

Proposal for a New Measure of Corruption, Illustrated with Italian Data[§]

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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 cumulative price government pays for public capital stocks. Where the difference is larger between the monies spent on infrastructure and the existing physical infrastructure, more money is being siphoned off to mismanagement, fraud, bribes, kickbacks, and embezzlement; that is, corruption is greater. We create this measure for Italy's 95 provinces and 20 regions as of the mid-1990s, controlling at the regional level for possible differences in the costs of public construction.

We analyze the proposed measure's reliability and validity. Our measure shows that corruption is greater in the southern Italian regions, which is not unexpected. It exhibits a strong and statistically significant relationship with Putnam's measure of regional government performance, suggesting that as corruption increases, government performance deteriorates. 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 XI Legislature (1992-94)—correlates significantly with the more general measure of corruption that we propose. Finally, we show that private sector construction costs are higher in the north than in the south of Italy, which is precisely the reverse of what we find for public sector data used to construct our corruption measure. We interpret this as additional confirmation that our proposed measure does a good job capturing genuine public sector corruption rather than variations in construction costs due to other factors, such as inefficiency.

We offer suggestions for constructing a similar measure for other countries.

JEL: C10, C44, H42, H54, K42

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Introduction

This methodological note presents a new measure of corruption, one based on the difference between the amounts of physically existing public infrastructure (roads, schools, hospitals, etc.) and the amounts of money cumulatively allocated by government to create these public works. Where the difference between the two is larger, more money is being lost to fraud, embezzlement, waste and mismanagement; in other words, corruption is greater. The utility and novelty of this measure come first from the fact that it draws on data other than the surveys that are currently typically used to construct indices of corruption. Second, our measure operationalizes insights of development scholars regarding possible causes of low growth among poor nations. Existing literature suggests that the costs of public investment and the value of existing capital may differ substantially, and that as much as half of government investment in developing nations may be “missing” (Pritchett 1996; Pritchett 1999). However, to the best of our knowledge, no one has previously developed a systematic way to measure this. We propose such a method and, using Italian data, detail the construction of an index of missing infrastructure, one that we call “corruption.”

The measure that we propose is of course only a proxy for corruption. It does not directly measure it, an enterprise that is not possible since corruption is a complex set of variable interactions, processes and phenomena with no single metric. We are aware as well that the measure we propose captures some inefficiencies as well as various illegal activities that comprise genuine corruption. However, as we argue at greater length in the pages to follow, because inefficiency and corruption vary together in the setting in which we work, the index that we create is essentially unaffected by the inclusion of inefficiency. Moreover, comparing public and private sector construction costs shows that public sector costs vary geographically in ways quite different from private sector costs: private sector costs are lower in the south, whereas the data we

examine show that public sector spending on infrastructure is higher in the south. We believe this offers persuasive if indirect confirmation that the measure of corruption we create is valid, reflecting the extensive graft and fraud that are especially common to public sector contracting in the south of Italy, rather than mere inefficiencies in the construction industry.

In what follows, we present different kinds of evidence to document that our measure is valid, reliable and robust for the context in which we create it: the 20 Italian regions in the mid-1990s. Our work may serve as a model for creating similar subnational proxies for corruption in other national settings. Our proposed measure is potentially useful for studying variations in the causes and consequences of corruption at the subnational level, an analytic strategy that is not possible using national-level measures. The availability of a measure of corruption that varies subnationally opens new research avenues.¹

We proceed in five steps. First, we discuss the concept of corruption, how it is usually measured, and analytic strengths and weaknesses of the alternative that we propose. Second, we detail the data we use and the method employed to construct our proposed measure of corruption. Third, we offer information about control variables that we have incorporated into our measure. Fourth, we present our index of corruption for the 20 Italian regions, both numerically and with a map, and we likewise provide a provisional corruption index for Italy's 103 provinces. Fifth, we compare our index with other types of information 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. An appendix provides technical details about the construction of the measure.

¹ The importance of developing subnational measures has already been recognized by one of the main international bodies known for its corruption measures; see the Mexican state-level indicators now available (Transparencia Mexicana 2003) and the index developed for a subset of the Russian Federation's regions (Transparency International Russia 2002).

Concept and Measurement

The emergence of the Transparency International (TI) Corruption Perceptions Index in the 1990s has fundamentally altered the cross-national study of corruption, typically defined as the (illegal) misuse of public office for private gain. The TI index, which is 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.² The availability of a standard index across so many countries (as well as earlier, similar survey-based indices) has generated a raft of crossnational statistical studies on the causes and the consequences of corruption (including Anderson and Tverdova 2003; Mauro 1995; Mauro 1997; Montinola and Jackman 2002; Persson, Tabellini and Trebbi 2003; 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, while also reducing the legitimacy of government. It has reinvigorated research into empirically and normatively important questions that political economists had temporarily abandoned, in part because of the lack of good data regarding the quality of government.³ Finally, research based on the Corruption Perceptions Index and similar measures has also had significant policy importance

Nonetheless, the TI measure of corruption currently in use has some intrinsic weaknesses, weaknesses that are likely to have become increasingly problematic over time. 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

² For details, see <http://www.transparency.org>. In 2001, for the first time, the TI index drew on surveys only of businesspeople and country experts, and did not use any surveys of public opinion (reported in Lambsdorff 2001a).

³ 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.

not involved typically lack accurate information. This is an intrinsic weakness to measuring corruption with survey information, especially when the surveys do not ask about firsthand experiences with corruption but merely “perceptions” of it. TI attempts to correct for this by aggregating information from multiple surveys. However, aggregation efforts may be less successful in some cases than 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).⁴ 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, very possibly making the index more reliable for developed nations than for less developed. In other words, the Corruption Perceptions Index is probably more reliable precisely where corruption is typically less prevalent.⁵

The reliability of the Corruption Perceptions Index may also deteriorate over time. As the index has become widely publicized, there is a danger that survey respondents, rather than reporting how much “real” corruption exists around them, are reporting what they believe based on the highly publicized results of 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 improves the enforcement of anticorruption laws, or increases media attention to purportedly corrupt transactions, the index

⁴ 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).

⁵ For a general discussion of the reliability of the TI index, see Lambsdorff (2001b).

may generate an increase in the amount of corruption known to the public. This is even more likely to be the case now that the TI index draws only on surveys of businesspeople and experts, and no longer uses broad public opinion surveys (see fn. 2), because these specific subpopulations are likely to be highly informed about and sensitive to the index. The construction of the index, in other words, may well become self-referential, and the measures may become endogenous to the index itself.

Precisely these kinds of concerns have led to attempts to develop alternate indices, or to use alternative, objective measures of corruption. Scholars at the World Bank have proposed an index that aggregates information from multiple surveys but that, unlike the TI index, 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-Lobaton 1999a; Kaufmann, Kraay, and Zoido-Lobaton 1999b). An alternative has been the use of survey instruments—we are aware of work currently available for four Latin American countries—that both sample large numbers of individuals⁶ and ask a battery of questions focused on firsthand experiences with corruption rather than perceptions of it (Seligson 2002). Finally, in a spirit similar to our own, recent work moves away from survey measures altogether, adopting alternative micro-measures, such as the procurement prices of publicly-purchased goods (Di Tella and Schargrodsky 2003; see also McMillan 1991) or prosecutorial measures (Adserà, Boix and Payne 2003; Alt and Lassen 2003).

Like scholars at the World Bank, we endorse the attempt to develop multiple measures of the same concept by employing different kinds of measurement techniques. Basing a measure of corruption on survey information has inherent limitations, ones that are recognized even by those

involved in their creation and dissemination. Complementary, objective measures based on other types of information are obviously welcome.

The information that we use to construct an alternative proxy for corruption is the difference between what government cumulatively pays for public infrastructure and the physical quantities of infrastructure that exist (controlling for local variations in the costs of 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.⁷

The rationale for focusing on public infrastructure spending is that activities surrounding public works construction are the classic locus of illegal monetary activities between public officials—both elected and appointed—and businesses. 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). Even among the relatively less corrupt developed democracies, corruption in public works contracting is apparently widespread (OECD 1976a; OECD 1976b). Although corruption occurs in settings other than public works contracting, the process of public works contracting is, because of inherent informational asymmetries, especially vulnerable, as substantial empirical and theoretical literatures suggest (e.g. Feinstein, Block, and Nold 1985; McMillan 1991; Porter and Zona 1993; Stigler 1964). While we have no way of knowing whether the extent of corruption in other activities parallels that occurring in the government procurement process, we suspect that by measuring corruption in public works contracting, we effectively capture a large part of overall

⁶ The *n.* reported is 9,747 across El Salvador, Nicaragua, Bolivia, and Paraguay.

⁷ 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 corruption. That is, our measure does not track the actual corrupt transactions that occur but instead measures corruption by examining government outputs.

corruption that occurs.⁸

We interpret public infrastructure for which government paid more than the national average—a level we use as a rough benchmark—as indicating greater waste, fraud, and mismanagement in the public contracting process. Although setting the national average as a benchmark is obviously arbitrary, it makes substantive sense in a national context that other types of evidence depict as relatively corrupt. According to the TI index, in the early to mid-1990s Italy ranked as the most corrupt of the developed democracies (see Golden and Chang 2001, pp. 591-92). This suggests that in the Italian context, the average level of waste, fraud, mismanagement and embezzlement in public works contracting is likely to represent a relatively high level of corruption compared to other countries, certainly compared to others at a similar level of economic development. While we thus consider it justifiable to use the national average as a threshold for distinguishing more from less corrupt areas of the country, in the absence of similar indices for other countries, this is merely a convenient (and somewhat arbitrary) distinction.

Our measure does not allow us to distinguish explicitly waste, inefficiency and mismanagement from outright fraud and other illegal monetary transactions that entail corruption in the construction of public works. Our measure captures what we might think of as the rate of return to government spending, which we assume, based on other types of information,⁹ to be influenced by corrupt dealings between political officials and actors in the private sector. Our

⁸ A study of press reports of Italian corruption during the twentieth century (through 1986) finds that only 17 percent of cases of corruption reported in the press concerned public works contracting. Larger percentages were reported for building permits (28 percent) and public services (20 percent) (see Cazzola 1988, p. 74, table III.9). The reliability of the data, referring as they do only to instances of corruption reported in a single news source, is questionable. For instance, Cazzola also finds that most cases of corruption reported by the press are in the south (pp. 64-65), whereas subsequent judicial investigations exposed political corruption throughout the country (see Golden and Chang 2001). We would expect media reports of corruption to vary positively with legal proceedings against political corruption.

⁹ For instance, a vast journalistic and sociological literature chronicles the judicial investigations in the 1990s that brought to light widespread, systematic and apparently chronic corruption in public works

inability to untangle corruption from inefficiency represents an underlying problem that is analytical, one that cannot be solved with better or additional data. In a setting characterized by endemic corruption, such as Italian public works contracting (and perhaps public works contracting generally), a portion of inefficiency is endogenous to corruption. For instance, in Italy delays in construction were often routine, and were intended to permit a renegotiation of the originally contracted price, resulting in what is called *variazioni in corso d'opera*, thereby inflating profits. Such delays sometimes even figure explicitly in illegal agreements between government officials and enterprises that were made as part of the process of the bidding out of contracts in the first place. If some portion of inefficiency is functional to and a premeditated component of corruption, it makes little sense to try to distinguish the two empirically. Legislation—the so called “Merloni laws”—adopted at several points during the 1990s as a response to what are known as the Clean Hands investigations that took place earlier in the decade severely limited the possibility of such “variations” in costs, precisely in increasingly stringent attempts to curtail corruption in public works contracting.

If we had reason to believe that inefficiency and corruption did not therefore vary similarly across the Italian regions, there would be a much stronger argument to try to separate the two. But this is not the case. We know of no evidence that would lead us to believe that corruption is high where inefficiency is low, for instance. If the two vary together, then the fact that our index comprises both is irrelevant for assessing its validity in properly measuring each component.¹⁰ Later, we subject our measure to some external validity checks and show that it stands up well.

contracting. The investigations touched a third of the members of Italy’s XI Legislature (1992-94), and subsequently catalyzed the collapse of the country’s system of political parties.

¹⁰ Let’s take the percentage of incomplete projects undertaken by local public authorities accessing credit—mostly for the purpose of financing public works—as reported in 1990 by the Cassa Depositi e Prestiti (Fontana and Petrina 2002) as one proxy for inefficiency. This measure displays a highly significant and positive correlation coefficient—as high as 0.575 (p -value = 0.008)—with the corruption

We hence infer that our 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 other European countries—in what follows, we demonstrate the utility of our proposed proxy with an analysis of Italian regions. The primary 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, there are cross-national differences in the costs of constructing public works that do not exist subnationally but that would make building a cross-national database correspondingly more complex. In 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 types of 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.

Although our measure draws on data of existing public works from a single year (1997), it is not aimed at or appropriate to capturing corrupt activities at a single point in time. It is not a measure of the flow of corrupt transactions. Instead, we might think of it as reflecting the degree of historically cumulated corruption in public work contracting. Even if we had data for another

measure that we propose, as documented in Table 5. This underscores the extent to which inefficiency and corruption are intertwined in public works contracting.

year—1998, say, or 2000—our measure is unlikely to show much year-to-year variation. By using data from the late 1990s, we capture the extent of corruption in public works contracting that characterized Italian practices during preceding years.

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 proxy of “corruption” that we propose is based on the ratio between the two. The first data we draw on is a measure of physical infrastructure, whereas the second is a historically cumulative measure of the price government paid for public investments, or infrastructure expenditures, computed using what is called the perpetual inventory method (PIM), a standard method for calculating capital assets.¹¹ The measure of existing physical infrastructure that we use exploits data devised and collected by the European Union (Biehl 1986; Commission 1986) to assess infrastructure needs across the terrain of its member states (see Ecoter 1999). The second uses standard econometric techniques employed by governments around the world (see OECD 2001). 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.” Later we also carry out a robustness analysis to show that our results do not depend heavily on the specific assumptions made building the two sets of measures.

In what follows, we therefore use two sets of terms: capital assets, government infrastructure, and gross capital stock are stock variables, referring to the works constructed on behalf of government, whereas public works and public investments refer to flow variables,

¹¹ The first uses data from Ecoter (2000), based on earlier studies by Mazziotta (2000) and by Biehl et al. (1990). The second uses data compiled by Bonaglia and Picci (2000), based on data from Picci (1995). The latter utilizes methods based on OECD (2001) and described in Appendix B.

involving the monies spent by government on public works. The two reflect differences in the metrics used to measure the object we study. The first metric is an approximation of physical quantity whereas the second is monetary. We now describe each measure and the underlying data.

Physical Public Capital

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 year¹² for the 103 Italian provinces, drawing on 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. Where feasible, the authors collect multiple measures of the same infrastructure good (different types of high-voltage energy lines, or different types of railway track, for instance).

Having collected these disparate measures of physical public infrastructure in obviously variable units, the authors face a series of standardization and aggregation problems. The various measures refer to geographic units that differ in size, and to goods constructed to serve different population bases. In addition, the units of measurement differ.

The first problem is taken into account in two ways. Goods that are “space serving,” such as roads and railroads, are normalized (i.e. divided) by the area of the geographical unit that they refer to, whereas goods that are “population serving,” such as public buildings, are normalized (i.e. divided) by population. Each type of good is then indexed on a scale of 0 to 100 by dividing each

¹² We use Ecoter’s data from 1997. Ecoter also has similar measures available for the years 1970, 1977 and 1987. Because the data on government expenditures become more reliable over time, as we detail, using the latest year possible seemed preferable. In addition, for complex technical reasons, the Ecoter data are not suitable for time-series analysis, thereby preventing us from building multiple cross-sections comparable across decades.

provincial and regional value by the maximum value found across the Italian provinces. This in essence scales each type of good to the maximum. The precise formula are presented in Appendix B.

After such normalization and standardization are carried out, the indices of different categories of goods are aggregated by averaging to form broader indices. Types of goods within a single class (transportation, for instance, or health) are averaged arithmetically, whereas the different classes of goods are averaged geometrically. The rationale for using the latter is that, because the geometric mean is more sensitive to extreme values, it more nearly captures the fact that transportation goods are not useable substitutes for public health goods, for instance; a road is not a substitute for a hospital. Hence, if there are high values of one class of good but low values of another, this will be better approximated with the geometric average than the arithmetic.

The resulting measures are then expressed as ratios to the national average and multiplied by 100, 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. The method used is addressed at length in Mazziotta (2000), who shows how altering details of the aggregation method does not substantially affect the resulting index.

Ecoter (2000) presents provincial and regional indices of physical infrastructure for the year 1997. The regional data are shown in the leftmost column of Table 1. The data show that northern Italian regions, which are located in the top portion of the list, are more infrastructure-abundant than regions in the south of the country, which are featured in the bottom half of the list (See Appendix A for a list of regional abbreviation, and Figure 1 for a map of Italy). For instance, the southern region of Calabria has slightly more than half the stock of (normalized) infrastructure than the national average, whereas 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 existing 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 deducting the value of assets as they reach the end of their service lives. To clarify the computation involved, consider the following equation:

$$K_t = \sum_{i=0}^{SL} I_{t-i}$$

where K_t is the (gross) capital stock and I_t is investment. Past investments contribute to today's capital stock unless they are older than their service life (SL). When its service life is over, a given vintage of investment goods is retired.¹³

In order to compute public capital stocks for Italian regions, we tap two main data sources. Rossi, Sorgato, and Toniolo (1993, RST from here on), draw on several statistical sources to create one long time series (covering 1890 to 1992) of public investments at the national level for Italy. We have then used data from ISTAT (1999) to extend RST 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 found in a census or in administrative property records. If one is not interested in the early decades of the sample period, however, the RST data can be used to compute the total stock at the national level by means of a perpetual inventory technique even

when an initial benchmark is not available. Since goods are retired from the capital stock after their service lives, initial estimates are no longer necessary after a certain number of years.

To create a similar regional series of data on capital stocks, we turned to information contained in ISTAT (1954-1998). ISTAT collects regional data on infrastructure investments by means of a quarterly survey of relevant public officials, using these to estimate the annual amounts spent on public investment by geographic area, type of good, and administrative unit responsible for realization and 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;¹⁴ b) with total or partial financing by national or territorial branches of the public administration (Inail,¹⁵ Inps,¹⁶ 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). Ordinary infrastructure maintenance is excluded from these figures.

There are nine types of goods included in ISTAT’s investment expenditure data. These are: roads and airports; railroads and subways; ports and rivers; electric and hydroelectric; public buildings and schools; sanitation, public health and hospitals; land reclamation and irrigation; telecommunications; and other types of works (such as pipelines, tourist infrastructure, etc.).

We first use ISTAT’s survey data covering 1954 to 1998 to apportion the aggregate

¹³ For a more elaborate formulation of this basic relationship, the reader is again referred to OECD (2001); details on its present application appear in Appendix B.

¹⁴ The Cassa per il Mezzogiorno, which no longer exists, was a special national governmental unit responsible for financing economic development in the south of Italy.

¹⁵ Istituto Nazionale per l’Assicurazione contro gli Infortuni sul Lavoro, a social security body covering certain classes of employees.

¹⁶ Istituto Nazionale di Previdenza Sociale, the main national social security body.

national totals from RST to regions and types of goods.¹⁷ 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 of the ISTAT data, and whose overall total is equal to the aggregate in RST. (Again, Appendix B provides details and an example.) These long time series are 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 Italy’s 20 regions.

We use these expenditure figures to compute indices of infrastructure spending using procedures parallel to those already described for the physical data; that is, by normalizing space and population serving expenditures appropriately. While it is impossible to precisely replicate the methodology used in Ecoter (2000) for the physical data, since the two datasets feature similar but not identical categories of goods, we have sought to make the two indices as comparable as possible. (Details of the procedure used appear in Appendix B.) Results are shown in the second column of Table 1.

This second measure of public capital generates figures that are quite different from those measuring the physical data examined earlier. In particular, southern Italy is, on average, *better* equipped than the north, according to this second measure. This is the reverse of what we found using the physical infrastructure measure, and on the face of it, rather surprising, since it means that cumulative infrastructure investments have generally been higher in the south than in the north. What happened to all that money? Where is all of Italy’s missing infrastructure? Our

¹⁷ Essentially, this procedure relies on the assumption that the response rates across different administrative units reporting infrastructure spending are not systematically biased; that officials at the national level or in selected regions are not systematically more (less) likely to send back their quarterly questionnaires. The only information publicly available on response rates is the proportion of communes responding in each province, but this does not include information about response rates from units other than communes, so it is not useful for verifying the absence of systematic bias in response rates. We know of no reason why government offices would want to deliberately withhold information on investments made under their purview, especially given that the reports themselves are not in the public domain, only the annual totals.

proposed measure of corruption provides an interpretation for this puzzle.

A noteworthy outlier 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 1.99 times the national average. Liguria houses a large population on a very narrow wedge of land running between mountains and sea. In such a setting, public works construction often requires daunting—and expensive—techniques, familiar to anyone who has driven the freeway running the Ligurian coast. In what follows, we control for regional variations in altitude to attempt to capture regional differences of this sort, and we later verify that the Ligurian discrepancy is indeed due to unmeasured aspects of its orography. Before doing so, however, we incorporate some regional cost controls into our measure.

Cost Controls

Several factors may affect the price paid for a given public work. Casual observation suggests that in Italy, infrastructure construction costs should be relatively uniform in different parts of the country. First, national labor contracts force 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 throughout Italy, the fruit of a tradition dating back to the Romans. Third, the data on infrastructure expenditures that we use exclude the costs of land, thereby removing possible differences of this type from the data. Finally, we note again that the data we use exclude ordinary maintenance costs, so differences in usage or varying political commitments to maintain existing infrastructure will not affect our measure. Given these factors, we have little reason to believe that public infrastructure should exhibit large cost variations across the country.

Notwithstanding these considerations, we collected data measuring regional cost

differentials in order to ensure as much 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 data¹⁸ on labor costs in the construction industry, including annual updates with information from the industry's national labor contract, which 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 in two-month intervals on the costs of construction materials at the regional and provincial levels. According to ministry officials whom we interviewed for the purpose of assessing the quality of these data, their purpose is to record temporal more than geographic variations; 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.¹⁹

We next construct an aggregate regional cost index, using data from January 2001, as the geometric average of the labor, sand and cement indices. While other factors may affect

¹⁸ Provinces are geographic entities smaller than regions; data at the provincial level are easily aggregated into regional data.

¹⁹ 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. Given the small differences characterizing construction costs that we have found, this should not affect results much.

construction costs—the cost of transporting heavy equipment to site, for instance—our cost index captures the bulk of possible differences. According to the overall cost index, the least costly region, Lazio, has construction costs approximately 7 percent below the national average, whereas Tuscany is the most expensive region, with costs 12 percent above the national average.

We use this cost measure from 2001 to scale the 1997 perpetual inventory capital stock data, assuming that the cost differences across regions are essentially unchanged over the years. Such an assumption is unavoidable, given the sheer difficulty in finding comparable cost information for other years;²⁰ we know however of no reason to believe that they may have undergone differential rates of change by region.

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 2.²¹ But controlling for cost differences 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 chose to test their importance rather than assuming they were important and folding 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 hypothetical importance of the former. A freeway crossing a range of mountains is more expensive to build than a freeway across a plain or a plateau, simply because of the corresponding differences in terrain. To capture this effect, we used a dataset provided by ISTAT containing

²⁰ Strictly speaking, this is not entirely true. Until 1969, wage rates were geographically-differentiated in Italian national labor contracts.

communal data—communes are a smaller administrative subdivision than provinces—on surface, population, and highest and lowest altitude. For each commune, we experimented with different functions of the difference between the lowest and highest altitude, excluding altitudes above 1000 meters in order to limit the influence of (relatively unpopulated) mountains, and then aggregating the data at the regional level by weighting the municipal data by population.

We also used the same dataset to compute several measures 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 also experimented with a measure of seismicity, since government standards for the construction of public works are more stringent in areas of the country that are more susceptible to earthquakes. We compute this as a population-weighted aggregation of the standard seismicity index (Istituto Sismico Nazionale 2001) at the municipal level.

In the end, therefore, we adjust our regional measure of public capital stocks only with two controls:

- construction wages;
- basic construction materials (sand, cement);

and we estimate the impact of possible controls for:

- altitude;
- population density;
- seismicity.

The next section reports the resulting index.

²¹ In fact, the correlation coefficient between the two measures is 0.995, meaning the cost corrections are substantially small.

Results: An Index of Corruption

The ratio at the regional level between the physical index and the cost-corrected perpetual inventory index, normalized so as to have a unit average, is shown in column 4 of Table 1, and it represents the differences between the two ways of estimating public goods, correcting for the differences in two types of costs (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 0.607, has a little over 60 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 demonstrate impressive differences across Italy's regions.

This ratio is next used as the dependent variable in a regression analysis, the model for which includes the three control variables: variations in altitude, population concentration, and seismicity. In all cases, after having experimented with several versions of the proxies, we were not able to detect statistically significant effects.²² We interpret our failure as stemming from a relative uniformity in the orography and population density of Italian regions. With a few the exceptions (such as Liguria, which we have already discussed) most Italian regions comprise a mix of plains and mountains, since the combined Alp and Appennine mountain ranges run the whole of the Italian peninsula. Hence, most regions have some mountainous parts. Moreover, again with a few exceptions, most regions are characterized by the presence of a main city, one rarely above half a million inhabitants, and by other provincial cities of smaller size. Rome, Milan

and Naples—the major cities of the regions of Lazio, Lombardy and Campania respectively—are the only relevant exceptions to this general picture. This makes it hard to capture regional variations in congestion costs via variations in population density. As far as seismicity is concerned, new construction has started taking locational seismicity into account only recently. Most of the Italian territory is characterized by some degree of seismicity, and major earthquakes have affected both northern and southern parts of Italy in recent decades.

The ratio reported in Table 1, column 4, then, is our corruption “G” measure, where “G” stands for “general,” meaning that it is computed across all categories of public goods. Its interpretation is straightforward. Consider Umbria, whose “corruption index,” at 1.78, is the highest in the country, meaning that Umbria is Italy’s least corrupt region. In Umbria, there is 79 percent more public infrastructure than would be the case if the Italian government had paid the national average for the public works constructed there. Consider next Campania, the most corrupt region by our measure, with an index value of 0.36. Infrastructure there is only 36 percent of what it would have been had resources been used to the same extent as the national average. These differences are staggeringly large. Note in particular that *all* the southern regions 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 among the four 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. For most of them, the index value is above 1. There are two exceptions: Liguria and, to a lesser extent, Valle d’Aosta. We have already mentioned how the orography of Liguria could influence the

²² Results available upon request.

resulting value. Valle d’Aosta, on the other hand, is a small mountainous region bordering France, comprising a single province. However, unlike Liguria, most infrastructure is located in several valleys. Our (admittedly ad hoc) explanation is simply that the Valle d’Aosta is unusually remote, and unusually small.

In order to get further insight, we develop a second measure of corruption, analogous to the previous one, but including only those types of goods that have been classified as “population serving” (see Appendix B). Since these are mostly “social” infrastructure goods, such as various types of public buildings, we call the resulting measure “S.” Simply on *a priori* grounds, we think that the costs of constructing buildings should be less influenced by the orography of the region than goods designed to cover a specific topography (railroad tracks, roads, power lines, etc.).

Table 2 about here

Column 4 of Table 2 reports the “S” index. It is highly correlated with the “G” index, with a correlation coefficient of 0.87 (or 0.91 excluding Liguria, Valle d’Aosta and Trentino-Alto Adige; see Table 3). According to the “S” measure, as might be expected based on *a priori* grounds, Liguria no longer appears anomalous. Its high value on the “G” measure was in fact driven by the space serving infrastructure component, which we believe is heavily influenced by the nature of the terrain. Once population serving infrastructure is considered separately, Liguria no longer appears an outlier. This means simply that our attempt to capture the importance of altitude variations for infrastructure costs was inadequate.

Table 3 about here

On the other hand, the “S” measures for Valle d’Aosta, and also for Trentino-Alto Adige, both of which are very northern regions, are unexpectedly below 1. Trentino Alto-Adige is a small mountainous region, bordering Austria, whose infrastructure is concentrated along the Adige

valley. Valle d’Aosta is also unusually mountainous. Given the controls we currently use, these two regions remain a bit anomalous.²³

In Appendix C, we present a provincial-level version of the regional corruption index that we have constructed. Our procedure for constructing the provincial-level version is identical to the one we use for the regional index, except that, because of an absence of appropriate data, we do not include any cost or other control variables. The regional index is thus a more reliable measure than the provincial figures, which we include for purposes of illustration.²⁴

However, the provincial measure also serves to better interpret the regional indices. The provincial data show that the regional results for Trentino Alto-Adige are driven by its northern province of Bolzano. This means that to understand the unusual Trentino index result for “S,” we would probably want to investigate those types of infrastructure goods in Bolzano.

Robustness Tests

One possible objection to the corruption indices presented is that, by basing the construction on two measures of infrastructure, they depend on the assumptions made with respect to those underlying measures. Perhaps our attempt to make the permanent inventory measure comparable to the physical infrastructure measure was inadequate. We now show that various assumptions made are actually not critical. We provide some simulations of what happens when we modify some assumptions during the process, and we then provide an interpretation of the results.

²³ Both Valle d’Aosta and Trentino-Alto Adige are “regioni a statuto speciale” (special statute regions), meaning they enjoy special administrative status, and both have received substantial transfers from the central government over time. The other three “special statute regions” are Sicily, Sardinia, and Friuli-Venezia Giulia. Of the five, only Friuli-Venezia Giulia exhibits a (slightly) better than average corruption measure. Their special administrative status may make these regions unusually vulnerable to corruption, perhaps because the monitoring of expenditure disbursements is more decentralized than elsewhere.

The assumption that we change regards the different goods' average lives, which are used in the computation of the permanent inventory capital stocks. In permanent inventory computations, average lives are always arbitrary to some degree. By changing some goods' average lives but not others, we effectively change the weights used to obtain our aggregate index. This seems a critical aspect of the construction of our measure, and worth additional scrutiny.

We experiment with three scenarios. In the first, we recompute the capital stocks after increasing the average lives of all goods by 20 years. In the second scenario, we increase the average lives by 20 years for goods involving some type of construction, such as streets and buildings, but not for other types of goods. In the third scenario, finally, we do the opposite, and increase the lives of the goods that exclude construction.

Using the three new estimates of permanent inventory capital stocks, we next recompute the two corruption indices presented in Table 1. In Table 4, we report the newly-modified corruption indices. The first column of the table shows the initial benchmark results for the "G" index, already reported in Table 1, column 4. The next three columns show the indices obtained under each of the scenarios just described.

Table 4 about here

The corruption index changes remarkably little as we move from one scenario to the other. The index that we propose seems to be robust to changes in assumptions about average lives. The robustness of our index is not surprising. In fact, different weightings in the construction of the permanent inventory and in the physical measure indices by themselves are not enough to make our resulting proxy unreliable, because the weighting really matters only when the different types of goods behave differently with respect to the phenomenon under scrutiny. There are good

²⁴ The provincial index is presented so that its median is 1. This explains, for example, why the provincial index for the province of Aosta (corresponding to the region of Valle d'Aosta) is different than the corresponding "G" measure (reported in Table 1, column 4).

reasons to expect this not to be true: if a particular region exhibits a high degree of corruption, say in the construction of roads, we believe that it is likely that this is also true for the construction of public buildings and other types of works. As a result, the exact weighting used in the aggregation of the different types of goods is not as critical as it may seem initially.

Validity Tests

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 more 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 in his study, 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 uniting;
- 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 first row of Table 5 reports the estimated correlation coefficients for 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 measure “G” of corruption accounts for 75 percent of the variation in the performance measure, corresponding to a correlation coefficient of 0.869, and is statistically significant well below the 1 percent level,²⁵ suggesting that where corruption is least—recall that our measure has lower numbers for higher levels of corruption—government performance is best.²⁶

Table 5 about here

We next assess our proposed index of corruption against a measure of high-level political malfeasance. This measure counts the number of charges against members of Italy’s lower house

²⁵ There is an obvious temporal gap between Putnam’s measure, constructed using data from the period 1978-1985, and our measure, which uses data from the late 1990s. A study (Simoni 1997) updating Putnam’s index shows that it is relatively unchanged between the period of original data collection (1978-1985) and a more recent period (1990-1994). Simoni reports a correlation coefficient of .81 between the two. We have not used the updated index, however, since it is available for only 15 of Italy’s 20 regions (see Simoni 1997, p. 431, table 5).

(the Chamber of Deputies) who were investigated by the judiciary for malfeasance during the XI Legislature (1992-94) for all crimes excluding those such as libel, slander, and likewise.²⁷ The count is performed over the twenty regions, and the number of charges is put in proportion to the number of deputies elected from each region.²⁸ Hence, the measure used is akin to the percent of deputies charged with non-opinion crimes during the life of the legislature.²⁹ The measure of high-level political malfeasance is conceptually different than the corruption index proposed here, because the former encompasses illegal activities of all sorts by legislators, not specifically bribes and kickbacks in public works construction. Most charges involved violations of the law on campaign contributions (see the data in Ricolfi 1993, p. 24, table 3).

The second row of Table 5 reports the correlation coefficients between our proposed “G” measure of corruption and the 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 perhaps even explicitly encouraged greater numbers of bribes, payoffs, and kickbacks surrounding the procurement process for public works. Hence, the two measures should be strongly and negatively related (because they are inversely scaled).³⁰

²⁶ Table 5 also reports correlations for the “S” index, and considers the exclusion of the “anomalous” regions already discussed.

²⁷ For other work using this measure, but examining only Christian Democratic members of Parliament, see Golden and Chang (2001).

²⁸ 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. No charges were made against the sole deputy representing the Valle d’Aosta, so we excluded that region, which uses a non-standard electoral system.

²⁹ Because some legislators were charged more than once, the measure is not identical to the percent of deputies charged. Also note that because multiple charges may be lodged against a single legislator, the percent of charges against those elected in the district may in principle be higher than 100.

³⁰ For this analysis, data on charges of malfeasance for non-opinion crimes had to be aggregated at the regional level. The region of Lazio comprises provinces from two different electoral districts. The results reported thus reflect this. The number of deputies charged from the electoral district that cuts across two

Our proposed measure exhibits the correct sign, and is negatively associated with purported legislative malfeasance. We would expect this given that lower numbers of our measure indicate greater corruption, whereas the reverse is the case for the legislative measure. The estimated correlation is equal to -0.358 (p -value of 0.13).³¹ The correlation reaches the 10 percent significance mark once we we exclude Liguria from the computation. While correctly signed, the correlation of legislative malfeasance with the corruption “S” measure is weaker and statistically insignificant.

The results of these correlation analyses are just what we would expect if our proposed measure were doing a reasonable job capturing the extent of bribes, kickbacks, and payoffs in public works across the Italian regions. While it would obviously be ideal were we able to compare our proxy with more direct measures of such payoffs and kickbacks, we know of no studies of price-fixing in Italian public contracting that would permit this. Despite the absence of direct measures of corruption, comparing our proxy measure with other closely related phenomena, such as high-level political malfeasance, offers grounds for considerable confidence in our measure.

Finally, we compare our measure with a measure of construction costs in the private sector. We do so to confirm that the geographic variations that we claim reflect public sector corruption do not merely capture geographic differences in construction costs. Such a comparison will increase our confidence that our measure is not simply capturing geographically-variable efficiency. One possible reason why southern Italy and the islands of Sardinia and Sicily receive a much smaller “bang for the *lira*” in the construction of public works than occurs in the north is

regions is only one, however, so the unavoidable error in the analysis is very small and does not substantially affect the results we report.

³¹ 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 2003). After 1994, the

because of possible differences in the cost structure of the building industry; that is, perhaps there are intrinsically higher production costs in the south (because workers are chronically less efficient, or the markets for construction materials characterized by price distortions). Since this objection, if true, would invalidate the main interpretation offered by this paper, we consider it in detail. We start by some providing general arguments, mostly based on *a priori* knowledge of the context, and then we move on to presenting some systematic, if limited, empirical evidence.

Differences in the final prices paid by government for public works could be due to a combination of differences in the price of inputs, in the price of labor, and in the efficiency of the production process.³² Regarding the first component, as already noted, we collected a proxy for the costs of materials and factored that into the construction of our corruption index, although the geographical differences in costs proved to be relatively trivial.

Regarding the cost of labor, we have already noted that labor costs are included in our cost corrections. It is nonetheless possible that southern firms are so inefficient that their costs are more expensive. We believe this is not likely to be the case, however. The building industry is well distributed over the national territory. Barring unusually demanding projects, where the market may be thin and possibly geographically concentrated, for the vast majority of construction projects the market is highly competitive across Italy, and arbitrage would be possible to take advantage of other producers' inefficiencies. Indeed, we do observe such arbitrage: casual observation suggests that many public tenders, including many in the north, are won by firms coming from distant regions.

In addition, there is compelling evidence that private buildings are on average *less* expensive to build in the south. We talked with professionals from the construction industry, as

institutional conditions systematically promoting corruption declined; in addition, the constitutional procedures surrounding the removal of parliamentary immunity of legislators were altered.

³² The difference in the cost of land is not an issue, since it is not included in the investment data.

well as from relevant professional organizations and associations, and all of them corroborated this piece of conventional wisdom.

As a check on the conventional wisdom, we analyzed a set of data provided by Nomisma's quarterly Property Market Report (Nomisma, various years). For several major cities, Nomisma runs a quarterly survey on the prices of residential housing. We analyzed the differences between the price of a house "new or restructured" and a house "needing complete restructuring." Such differences should proxy the construction costs; that is, they should reflect the full cost minus the value of the land and the building permits. We averaged such differences over the full period of data availability (May 1988 to May 2003, for a total of 31 observations), in order to dampen any cyclical or short-term effects in the data. We normalized the data so that the average is equal to 1. Results appear in Table 6.³³

With the exclusion of Bari, where costs are slightly above average, all the large cities in the south (Cagliari, Catania, Naples, Palermo and Rome) have private sector construction costs below the national average. Deviations from the average are not important for most cities, with the notable exception of Catania. The northern cities for which data are available (Bologna, Florence, Genoa, Milan, Turin, Padova and Venice) all exhibit above-average construction costs.

These data confirm that construction costs in the private sector are typically lower in southern Italy than in the north. In the public sector, by contrast, our corruption index is driven by the fact that construction spending is cumulatively higher in the southern regions than their northern counterparts. We interpret the different results for prices paid for public versus private

³³ Results are presented so that the average across all cities is 1. For each observation, both a minimum and a maximum estimate is available; the table illustrates results including both. Using the minimum or the maximum provides almost identical results. All estimates are for construction in the outer zones of the city (i.e. for "periferia"). The dataset records "Venezia Mestre" (the part of Venice located on the Italian mainland) separately from Venice proper (the islands). The latter has been discarded, given that its unique building technology sets it apart from the other main Italian cities.

sector construction as corroborating our underlying argument: namely, public sector investments in southern Italian regions are artificially inflated by corruption costs.

Conclusions

The measure we propose can be constructed for other countries, although doing so will be painstaking.³⁴ 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 these countries it would be relatively easy to assemble measures of corruption similar to those proposed here; all that would be needed, in addition, would be the country expertise to collect potentially relevant cost controls. For other countries, it would be more difficult to construct equivalent measures. Nonetheless, with sufficient country expertise, they would be a starting point for assembling crossnational measures of corruption that draw on objective sources of data rather than surveys.

Such crossnational studies could also (or alternatively) draw on specific categories of public outlays for which the needed data are readily available. One example is provided by military investments. Accurate physical data are available for these, for example, through specialized firms such as Jane's, and the financial outlays are documented, even if imperfectly, in government budget figures. Using these data would permit the assembly of a cross-national database of estimated relative corruption in military infrastructure investments. Such an approach would also contribute to the study of the relationship between corruption and the size and

³⁴ An international team with multinational funding would probably be required to do so expeditiously.

composition of the government budget (see also Gupta et al., 2002). Similarly, it may be possible to collect cross-national (and potentially even time-series) measures of both the spending and physical components for selected subcategories of infrastructure, such as roads and highways, since cross-national datasets already exist with some relevant physical measures readily available (Canning 1995).

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Tables

Table 1. General Infrastructure Indices and Corruption Measure “G,” 1997.

<i>Region</i>	<i>Column 1 Ecoter Physical Capital</i>	<i>Column 2 PIM Capital Stocks</i>	<i>Column 3 PIM Cost Corrected</i>	<i>Column 4 Ratio Ecoter/PIM (col. 1/col. 3): Corruption “G” Measure</i>
PI	118.4	74.318	75.360	1.638
VA	132.6	159.32	161.69	0.855
LO	118.4	109.64	106.36	1.161
TA	122.9	108.24	103.64	1.236
VE	115.3	97.356	98.555	1.220
FR	125.5	117.75	121.51	1.077
LI	127.3	199.18	198.46	0.669
EM	144.1	101.14	93.275	1.611
TO	112.8	81.902	72.891	1.613
UM	109	64.203	63.719	1.783
MA	109.7	85.925	87.188	1.312
LA	111.3	132.12	141.96	0.817
AB	92.3	98.889	100.60	0.956
MO	62.1	109.01	111.11	0.583
CM	51.1	140.34	147.15	0.362
PU	63.3	87.450	91.373	0.722
BA	70	135.23	136.93	0.533
CL	50.3	123.75	128.20	0.409
SI	66.1	108.15	113.52	0.607
SA	66.5	89.434	82.770	0.838

Notes: For regional abbreviations, see Appendix A.

Column 4: data are normalized so that the average is equal to 1.

Table 2. Population Serving Infrastructure Indices and Corruption Measure “S,” 1997.

<i>Region</i>	<i>Column 1 Ecoter Population Serving Capital</i>	<i>Column 2 PIM Capital Population Serving Stocks</i>	<i>Column 3 PIM Cost Corrected</i>	<i>Column 4 Ratio Ecoter/PIM (col. 1/col. 3): Corruption “S” Measure</i>
PI	114.10	88.278	89.515	1.351
VA	142.80	358.57	363.91	0.416
LO	112.70	86.989	84.389	1.416
TA	152.00	199.62	191.13	0.843
VE	101.60	92.479	93.618	1.150
FR	121.00	121.45	125.32	1.023
LI	113.60	77.983	77.704	1.550
EM	147.40	101.78	93.865	1.664
TO	117.90	90.073	80.163	1.559
UM	118.50	71.655	71.115	1.766
MA	111.40	82.069	83.276	1.418
LA	113.30	109.95	118.13	1.017
AB	102.00	123.78	125.92	0.859
MO	78.400	180.35	183.82	0.452
CM	48.400	90.783	95.187	0.539
PU	64.700	81.501	85.158	0.805
BA	82.700	218.94	221.70	0.395
CL	56.900	118.54	122.80	0.491
SI	66.100	90.385	94.870	0.738
SA	83.800	175.22	162.16	0.548

Notes: For regional abbreviations, see Appendix A.

Column 4: data are normalized so that the average is equal to 1.

Table 3. Correlations of “G” and “S”Corruption Measures

<i>correlation</i>	<i>p-value</i>	<i>Notes</i>
0.799	0.000	All regions: $n=20$
0.940	0.000	Excluding Liguria, Valle d’Aosta and Trentino-Alto Adige: $n=17$

Note:

“G” corruption measure: Table 1, column 4; “S” corruption measure: Table 2, column 4.

Table 4. Robustness Analysis. Corruption Measure “G” under Different Scenarios.

<i>Region</i>	Benchmark (Measure “G”)	Scenario 1	Scenario 2	Scenario 3
PI	1.638	1.684	1.641	1.691
VA	0.855	0.905	0.891	0.874
LO	1.161	1.163	1.142	1.186
TA	1.236	1.311	1.279	1.275
VE	1.220	1.196	1.191	1.231
FR	1.077	1.247	1.182	1.147
LI	0.669	0.662	0.665	0.675
EM	1.611	1.570	1.570	1.615
TO	1.613	1.538	1.559	1.591
UM	1.783	1.770	1.736	1.825
MA	1.312	1.295	1.309	1.301
LA	0.817	0.844	0.855	0.809
AB	0.956	0.921	0.939	0.939
MO	0.583	0.559	0.563	0.580
CM	0.362	0.367	0.386	0.344
PU	0.722	0.730	0.747	0.708
BA	0.533	0.475	0.516	0.491
CL	0.409	0.335	0.390	0.353
SI	0.607	0.658	0.663	0.606
SA	0.838	0.771	0.819	0.788

Notes:

Benchmark: Same as reported in Table 3.

Scenario 1: The average lives of all types of goods are 20 years longer than in the benchmark

Scenario 2: The average lives of goods involving construction are 20 years longer than in benchmark; other goods’ average lives are unchanged.

Scenario 3: The average lives of goods not involving construction are 20 years longer than in the benchmark; other goods’ average lives are unchanged.

Table 5. Proposed Corruption Measures Correlated with Governmental Performance and Charges of High-level Legislative Malfeasance

Correlation of proposed “G” measure of corruption with:	<i>correlation:</i>	<i>p-value</i>	<i>Notes</i>
government performance	0.869	0.000	All regions: <i>n</i> =20
	0.908	0.000	Liguria excluded: <i>n</i> =19
charges of malfeasance	-0.358	0.132	Valle d’Aosta excluded: <i>n</i> =19
	-0.397	0.090	Liguria and Valle d’Aosta excluded: <i>n</i> =18
completed public works, 1990	0.575	0.008	All regions: <i>n</i> =20
Correlation of proposed “S” measure of corruption with:	<i>correlation:</i>	<i>p-value</i>	<i>Notes</i>
government performance	0.793	0.000	All regions: <i>n</i> =20
	0.876	0.000	Liguria excluded: <i>n</i> =19
charges of malfeasance	-0.187	0.444	Valle d’Aosta excluded: <i>n</i> =19
	-0.211	0.397	Trantino Altro-Adige and Valle d’Aosta excluded: <i>n</i> =18
completed public works, 1990	0.428	0.059	All regions: <i>n</i> =20

Note:

Sources: Data on governmental performance courtesy of Robert Putnam.
 Data on charges of malfeasance taken from Golden 2004.
 Data on 1990 completed works taken from Fontana and Petrina 2002 (see note 10).

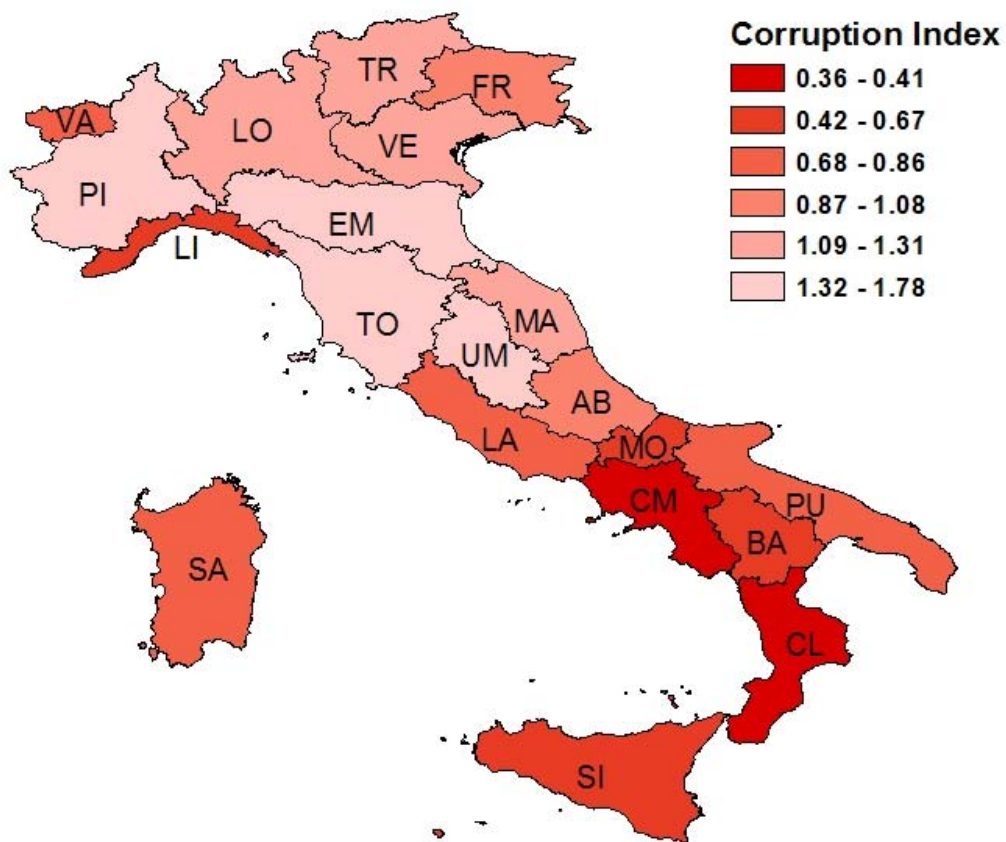
Table 6. Average Costs of Construction in Private Sector Housing, Various Italian Cities, 1988-2003.

City (located in Region)	Cost index
Bari (PU)	1.053
Bologna (EM)	1.339
Cagliari (SA)	0.835
Catania (SI)	0.551
Florence (TO)	1.084
Genova (LI)	1.008
Milan (LO)	1.294
Naples (CM)	0.779
Padova (VE)	1.003
Palermo (SI)	0.821
Rome (LA)	0.884
Turin (PI)	1.342
Venice (mainland) (VE)	1.006

Index computed by the authors using data from Nomisma, (various years), *Osservatorio sul mercato immobiliare, Rapporto Quadrimestrale*. Courtesy of Gualtiero Tamburini and Nomisma.

Figures

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.

1) Ecoter's Measures of Physical Infrastructure³⁵

Our data on existing physical infrastructure are taken unaltered from Ecoter (2000). The Ecoter measures are developed in five steps, as follows:

A) Construction of the primary measures for Italian regions and provinces. These are dictated by the available data for a given type of infrastructure. Examples are: length in kilometers for roads and railroads, area of runways for airports, number of rooms for public buildings and schools, etc. Measures are recorded in the form in which they are presented in publicly-available records. For instance, roads are recorded as kilometers for each of four types (comunal roads, provincial roads, state roads and highways). The data are presented for both the 103 provinces and the 20 regions, with regional figures comprising aggregates of the relevant provincial figures.

B) Normalization of the primary measures. Each of the primary measures is “normalized” (i.e. divided) either by present population or by the dimension (square kilometers) of the area which it serves (province or region), depending on whether the good is defined as “people serving” (schools, public buildings, etc.) or “space serving” (roads, railroads, etc.). The result is of the type: number of schoolrooms per inhabitant, or kilometers of roadway of a certain type per square kilometer.

C) Standardization of the normalized measures. The output of the previous step (normalization) is a set of measures that are still represented in different units (kilometers per square kilometer, or hospital beds per inhabitant) and, as such, are not directly comparable. Each normalized infrastructure measure is now “standardized” by expressing it on a scale from 0 to 100 (respectively indicating the territorial unit with the least and the most infrastructure). The computation is conducted by dividing each of the units by the value of the unit (i.e. province) with

the highest normalized number.

D) Aggregation into nine standardized indices. The arithmetic mean is then used to average the standardized indices created for each geographic unit (region and province) within each category of good (e.g. roads, railways, airports, ports, etc.). The means are then again put on a scale of 0 to 100, by dividing each value by the maximum value from Italy's provinces and regions. The resulting values are then again averaged arithmetically, producing standardized, normalized arithmetic average indices for each of nine classes of infrastructure goods.

E) Aggregation of the nine standardized indices. The geometric mean is then used to aggregate these indices across the nine main categories of good. The nine main categories (reported in Ecoter (2000)) are: i) transportation (including roads, railroads, airports, ports, other transportation systems); ii) telecommunications (including telephones); iii) energy (including long-distance power lines, oil pipelines, gas pipelines); iv) water supply; v) education (including nursery schools, elementary schools, junior high schools, high schools, universities); vi) health (hospitals); vii) social infrastructure (child care facilities); viii) sports (sports facilities); ix) culture (including theater and other cultural venues). For the rationale for using the geometric mean rather than the arithmetic at this last step, see the earlier discussion in the body of this paper. This procedure uses the indices of the nine categories of goods to generate a general regional infrastructure index (reported, for 1997, in Table 1, column 1), as well as separate aggregate indices for space serving infrastructure and for people serving infrastructure. The former is reported in Table 2, column 1.

In what follows we explain how an analogous set of infrastructure indices can be obtained for government infrastructure expenditures. The procedure utilizes the perpetual inventory method to assemble expenditure data on public capital.

³⁵ Our description is drawn from Ecoter (2000) and Mazziotta (2000). We are grateful to Claudio

2) The Perpetual Inventory Method (PIM) Used to Calculate Cumulative Government Infrastructure Spending³⁶

We first present the construction of the public investment data. Afterwards, we describe how, using the perpetual inventory method, we compute the public capital stock with these data. In a following section, we study the robustness of such a measure, and in the final section of this appendix, we describe how the estimates of regional public capital are used to compute the infrastructure indices.

ISTAT (various years) presents data on public investments by province and by type of good, starting in 1953 to the present day. The data are collected by means of a quarterly survey of administrative units, who are asked to report on monies spent on new public investments, a category that excludes ordinary maintenance expenses. Let us call $I_{r,g,t}$ the investment reported in region r ³⁷ for type of good g in year t , where $r = 1, \dots, 20$, $g = 1, \dots, 9$ and $t = 1953, \dots, 1998$.

The nine types of goods are labelled as follows: *str*, *fer*, *mar*, *idr*, *edp*, *igi*, *bon*, *com*, *altre* (for “*strade e aeroportuali*” (roads and airports), “*ferroviarie e altre linee di trasporto*” (railroads and other kinds of transportation), “*marittime lacuali e fluviali*” (ports and rivers), “*idrauliche e impianti elettrici*” (electric and hydroelectric), “*edilizia pubblica sociale scolastica*” (public buildings and schools), “*igienico-sanitarie*” (public health and hospitals), “*bonifiche*” (swamps, land reclamation), “*impianti di comunicazione*” (telecommunications), “*altre categorie*” (other categories).

Now let us call NAI_t the national accounts figure for public investments in a given year. Such a figure is available only at the national level, and are not broken down by the types of goods that were financed.

Mazziotta for helpful discussions of the Ecoter data and procedures.

³⁶ We are grateful to Fabio Bacchini of ISTAT for helpful discussions of ISTAT’s public works data.

Typically, the total across types of goods and across regions of the survey data will be different from the national accounts figure. First, the definition of public goods will typically not be the same. Second, $I_{r,g,t}$ refers to survey data, with response rates by the relevant administrative units that are less than unity. That is, $NAI_t \neq \sum_r \sum_g I_{r,g,t}$. For this reason, we do not use the survey data directly, but we employ them to apportion the overall national accounts data to the different regions and types of goods, resulting in an aggregate figure for public investments that is identical to that reported in the national accounts. An simple example clarifies the point.

Assume that Italy has two regions, A and B, and that there are two types of public goods, roads (R), and schools (S). Suppose that Italy spent 100 Euros in public investments last year. However, we do not know how much of this money went to which region or to which type of good.

In order to estimate that, we must resort to the ISTAT annual survey. Assume that it reports that, this year, 10 euros have been spent in region A for roads and 20 euros in region A for schools. Five euros went to region B for roads and 15 for schools. According to the survey, the total investment was 50 euros (which is less than the national accounts figure of 100, because not all the administrative units responded to ISTAT's surveys during the year). According to the ISTAT data, twenty percent of the total went to region A for roads (10 of 50 euros), and 40 percent of the total was spent in A for schools (20 of 50 euros), etc.

We use these last ratios to apportion the national accounts total spending figure for the year. On the basis of this, we estimate that 20 euros went to region A for roads (20 percent of 100 euros), 40 euros went to A for buildings (40 percent of 100 euros), 10 euros went to B for roads,

³⁷ In fact, the data are available by province.

and 30 euros went to B for buildings. The sum of these estimated expenditures is now equal to the national accounts number (100 euros) that has thus been effectively apportioned into regional expenditures by type of goods.

In more general terms, the apportionment of the national accounts aggregate figure is carried out by defining the ratios of the reported spending with respect to their total:

$$R_{r,g,t} = I_{r,g,t} / \sum_r \sum_g I_{r,g,t}, \text{ where:}$$

$$\sum_r \sum_g R_{r,g,t} = 1.$$

The apportioned national accounts data are then equal to:

$$NAI_{r,g,t} = R_{r,g,t} \cdot NAI_t$$

It follows that:

$$\sum_r \sum_g NAI_{r,g,t} = NAI_t$$

With the help of the permanent inventory technique, the $NAI_{r,g,t}$ data are then used to estimate regional capital stocks, disaggregated by type of goods, that we indicate with $KP_{r,g,t}$. The perpetual inventory method employed is the same as that traditionally adopted by ISTAT, Italy's national statistical agency. In the case at hand, gross capital stocks are computed, with average lives determined as the average of the mean lives adopted for comparable categories of goods by the OECD (1993), following ISTAT's practice (reported in ISTAT (1995)), with retirement lives distributed according to a normal distribution truncated at ± 40 percent of the average lives of the goods. Using this procedure, 90 percent of goods are retired within 25 percent of the mean life. All vintages of goods put into service prior to 1946 have been reduced by 8 percent in all regions to take into account the effects of World War II, following suggestions made by Rosa and Siesto (1985). Further details are available in Bonaglia and Picci (2001).

3) The Sensitivity of Public Stock Estimates to Pre-1954 Data

In principle, in order to compute the capital stock for the year 1997, data on how the aggregate national public investment is divided into regions and types of goods are needed for the years before 1954, which marks the beginning of ISTAT's infrastructure surveys that we use to apportion the national accounts public investment figure. However, the data used to apportion the aggregate data area to regions and types of goods are available only from 1954 onwards (ISTAT, various years). The share of the national flow that goes to the different regions and types of goods has to be assumed for earlier 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 entirely unaffected by the method we adopt for the period before 1954: i) most of the public works built before 1954 had already exhausted their mean lives by 1997; and ii) 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 later years in the postwar era. Relatedly, the physical destruction that had occurred in 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 (results available from the authors upon request).

4) Computation of the Index of Infrastructure

As illustrated previously, in Ecoter (2000) an overall index for existing physical infrastructure as of approximately 1997 is produced by dividing infrastructure measures into "space serving" and "population serving" goods. "Space serving" public capital refers to roads,

railroads, airports, ports, other transportation infrastructure, telecommunications, energy, oil and natural gas pipelines, and water supply. “Population serving” public capital refers to schools of all types, hospitals, kindergartens, sports facilities, theaters, museums, parks and other types of cultural establishments.

Because the categories used by Ecoter and ISTAT present some differences (see the two sets of categories reported earlier), in order to put Ecoter’s physical measures in relation to ISTAT’s measures of monies spent, we needed to aggregate the two sets of measures in some way that makes them most comparable. Of the nine categories of goods defined by ISTAT, we defined six (str, fer, mar, idr, bon, com) to be “space serving” and two (edp, igi) to be “population serving.” ISTAT’s final category (altre, or other), which is of minor quantitative importance, has been arbitrarily attributed equally to each of the two types of public capital. Formally, we define space serving public capital as $KP_{r,SPACE,t}$, and its population serving counterpart as $KP_{r,POP,t}$. For the ISTAT spending data, they are then given by:

$$KP_{r,SPACE,t} = KP_{r,STR,t} + KP_{r,FER,t} + KP_{r,MAR,t} + KP_{r,IDR,t} + KP_{r,BON,t} + KP_{r,COM,t} + \frac{1}{2} \cdot KP_{r,OTH,t}$$

and:

$$KP_{r,POP,t} = KP_{r,EDP,t} + KP_{r,IGI,t} + \frac{1}{2} \cdot KP_{r,OTH,t}$$

where the definitions of symbols should be obvious.

An overall infrastructure index reporting the relationship between existing infrastructure goods and our estimate of cumulative monies spent can be obtained by normalizing space serving capital stock by space and population serving capital stock by present population. Let us call such an index $INFR_{r,t}$. We build it in two steps. First, we develop specialized indices for space and

population serving infrastructure, which we call respectively $INFR_{r,SPACE,t}$ and $INFR_{r,POP,t}$. These are defined as follows:

$$INFR_{r,SPACE,t} = (KP_{r,SPACE,t} / S_r) / \left(\frac{\sum_r KP_{r,SPACE,t}}{\sum_r S_r} \right) \cdot 100$$

$$INFR_{r,POP,t} = (KP_{r,POP,t} / P_{r,t}) / \left(\frac{\sum_r KP_{r,POP,t}}{\sum_r P_{r,t}} \right) \cdot 100$$

where S_r is the area of a region (which is unaltered over time), and $P_{r,t}$ is the population of a region at any given time. The latter of the two is reported in Table 2, column 2.

The aggregate infrastructure index is then obtained as a weighted average of the space serving and population serving indices, with the weights given by the relative importance of the two types of capital stocks:

$$INFR_{r,t} = \left(\frac{KP_{r,SPACE,t}}{KP_{r,SPACE,t} + KP_{r,POP,t}} \right) \cdot INFR_{r,SPACE,t} + \left(\frac{KP_{r,POP,t}}{KP_{r,SPACE,t} + KP_{r,POP,t}} \right) \cdot INFR_{r,POP,t}$$

This index is reported in Table 1, column 2.

One obvious problem arises when we compare these indices with the Ecoter (2000) indices, because the two are not necessarily based on the same weightings for the different types of infrastructure categories. However, this should have only a minor impact on the outcome. With respect to the aggregation of the nine indices into the “space” and “population” categories, note that different types of infrastructure are highly correlated across regions—that is, regions well equipped in one type of good tend to be well equipped in all types of goods. With respect to the aggregation of “space serving” and “population serving” infrastructure—the last equation—note that if there were a perfect correlation between the regional dimension and the population, any aggregation would produce the same result. In the case of the Italian regions, the correlation

between size and population is equal to 0.71. The inevitable discrepancies between the aggregation procedures of the two indices have a minor impact on the outcome. The high correlation between the “G” and “S” corruption measures, which derive from extremely different aggregations of the base index—the former has a zero weight to the space serving public capital stock—demonstrates this. Further corroboration of the robustness of the chosen methodology to variations in the weighting assumptions is provided by the results presented in Table 4, and are also illustrated in the text.

Appendix C. Provincial Corruption Index (1997)

Region	Province	Index	Region	province	Index	Region	province	Index
PI	Turin	0.850	EM	Piacenza	0.412	MO	Campobasso	1.556
	Vercelli	0.552		Parma	0.495	CM	Caserta	2.712
	Novara	0.468		Reggio Emilia	0.449		Benevento	1.864
	Cuneo	0.432		Modena	0.654		Naples	6.440
	Asti	0.492		Bologna	0.825		Avellino	1.883
	Alessandria	0.503		Ferrara	0.839		Salerno	1.642
VA	Aosta	1.014	Ravenna	0.653	PU	Foggia	1.200	
LO	Varese	0.920	Forli	0.651		Bari	1.299	
	Como	0.806	TO	Massa Carrara		0.883	Taranto	1.989
	Sondrio	1.204		Lucca		0.708	Brindisi	1.735
	Milan	2.075		Pistoia	0.785	Lecce	0.919	
	Bergamo	0.683		Florence	0.774	BA	Potenza	1.702
	Brescia	0.621		Livorno	1.024		Matera	1.549
	Pavia	0.442		Pisa	0.931	CL	Cosenza	2.366
	Cremona	0.591		Arezzo	0.546		Catanzaro	1.991
	Mantova	1.080		Siena	0.430		Reggio Calabria	2.510
TA	Bolzano	1.100		Grosseto	0.570	SI	Trapani	1.788
	Trento	0.522	UM	Perugia	0.422		Palermo	1.419
VE	Verona	0.703		Terni	0.824		Messina	1.485
	Vicenza	0.678	MA	Pesaro-Urbino	0.501		Agrigento	1.795
	Belluno	0.738		Ancona	1.022		Caltanissetta	3.676
	Treviso	0.789		Macerata	0.465		Enna	1.333
	Venice	0.918	Ascoli	0.986	Catania		1.628	
	Padova	0.955	LA	Viterbo	2.781		Ragusa	0.813
	Rovigo	1.301		Rieti	1.484		Syracuse	1.893
FR	Udine	0.787	Rome	1.607	SA	Sassari	1.437	
	Gorizia	1.320	Latina	0.943		Nuoro	1.123	
	Trieste	3.280	Frosinone	1.125		Cagliari	1.598	
LI	Imperia	1.549	AB	L'aquila	0.803			
	Savona	1.279		Teramo	0.811			
	Genoa	1.823		Pescara	1.517			
	La Spezia	1.964		Chieti	1.108			

Notes:

For regional abbreviations, see Appendix A.

Normalization of the index: median is equal to 1.

Values above the median (greater than 1) are reported in bold.

Only 95 provinces are included. The eight additional provinces created in 1995 are not included due to lack of data.

The pre-1995 boundaries are used for the provinces.