Conclusions

The measure we propose can be constructed for other countries, although doing so will be painstaking.[19] Data on public capital stocks exist for most countries, and can be assembled relatively easily by persons familiar with them. Data on physical infrastructure are much more difficult to collect, standardize, and aggregate. For the other main member states of the European Union—France, Germany, the United Kingdom and Spain—data compatible with those that we have presented here for Italy exist at the regional level (what is called NUTS 2) (Ecoter 1999). Hence, for those countries, it would be relatively easy to assemble measures of corruption similar to that proposed here; all that would be needed, in addition, would be the country expertise to collect various types of potentially relevant cost controls. For Latin America, as well as countries in various other regions, some data on physical infrastructure is available from the World Bank (World Bank 1999), including recent data on kilometers of paved roads, number of hospital beds, and various others. What is gained in availability of data across countries is lost in the precision of data within countries; these data exist for many countries, but are highly incomplete. Nonetheless, with sufficient country expertise, they would be a starting point for assembling crossnational measures of corruption that drew on objective sources of data rather than surveys.

[19] An international team with multinational funding would probably be required to do so expeditiously.

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Tables

Table 1. Infrastructure Indexes, 1997.

Region	*Column 1 Ecoter physical capital*	*Column 2 PIM capital stocks*	*Column 3 PIM cost corrected*	*Column 4 Ratio Ecoter/PIM (col. 1/col. 3)*
PI	118.4	64.0	64.9	1.8230
VA	132.6	73.0	74.1	1.7895
LO	118.4	110.8	107.5	1.1015
TA	122.9	66.1	63.3	1.9405
VE	115.3	92.0	93.1	1.2379
FR	125.5	111.1	114.7	1.0945
LI	127.3	236.3	235.5	0.5406
EM	144.1	94.2	86.8	1.6593
TO	112.8	74.3	66.2	1.7049
UM	109	57.7	57.2	1.9040
MA	109.7	83.3	84.5	1.2981
LA	111.3	130.7	140.5	0.7922
AB	92.3	83.9	85.3	1.0818
MO	62.1	75.7	77.1	0.8051
CM	51.1	150.5	157.8	0.3238
PU	63.3	85.0	88.8	0.7127
BA	70	96.0	97.2	0.7199
CL	50.3	121.1	125.5	0.4008
SI	66.1	111.9	117.5	0.5626
SA	66.5	51.2	47.4	1.4040

Note: For regional abbreviations, see Appendix A.

Table 2. Regression Output, Corruption Measure with Additional Controls

Dependent Variable: Column 4 of Table 1
Included observations: 20

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob.*
C	1.353089	0.456152	2.966314	0.0091
Dummy Liguria	-0.561016	0.642474	-0.873212	0.3955
Altitude Variation	-0.010263	0.305222	-0.033624	0.9736
Pop. Concentration	-0.418331	1.120161	-0.373456	0.7137

R-squared	0.082371	Mean dependent var	1.144853
Adjusted R-squared	-0.089684	S.D. dependent var	0.528650
S.E. of regression	0.551847	Akaike info criterion	1.825764
Sum squared resid	4.872557	Schwarz criterion	2.024910
Log likelihood	-14.25764	F-statistic	0.478749
Durbin-Watson stat	0.736249	Prob(F-statistic)	0.701557

Table 2A. Regression Output, Corruption Measure with Additional Controls, Excluding Liguria

Dependent Variable: Column 4 of Table 1
Included observations: 20

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.473151	0.431887	3.410963	0.0033
Altitude Variation	-0.117513	0.277461	-0.423530	0.6772
Pop. Concentration	-0.496010	1.108795	-0.447342	0.6603

R-squared	0.038641	Mean dependent var	1.144853
Adjusted R-squared	-0.074460	S.D. dependent var	0.528650
S.E. of regression	0.547978	Akaike info criterion	1.772319
Sum squared resid	5.104764	Schwarz criterion	1.921679
Log likelihood	-14.72319	F-statistic	0.341647
Durbin-Watson stat	0.813318	Prob(F-statistic)	0.715367

Table 3. Proposed Corruption Measure

region	*ONE+RESID=corruption*
PI	1.658993
VA	1.562387
LO	0.910215
TR	1.715348
VE	1.026372
FR	0.897277
LI	1.000000
EM	1.522561
TO	1.570402
UM	1.767413
MA	1.108461
LA	0.749103
AB	0.882820
MO	0.560958
CM	0.206093
PU	0.581630
BA	0.457840
CL	0.182298
SI	0.439347
SA	1.200483

Note: For regional abbreviations, see Appendix A.

Table 3a. Proposed Corruption Measure, Including Liguria

region	*ONE+RESID=corruption*
PI	1.723601
VA	1.512756
LO	0.899253
TR	1.689323
VE	1.141085
FR	0.960856
LI	0.586095
EM	1.624810
TO	1.618104
UM	1.729374
MA	1.111404
LA	0.828587
AB	0.878434
MO	0.514105
CM	0.276311
PU	0.623645
BA	0.397513
CL	0.168070
SI	0.482516
SA	1.234157

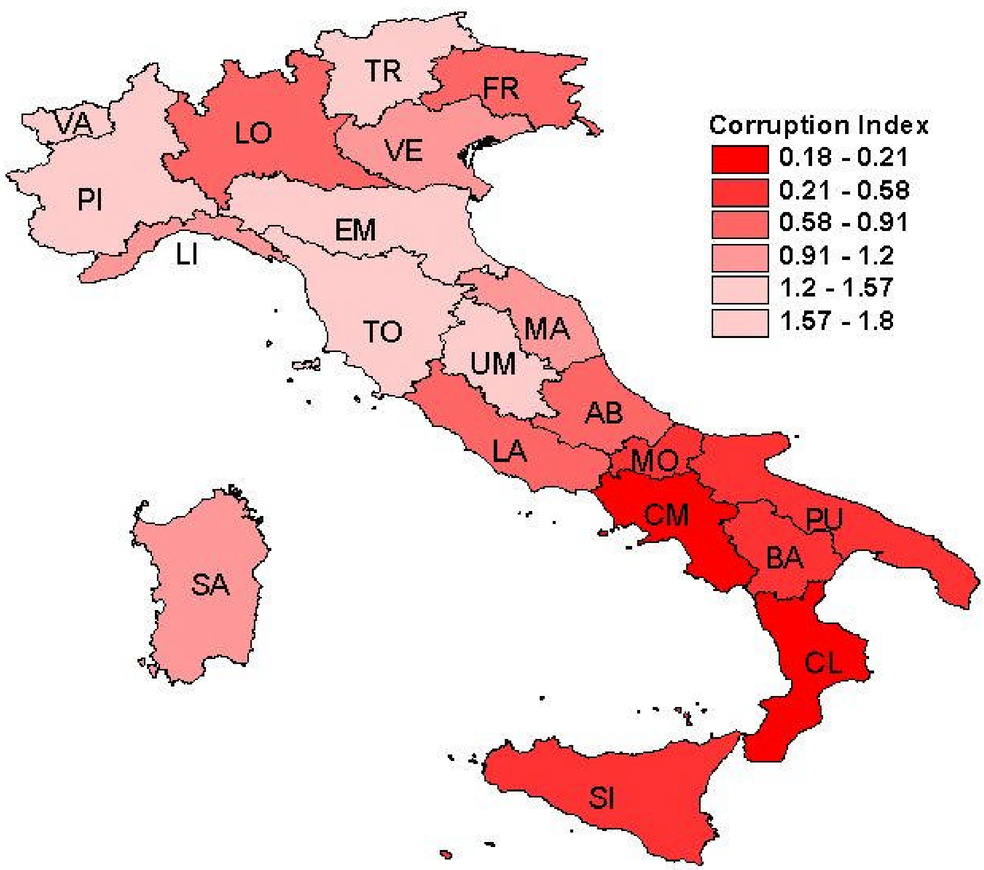
Note: For regional abbreviations, see Appendix A.

Table 4. Correlation of Proposed Corruption Measure with Governmental Performance and Charges of High-level Legislative Malfeasance

Correlation of the proposed measure of corruption with:	*Correlation:*	*P-Value*
Government Performance	0.824	0.000
Charges of malfeasance	-0.662	0.000

Sources: Data on governmental performance courtesy of Robert Putnam.
Data on charges of malfeasance courtesy of Miriam Golden.

Figure 1: Map of Proposed Measure of Corruption by Region, 1997 c.



Appendix A.

Regional Abbreviations Used in Tables and Figures

AB	Abruzzi
BA	Basilicata
CL	Calabria
CM	Campania
EM	Emilia-Romagna
FR	Friuli-Venezia Giulia
LA	Lazio
LI	Liguria
LO	Lombardy
MA	Marche
MO	Molise
PI	Piedmont
PU	Puglia
SA	Sardinia
SI	Sicily
TO	Tuscany
TR	Trentino-Alto Adige
UM	Umbria
VA	Valle d'Aosta
VE	Veneto

Appendix B. Measures and Methods Used.

The Perpetual Inventory Method (PIM)

The perpetual inventory method used is the same as that traditionally adopted by ISTAT, Italy's national statistical agency. Capital goods are retired according to a normal distribution centered on the goods' mean life, such that 90 percent of goods are retired within 25 percent of the mean life. The distribution is truncated at 40 percent of the mean life, as in ISTAT (1995). Mean lives have been computed as the average of the mean lives adopted for comparable categories of goods by those OECD countries for which an indicator exists (Italy not among them), as recorded in OECD (1993). All vintages of goods before 1946 have been reduced by 8 percent in all regions to take into account the effects of World War II, following suggestions in Rosa and Siesto (1985).

Sensitivity Analysis of Public Stock Estimates to Pre-1954 Data

In principle, data on how the national aggregate public investment is split into regions and type of goods is needed for the years before 1954. However, the data used to apportion the aggregate data area to regions and types of goods are available only from 1954 (ISTAT, 1954-1998). The share of the national flow that goes to the different regions and types of goods has to be assumed for the missing years. We assume that the share of the national public investments before 1954 are equal to the average of the shares observed between 1954 and 1959.

There are two main reasons why the capital stock estimate for 1997—which we use to compute our measure of corruption—is almost unaffected by the method we adopt for the period before 1954: a) most of the public works built before 1954 had already exhausted their mean lives by 1997; and b) the flows of investment increased considerably over time, at constant prices, following the economic expansion of the post-war period, giving greater substantive importance to the postwar era. Moreover, the physical destruction that occurred with World War II decreased the importance of the preexisting capital stock.

A sensitivity analysis was carried out by assuming, for selected regions and types of goods, that pre -1954 investments were 1/10 of the values that we used. In all cases, the estimate for the corresponding stock in 1997 was less than 1 percent smaller than otherwise computed.

Computation of the Infrastructure Index

In Ecoter (2000), the general index for infrastructure for 1997 is produced by dividing infrastructure into "space serving" and "population serving" goods. "Space serving" public capital refers to:

- Roads, railroads, airports, ports, other transportation infrastructure, relecommunication, energy, oil and natural gas pipelines, and water supply.

"Population serving" public capital refers to:

- Schools and universities, hospitals, kindergardens, sports facilities, theaters, museums, and libraries.

To obtain our measure for 1997, we divide the available nine categories of capital, computed using the Permanent Inventory Method, as follows:

"Space serving" public capital is:

- Roads and airports, marine, water and electrical lines, land reclamation and irrigation, telecommunications, half of all other types of works.

"People serving" public capital is:

- Public buildings and schools, sanitation and public health, half of all other types of goods.

The definitions of goods are similar across the two types of data, but they are not identical. Note however that a) different types of infrastructure are highly correlated across regions—that is, regons well equipped tend to be well equipped in all types of goods (Ecoter 2000)—and b) that any discrepancy is mitigated by the fact that population and the territorial dimension are highly correlated, with a correlation coefficient equal to 0.71. If they were perfectly correlated, the distinction between "space" and "people" serving infrastructure would be irrelevant.