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SCHOOL CHEATING AND SOCIAL CAPITAL

by Marco Paccagnella* and Paolo Sestito†

Abstract

In this paper we propose and validate cheating in standardized tests as a new indirect measure of social capital. Given the low-stakes nature of most of the tests examined here, we interpret the widespread presence of cheating as a signal of limited trust in central education authorities. Cheating is negatively correlated with several social capital proxies in the local environment where a school is located (the municipality or the province), even controlling for area-wide differences in social capital and for a number of features of the local environment. When distinguishing between different kinds of social capital – contrasting *universalistic* and *particularistic* social values (along the lines of de Blasio, Scalise and Sestito, forthcoming) – cheating appears to be negatively correlated only with measures of universalistic social values (while the correlation of cheating with particularistic social values, if any, is positive). We also document a number of empirical regularities in cheating behavior: (i) within classes student homogeneity is associated with higher cheating (Lucifora and Tonello, 2012); (ii) the presence of external inspectors greatly reduces cheating (Bertoni, Brunello and Rocco, 2013), and to a greater extent in low social capital environments; (iii) in primary schools, cheating is more pervasive in smaller classes; (iv) and a larger share of "local" teachers, or of teachers with a permanent contract, is generally associated with higher levels of cheating.

JEL Classification: I28, D73, Z10.
Keywords: cheating, social capital.

Contents

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† Bank of Italy, Economics, Statistics and Research.

1 Introduction*

A vast literature in the social sciences has documented the relationship between social capital and social and economic outcomes, and Italy has been a widely explored case since at least Banfield (1958) and Putnam (1993).

Social capital remains, however, a rather vague concept, with the same term being used by different disciplines with different meanings. Consequently, the measurement of social capital poses relevant challenges. Guiso, Sapienza, and Zingales (2011) provide a thorough review of this debate; more importantly, they also propose a definition of social capital (which they actually call *civic capital*) that is very well suited to be incorporated in standard economic models and used for the empirical analysis of economic phenomena. In their words, social (civic) capital refers to

> *those persistent and shared beliefs and values that help a group overcome the free rider problem in the pursuit of socially valuable activities.*

According to this definition, social capital has a clearly positive aggregate economic payoff. This is not necessarily the case of other definitions of social capital, such as those (more common in the sociological literature) referring to the advantages and opportunities accruing to people through membership in certain networks or communities. According to Bourdieu (1986), social capital is "the aggregate of the actual or potential resources which are linked to the possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition", while Coleman (1990) sees social capital as the "set of relationships that support effective norms". A relevant distinction here is between "bridging" and "bonding" social capital (Beugelsdijk and Smulders, 2003; Putnam, 2000): the former should favor interactions among people linked by weak ties, while the latter captures the existence of strong ties within narrowly defined groups. Under these network-based definitions, social capital lack any ethical or moral characterization: it is relatively easy to think of closed and tight networks that, while benefitting their members, are clearly detrimental for the society at large (Portes, 1988).[1] A related distinction is the one between "universalistic" and "particularistic" social values (Sestito, 2011), cutting across both the network-based and the values-related dimensions of social capital, which we will exploit in the empirical analysis, borrowing from de Blasio, Scalise, and Sestito (2014). Finally, political scientists like Putnam (1993) and Fukuyama (1995) identify social capital with "civic virtues", like the degree of spontaneous cooperation and obedience to

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[1] Although Satyanath, Voigtländer, and Voth (2013) show that membership in both "bridging" and "bonding" associations positively predict entry in the Nazi Party.

law. This definition is ambiguous, because such behaviors could in principle be driven by other factors, like economic payoffs or legal enforcement.

All these definitorial issues have clearly a bearing on the operationalization of the concept of social capital. Guiso, Sapienza, and Zingales (2011) distinguish between *direct* and *indirect* measures. The former are tipically collected through either surveys or field experiments, with the purpose to measure (or infer) the actual values and beliefs people are endowed with, while the latter are tipically outcome-based, measuring actual people's behavior. Survey measures of values are tipically criticized as being subject to confirmatory or social-desirability biases: respondents have no incentives to report their true values, and reported values may be biased towards what is deemed as socially acceptable. Beliefs relevant to economics transactions (like trust) are more precisely measurable, since they can be given a very specific probabilistic content. However, there may be doubts about how people interpret the trust questions. Furthermore, Fehr (2009) argues that such measures might be partly picking up individual preferences, rather than actual beliefs, a fact emprically confirmed for Italy by Albanese, de Blasio, and Sestito (2013).

Values and beliefs can also be measured through controlled laboratory experiments (Camerer and Fehr, 2004). Experimental measures of values can be made incentive compatible, by providing participants with appropriate monetary incentives. Coming to beliefs, the trust game (Berg, Dickhaut, and McCabe, 1995) is now a routine tool to obtain easily interpretable measures of trust. However, it is very difficult (or very costly) to run experiments on representative samples of the population. Furthermore, subjects' behavior in the lab might be distorted by the so-called "experimenter effect" (Levitt and List, 2007), and Sapienza, Toldra, and Zingales (2007) argue that the sender behavior in the trust game is not a good measure of trust beliefs, being affected by other-regarding preferences.

Indirect (outcome-based) measures can be difficult to interpret: ideally, one would like to isolate the "spontaneous" component of law abidance. Good indirect measures are those for which the relationship between input (social capital) and the measured output is stable and unaffected by other factors, such as legal enforcement. Widely used measures that in principle satisfy these properties are blood (or organ) donations and (partly) voter turnout.

In this paper we propose and validate (by showing it is positively correlated to traditional and commonly used indicators of social capital) a new *indirect* measure, namely cheating in standardized tests, as measured by the Italian National Education Authority (Invalsi).[2] Figure 1 provides suggestive evidence about the existence of a negative correlation in Italian municipalities between cheating and social capital (proxied here by average electoral turnout). In the figure, the usual North-South divide is apparent, as well as ample within-regions variability.

The rationale for our exercise is that the tests we are examining are mostly low-stakes for both students and teachers and schools. Students' career (progression to subsequent grades) is

[2]More details on the estimates of cheating produced by Invalsi are provided in Section 2.1.1.

not affected by such tests,[3] and individual test scores are not released to anybody; no personnel decisions (like teachers' promotions or salary increases) are taken on their basis, not even within individual schools, given the very limited powers of school principals;[4] no school league tables are produced and made public, although schools' principals might decide (on a voluntary basis) to publish the aggregate results of their schools. For such reasons, we find it natural to interpret cheating as indicator of low trust towards the central education authorities[5] and as a lack of acceptance of the rule of law. Under these respects, our work is similar in spirit to Fisman and Miguel (2007), who show that parking violations by U.N. diplomats (protected by diplomatic immunity) are strongly related to the degree of corruption of their country of origin.[6]

While the negative correlation between cheating and social capital may be rooted into a structural mechanism according to which parents' social capital affects kids' behavior and/or schools functioning, we are not capable to identify such a structural mechanism. We consider traditional measures of social capital in the local environment and classroom-level measures of cheating, with no possibility to analyze the beahaviour of individual students and their family background. More importantly, cheating in Invalsi tests is jointly determined by students' and teachers' behavior (at least in terms of teachers' forbearance) and we are unable to tell these two components apart. While we control for some elements related to each of them, such an exercise has to be interpreted as a robustness check for the basic correlation between cheating and social capital in the local environment, which is the main objective of the paper - we therefore refrain from any explicit causal interpretation of our results.

Rather, we stress the fact that our results provide for a validation of the possible use of measures of cheating as a finely grained additional measure of social capital. Other than satisfying what Guiso, Sapienza, and Zingales (2011) indicate as good properties of an indirect measure of civic capital, cheating has the advantage of being measured each year for each individual classroom within each of the over 5,000 Italian primary and lower-secondary schools. Future releases of data linking individual classrooms (and students) over time will in principle allow to investigate the evolution of social capital over time, as well as the effects that being exposed to "low-social capital" environments in childood might potentially have on future adult outcomes and behaviors.

Our paper speaks to at least three different strands of the literature. First, we add to the literature about the measurement of social capital, proposing and validating a new and potentially very useful indicator, that is consistent with the definition of civic capital given by

[3]Tests are high-stakes only in the 8th grade, where they contribute to the national lower-secondary school leaving exam. All togheter, they account for about 1/6 of the total mark.

[4]At most, principals can decide to change the allocation of teachers to classes within the same school.

[5]Teachers' unions fiercely oppose the administration of such tests, arguing that they represent very poor indicators of schools' or teachers' performance: therefore, their eventual usage in order to inform personnel decisions and the allocation of resources between schools would lead to severe misallocations of resources and to unjust punishments or rewards.

[6]Interestingly, when enforcement authorities acquired the right to confiscate diplomatic license plates of violators, unpaid violations dropped sharply. This is consistent with the fact that, in classes randomly monitored by an external observer sent by Invalsi, cheating is virtually absent.

Guiso, Sapienza, and Zingales (2011). Under this respect, we also show how different measures of social capital can capture very different concepts. Consistent with the idea that from the definition of civic capital are purposefully excluded those values that favor cooperation in too-narrowly defined networks (thus potentially harming society at large), we find that cheating is *positively* related to measures of *particularistic* (as opposed to *universalistic*) social values recently proposed by de Blasio, Scalise, and Sestito (2014).

Second, our paper also informs the literature on the formation and transmission of social capital. While the literature has traditionally focused upon the role of the family as the main channel for social capital transmission (Bisin and Verdier, 2001; Guiso, Sapienza, and Zingales, 2007; Tabellini, 2008), more recent studies have highlighted the importance of schools. Under this respect, the school system constitutes a very interesting setting to study, because of its peculiar role in fostering both cognitive skills and non-cognitive skills, as well as transmitting values, norms, and beliefs. Our results suggest (as in Durante, Labartino, and Perotti, 2011) that the functioning of the school system is affected by the amount of social capital present in the local area.[7] Although we are not able to directly investigate the transmission of values, norms and beliefs,[8] the higher incidence of opportunistic behavior in areas with lower endowments of social capital suggests that the school system is somehow failing in transmitting more appropriate norms of behavior, at least to the extent that cheating is a teacher-induced phenomenon (an issue that will be discussed in more details in section 3.1).

Finally, although being not particularly sophisticated, our analysis is still potentially interesting for the burgeoning literature that is trying to construct measures of schools' and teachers' performances: cheating behavior obviously constitute a serious threat to the construction of such measures, calling for a better understanding of its causes and effects (Bertoni, Brunello, and Rocco, 2013; Ferrer-Esteban, 2012; Jacob and Levitt, 2003; Lucifora and Tonello, 2012).

The rest of the paper is organized as follows. In Section 2 we describe in more detail the institutional setting and the various data sources used in the study. In Section 3 we describe the empirical model and present the main estimation results. In Section 4 we perform some robustness checks and some extensions of our main results. Section 5 concludes.

2 Data and Institutional Setting

2.1 Invalsi Survey of Students' Assessment

The main data source for this study is the 2009/10 wave of the National Survey of Students' Assessment (SNV) conducted by Invalsi. The available data contain information on the individual answers to each item of the tests administered to 2nd, 5th, 6th and 8th graders. Tests in

[7] Actually, the very first use of the term "social capital" can be found in Hanifan (1916), a sociological analysis of the impact of parents' involvement into schools' life upon schools' performance.

[8] Future releases of data following individuals over time and grades will eventually allow to study the evolution of social capital.

Mathematics and Italian Language took place in May, in two different days. Tests administration and marking was carried out by school teachers, who should (in principle) have followed a strict Protocol set by Invalsi (see Invalsi 2010a,b for more details). The tests were not to be administered by the class teacher herself, but by a different teacher (of the same school) specialized in a different subject; marking was to be jointly done by all school teachers simultaneously, with the school principal supervising the entire process. The Protocol entailed also the use of external inspectors, sent to a randomly selected sample of schools (and then to some classes within the selected schools), with the goal of invigilating students during the test, provide information and support on the test administration, compute test scores and send back results and documentation to Invalsi.[9] Other than test scores, the data contain a wealth of informations on students' socio-economic characteristics, like gender, citizenship (Italian, first generation immigrant, second generation immigrant), parental occupation and education, school mid-year marks. For 5th and 6th graders, an index of economic social and cultural status (ESCS) can be computed, by aggregating information on parental education, parental wealth and home educational resources. With the exception of 8th graders (who sat the tests in the context of their final junior-high school exams, with the tests partly contributing to their lower-secondary school leaving mark), the test is low-stakes for all students, since it does not affect in any way their school career.

2.1.1 Measuring cheating

The crucial piece of information is the measure of cheating produced by Invalsi. Cheating is detected following the procedure described in Castellano, Quintano, and Longobardi (2009),[10] who applied this method to the 2004/05 and 2005/06 waves of the Invalsi surveys.[11] Classroom-level cheating is identified on the basis of "anomalous" results, i.e. of scores which are jointly: (i) high on average; (ii) with a low internal variance across students; (iii) with a low share of questions left blank by respondents; (iv) with a similar pattern of responses to each individual item of the questionnaire (considering also the multiple nature of wrong answers) across all students in the class.

For each class, the procedure computes four indexes: (i) class mean score p_j; (ii) class standard deviation of scores σ_j; (iii) class index of answers homogeneity $\overline{E}_j$; (iv) class non-response rate MC_j. The computation of p_j and σ_j is straightforward. The index of answer homogeneity is the mean of Gini indexes computed at the item level:

$$\overline{E}_j = \frac{\sum_{s=1}^{Q} E_{sj}}{Q} \quad (1)$$

[9] Bertoni, Brunello, and Rocco (2013) and Lucifora and Tonello (2012) explicitly exploit this "natural experiment".

[10] This section borrows heavily from their paper.

[11] The same method was applied to the following waves, including the 2009/10 that we use.

where the numerator E_{sj} is a Gini measure of homogeneity, computed for each s^{th} test question administered to each student of the j^{th} class:

$$E_{sj} = 1 - \sum_{t=1}^{H_s} \left(\frac{n_{tjs}}{N_j} \right)^2 \tag{2}$$

Q denotes the number of items administered to the j^{th} class, while n_t/N_j is the relative frequency of students in the j^{th} class that gave the t^{th} answer to the s^{th} question. The index of answer homogeneity is equal to zero when all students of the j^{th} class give the same answer to *all* the items of the questionnaire, and is equal to $(H_s - 1)/H_s$ when answer heterogeneity is maximized (H_s is the number of possible alternative answers to question s).

The class non-response rate is computed as

$$MC_j = \frac{\sum_{k=1}^{N_j} M_{kj}}{N_j Q} \tag{3}$$

where M_{kj} denotes the number of invalid or blank answers for the k^{th} student in the j^{th} class. MC_j is equal to 0 when there are no missing or invalid responses in the j^{th} class and is equal to 1 when all students in the j^{th} class give only missing or invalid answers.

Next, the procedure extracts two principal components from the four indexes just described. In the original paper by Castellano, Quintano, and Longobardi (2009) (which refers to school years 2004/05 and 2005/06), the first two components accounted for 92% of the total variance. The first component displayed a high negative correlated with class mean scores and a high positive correlation with the two indicators of variability (standard deviation and answer homogeneity), and could thus be interpreted as capturing the degree of cheating; the second component was positively correlated with class non-response rate, and could therefore be interpreted as an index of "class collaboration".

A fuzzy classification approach (the *fuzzy k-means*, developed by Bezdek, 1981 and Dunn, 1974) is then used to identify clusters of outlier classes.[12] The final output of the *fuzzy k-means* algorithm is a matrix that reports, for each class, the degree of membership to each cluster: this procedure is therefore meant to go beyond the traditional approach that classifies each unit in a dichotomous way as either outlier or not (hard clustering), thus allowing to compute a continuous measure of the degree of belonging to suspicious clusters, that can be interpreted as a measure of cheating probability.

Suspicious clusters are identified by projecting the centroids on the factorial axes and applying the principal component interpretation: the suspicious centroid, in particular, is characterized by a negative value of the first component (and thus by high average score, high homogeneity, and low variability), and by a low value of the second component (and thus by a low number of missing responses).

Finally, calling the outlier cluster a, the degree of membership of class j to cluster a is u_{aj},

[12] See the Appendix for more details on the *fuzzy k-means* algorithm.

which varies between 0 and 1 and can be interpreted as a measure of “cheating probability” for class j. A correction factor $w_j = 1 - u_{aj}$ can be used to weight the average score of class j: Invalsi use this index to adjust test results of class j.

Ferrer-Esteban (2012) has proposed an alternative method to identify cheating behavior, based upon a more direct inspection of the data but implemented only for a few classes. When comparing the results of the two approaches, it emerges that both may suffer from the presence of “false positives”.[13] On average, the absence of systematic bias in the procedure traditionally used by Invalsi has been shown both by Tonello (2013) - who shows that adjusting test scores using the Invalsi procedure eliminates systematic differences in average scores between monitored and non-monitored classes - and by the original work of Castellano, Quintano, and Longobardi (2009), who focused upon the population distribution of results gross and net of the correction.

From the perspective of the present paper, the presence of false positives (as well as false negatives) has the only effect of reducing the precision of the estimates, as it is equivalent to measurement error in the dependent variable. In our empirical analysis we will use $c_j = 1 - w_j$ as a class-level measure of cheating intensity.

2.2 Social Capital

Given that the main purpose of the paper is to “validate” school cheating as a proxy for social capital, we use a number of traditional measures. In the attempt to exploit the very thin geographical disaggregation of Invalsi data, for our baseline estimates we proxy social capital using average turnout at national elections held from 1946 to 2008. This is the only variable which is available at the level of municipalities.[14] For robustness reasons we also experiment with a number of other measures, routinely used in the vast literature that has studied social capital in the Italian context: electoral turnout at referenda (and at the 1974 referendum on divorce, in particular), blood donations, and a measure of trust from the World Value Surveys (see Guiso, Sapienza, and Zingales 2004, among others). In particular, turnout at referenda is usually thought to be a better proxy of social capital, because at referenda people are less likely to participate for reasons related to economic returns (a clear example of an issue lacking direct economic consequences is the referendum on divorce).

As already discussed, social capital is a rather vague concept. On the one hand, it can be seen as “civicness” (a set of values, norms and beliefs able to facilitate cooperation among in-

[13] Actually, Invalsi (which since 2012 has started to give back the results to each individual school both gross and net of the cheating estimates) is currently revising its procedure in order to reduce the possible incidence of false positives. The new procedure is iterative. The first step is the standard procedure just described. In the second step, the plausibility of the gross results (in terms of class averages and within-class variances) is verified by comparing them to what one could expect on the basis of a model whose parameters are estimated using the subsample of classes randomly selected to receive external inspectors and by verifying whether the within-class distribution of the gross results is correlated with the within-class distribution of the marks attributed by the teachers. The final cheating estimate is then obtained by combining the results of the two steps.

[14] In Italy there are currently 8,092 municipalities, 110 provinces and 20 regions.

dividuals); on the other hand, it can be measured as the density of social networks an individual belongs to, with this latter interpretation lacking, ex-ante, any ethical or moral characterization. A crucial feature of both concepts lies in the degree of particularism or universalism - of norms and values as well as of (active) participation in social, political or family networks. de Blasio, Scalise, and Sestito (2014), using Italian microdata from 2010, compute some proxies for the degree of particularism (generalism) across different dimensions of social capital - namely trust, civic awareness and participation into associations. We use the same methodology to compute proxies for universalistic and particularistic social capital using the 2009 wave of the Multipurpose Survey on Italian Households, conducted by the National Statistical Institute (Istat, 2010). The 2009 wave allows us to construct measures at the provincial level, but lacks questions on trust; therefore, we have to limit ourselves to the dimensions of civic awareness and participation into associations. Measures of generalistic social values are constructed from questions that identify social behavior aimed at the good of the society as a whole, and not restricted to traditional social structures like family, kinship, neighbourhood, and so on. Universalistic civic awareness is computed from the following question: "How often do you get information about politics?" (with possible answers: (1) daily, (2) a few days a week, (3) once a week, (4) a few times a month, (5) a few times a year, (6) never), recoded as a dummy variable equal to 1 if the individual gets information at least once a week.[15]. Universalistic social participation is a dummy variable equal to 1 if the individual reports to have financed an association in the last 12 months.[16]

Measures of particularistic social values are built through the use of the difference operator, using different questions to avoid spurious correlation. As for civic awareness, we measure how much individuals refer to family and friends versus general mass media as a mean of acquiring political information. The question asks "From which sources you get information about politics", with the following possible answers: (a) daily newspapers; (b) news broadcast on radio or TV; (c) internet; (d) family members, (e) friends, (f) colleagues.[17] Individuals answer yes or no to each item (a)-(f), and we construct our measure of particularistic civic awareness as $(d + e + f) - (a + b + c)$ (ranging from -3 to 3). As for social participation, we measure how much individuals participate in associations centered around people of the same kind (or the same social group) versus associations with more broadly defined goals and objectives. The questions ask whether the individual was an active member (=2), an inactive member (=1), or was not supporting (=0) the following types of associations: (a) Political parties; (b) Labour unions; (c) Professional; (d) Humanitarian; (e) Environmental; (f) Cultural

[15]In italian: ""Con che frequenza si informa dei fatti della politica italiana?" (1) Tutti i giorni, (2) Qualche volta alla settimana, (3) Una volta alla settimana, (4) Qualche volta al mese, (5) Qualche volta all'anno, (6) Mai.

[16]In italian: "Negli ultimi 12 mesi ha dato soldi ad una associazione?"

[17]Recoded from the original version in Italian: "In che modo si informa dei fatti della politica italiana? Attraverso (1) Radio, (2) Televisione, (3) Quotidiani, (4) Settimanali, (5) Altre riviste non settimanali, (6) Amici, (7) Parenti, (8) Conoscenti, (9) Colleghi di lavoro, (10) Incontri presso organizzazioni politiche, (11) Incontri presso organizzazioni sindacali". Answers (10) and (11) were dropped.

or recreational.[18] Our measure of particularistic social participation ranges from -6 to 6, and is computed as $(a+b+c)-(d+e+f)$. Descriptive statistics of the different measures of social capital are presented in Table 2.

2.3 Other Data

Finally, we collected two other sets of data, both from administrative sources. The first set of data refer to a wide range of geographic and socioeconomic characteristics of provinces and municipalities: average heights, a dummy for municipalities that are also provincial capitals, dummies for whether the municipality lies on the coast or in the mountainside, average size (both in terms of population and of surface), the share of women and of people below 15 years old and above 65 years old, and the unemployment rate (only available at the province level). The second set of data refer to features of the schools and classes examined by Invalsi. From the administrative archives of the Ministry of Education we were able to collect informations on the number of students enrolled at the beginning of the school year in each class. This is a different measure of class size than the one obtained by simply measuring the number of test takers: some pupils could have been absent on the day of the test, and there are reasons to suspect that, in some cases, such absences were somehow strategic. Next, for a subsample of schools, we were able to collect information on teachers' characteristics. In particular, we know the share of teachers *in the school* that were born in a different region, province or municipality, and the share of teachers with a temporary contract (the same data were used in Barbieri, Rossetti, and Sestito (2011)). Controlling for such teachers' characteristics could inform about the degree to which cheating is a teacher-induced phenomenon.

3 Empirical Analysis

In this section we present our baseline results, documenting a negative association between cheating and social capital.

We estimate the following linear regression:[19]

$$c_{jm} = \alpha + \beta TURN_m + \gamma X_j + \varphi C_m + \lambda math + \epsilon_j \tag{4}$$

where c_{jm} is a measure of cheating in class j in municipality m, $TURN_m$ is a measure of social capital in municipality m (average electoral turnout between 1946 and 2008), X_j and

[18] In Italian: "E' iscritto a: (1) partiti politici, (2) Organizzazioni sindacali, (3) Associazioni o gruppi di volontariato, (4) Associazioni ecologiche, per i diritti civili, per la pace, (5) Associazioni culturali, ricreative o di altro tipo, (6) Associazioni professionali o di categoria". The second question asks whether, in the last 12 months, the individual has actively participated in the associations listed above.

[19] We also tried two alternative specifications: separate regressions for each subject and a system of seemingly unrelated regressions (SURE). Unsurprisingly, the results do not change significantly, and are available from the authors upon request.

C_m are, respectively, vectors of controls at the class and municipality levels and $math$ is a dummy for tests in mathematics. Standard errors are clustered at the municipality level and observations are weighted by class size.

The vector C_m includes municipalities' characteristics like population, area, elevation, share of females, share of inhabitants below 15 and above 65 years, dummies for whether the municipality is the provincial capital and for whether it lies on the seaside or in the mountainside. We also include four macro-region dummies, to control for deeper cultural differences between different parts of the country[20] and (in an alternative specification), 20 region dummies.

The variables in the vector X_j are measured at the class level and deserve a few comments, before jumping to the results.

The first obvious set of controls are dummies for whether an external examiner was present in the class or in the school. Bertoni, Brunello, and Rocco (2013) show that the presence of an external observer is an effective way to reduce cheating not only in the monitored class, but also in other classes of the same school. We therefore include a dummy for monitored classes and a dummy for unmonitored classes in monitored schools.

Second, we would like to control for class composition and students' characteristics. The relevant dimension to look at, in this context, is class heterogeneity. Lucifora and Tonello (2012) stress the importance of social interactions and show that spillover effects are larger in classes that are more homogeneus in terms of social ties and socio-economic background. For this reason we include in the regression two indices of fractionalization, related to immigrant status (Italian, first and second generation immigrants) and (quartiles of) ESCS.[21] It is reasonable to assume that in more fractionalized classes cooperation among students is more difficult. The fractionalization index is an easy to compute transformation of the Herfindal concentration index applied to population shares, and measures the probability that two randomly drawn individuals from the overall population belong to different groups (pre-defined, in our case, in terms of citizenship and socio-economic status; see Bossert, D'Ambrosio, and La Ferrara, 2011 and Vigdor, 2002). Formally, the fractionalization index is computed as

$$F(p) = 1 - \sum_{k=1}^{K} p_k^2$$

where $p = (p_1, ..., p_k) \in \Delta^K$ are the population shares for the K pre-defined groups.

Another important dimension to look at is past school performance and students' ability. The tricky aspect here is that we do not have an independent measure of students' ability. We have information on end-of-term school marks,[22] but these are assigned by class teachers: they

[20] Italy is routinely divided in four macro-regions: North-West, North-East, Center, South and Islands.

[21] We also experimented with fractionalization indices based on father's education and occupation, obtaining similar results.

[22] Marks are measured on a scale from 1 to 10, and are usually given at the end of term as a syntethic measure

are certainly not robustly comparable across different classes and schools, and they might be biased or inflated. Our strategy is to rely on the random allocation of external examiners to obtain reliable measures of students' test scores. We compute predicted test scores as the fitted values of a regression (run on the subsample of classes with external observer) of test scores on students' observable characteristics (gender, citizenship, ESCS). Then we standardize both such predictions and students' end-of-term marks and we compute the difference between the two. This is meant to be a measure of students' over (or under) evaluation by teachers. Such measures can be relevant for cheating behavior, since teachers could have more incentives to help students with inflated school marks, either because of reputational concerns or for the same desire to help their pupils that led them to inflate marks in the first place.[23]

Finally, we include measures of class composition (in terms of females and italians) and class size. As discussed in section 2, we use administrative class size. However, we also tried with *actual* class size (that is, attendance in the day of the test), and the results are virtually unchanged.

3.1 Cheating and Voter Turnout

Our baseline results are reported in tables 3 (for primary schools) and 4 (for lower-secondary schools).

The regression results robustly point towards a negative relationship between cheating and social capital. Even in the most data-demanding specification (the one which control for regional dummies, in which we only exploit the within-region variation in social capital), the coefficient associated to social capital is negative and statistically different from zero. To give an idea of the magnitude of the effect, in the 5th grade an increase in voter turnout of 1 standard deviation (roughly 7 percentage point) is associated with a reduction of 4 to 5% of a standard deviation in cheating. As expected, monitoring strongly reduces cheating behavior, as well as the degree of fractionalization. On the contrary, classes in which school marks are higher (relative to test scores) tend to be more prone to cheating. Finally, notice that the relationship between cheating and class size is negative in primary schools (a result consistent with Angrist, Battistin, and Vuri, 2013) and positive in lower-secondary school, particularly in 8th grade. This is consistent with the idea that in 8th grade cheating is likely to be mainly a student-lead phenomenon, given that 8th grade tests are high-stakes for students. In such a setting, it is reasonable to think that larger classes are more difficult to monitor, and it is therefore easier for students to cheat. On the other hand, in primary schools cheating is more likely to be teacher-driven: in such setting, smaller classes are easier for teachers to control, particularly if cheating takes place in the post-test phase, when teachers have to mark the answer sheets before giving

of student performance. Terms may span either a quarter or a semester, depending on the school.

[23]We also construct a more crude measure of over/under evaluation, which is the simple difference between average marks in the class and average marks in the entire schools. The results are virtually unchanged and are available from the authors upon request.

them back to Invalsi.

The relationship between cheating and social capital is apparently less robust for 6th graders. However, there are a number of reasons why 6th graders are a bit different. First of all, cheating is less precisely estimated in 6th grade: on the basis of the comparison between the gross results of classes with and without external inspectors, the average amount of cheating is much lower on average and more related to idiosyncratic factors. Second, in the Italian educational system 6th grade marks the beginning of lower-secondary school: children change school, classmates, and teachers; the number of teachers per class also increases substantially compared to primary school. All these factors create a class environment in which cooperation is much more difficult and in which teachers are less likely to shield their pupils from external tests, both because they are less likely to feel responsible for pupils' performance[24] and because pupils are now "grown-ups" (certainly much older than 2nd graders). Finally, the results presented in table 4 mask a large heterogeneity between cheating during tests in Italian and Mathematics (a phenomenon that is not present in other grades). Social capital seems to be uncorrelated with cheating in Italian tests, while the correlation with tests in Mathematics is much stronger and more robust, similar to the one observed in other grades. Actually, given that cheating in Mathematics in 6th grade has also a significantly lower standard deviation (see table 1), the impact of social capital on cheating in Mathematics for 6th graders would be even larger than the one observed in other grades. For these reasons, in the rest of the paper the main focus of our empirical analysis will be on primary schools, in particular on 5th graders, for which we have the most complete set of information (for 2nd graders we cannot compute the Index of Economic, Social and Cultural Status).

3.2 Alternative measures of Social Capital

An obvious robustness check consists in using different measures of social capital. In particular, it is interesting to see which dimensions of social capital is more strongly correlated to cheating behavior.

Alternative measures routinely used in the literature are unfortunately only available at the provincial level.

Table 5 shows, for 5th graders only,[25] the results of a number of regressions (analogous to equation 4) in which the following measures of social capital are employed: turnout at national elections, turnout at all referenda, turnout at the divorce referendum, blood donations, a measure of trust from the World Value Survey. Province-level controls include the variables previously used at the municipality level, the number of municipalities in the province and the

[24]Invalsi is actually envisaging to exploit such a fact by moving towards a system in which 5th and 6th grade tests are "unified", conducting a test at the very beginning of 6th grade, to get an overall measure of learning accomplishment in primary school. See `http://banner.orizzontescuola.it/Rilevazione_apprendimenti_as_2013_2014.pdf`.

[25]Results for other graders are available upon request and are consistent with what shown previously.

unemployment rate in 2009. The empirical results lend support to the hypothesis that cheating and social capital are negatively correlated. In particular, consistently with the idea that voter turnout at referenda is a better proxy of social capital, its impact on cheating is much larger than what we found when looking at turnout in national elections: an increase of 1 standard deviation of turnut at referenda (7 to 8 percentage points) translates into a reduction of more than 20% of a standard deviation of the cheating indicator.

Finally, we can look at possible differential effects of universalistic and particularistic social values, building on the measures estimated by de Blasio, Scalise, and Sestito (2014), as explained in Section 2.2, and as discussed in the Introduction.

Table 6 shows the results of a number of regressions, analogous to equation 4, in which we proxy social capital by means of universalistic and particularistic measures of social values. At least for measures of civic awareness, the results tend to confirm our hypothesis that universalistic social values are negatively correlated with cheating, while particularistic social values, being a sign of (too) strong cooperative behavior that can results in collusion and "amoral familism" (Banfield, 1958), are (if anything) positively correlated with cheating.

4 Extensions

4.1 Teachers' characteristics

In this subsection we extend the specification of equation 4 trying to account for teachers' characteristics.

For a subsample of schools we were able to collect information (unfortunately, only available at the school level) on teachers' birthplace and teachers' contract. Presumably, teachers born in a different municipality share less linkages with students, and are thus less prone to help them cheat. Similarly, teachers with a temporary contract share weaker ties with their pupils, are less prone to help and protect them and are less likely to think that they will be blamed for pupils' poor performance during the test. Based on these considerations, we expect that the presence of teachers born in a different municipality or with a temporary contract tend to discourage cheating behavior.

We therefore estimate the following equation:

$$c_{jms} = \alpha + \beta TURN_m + \gamma X_{js} + \delta T_s + \varphi C_m + \lambda math + \epsilon_{jms} \tag{5}$$

where T_s is the share of teachers in school s either born in a different municipality (with respect to the municipality in which the school is located) or with a temporary contract.

Results are presented in table 7 and clearly confirm our hypothesis.

4.2 Interaction effects

Our baseline estimates show that both monitoring and social capital may help in reducing cheating. It is therefore interesting to look at possible interaction effects between the two.

We thus estimate the following equation:

$$c_{jm} = \alpha + \beta TURN_{mq} + \delta MON_j + \chi MON_j * TURN_{mq} + \gamma X_j + \varphi C_m + \epsilon_j \quad (6)$$

where $TURN_{mq}$ are dummies for whether social capital in municipality m is in the qth quartile of the national distribution and MON_j is a dummy indicating whether class j was monitored during the test by an external observer.

Results are presented in table 8.

Given that the excluded category includes municipalities with the highest levels of social capital, the coefficients associated with the other quartiles are positive and decreasing in q. The effect of monitoring appears to be stronger at lowest levels of social capital, suggesting substitutability between monitoring and social capital. A possible policy implication of such finding is that it would be cost-effective to concentrate monitoring in low-social capital areas.

5 Conclusions

In this paper we have tried to contribute to three different strands of the literature.

First of all, we have proposed a new measure of social capital, namely cheating in standardized tests administered to primary and lower-secondary students in Italy. The Italian case is an interesting one. Standardized tests are low stakes, yielding no practical consequences on the careers of students, teachers or school principals; yet, since their introduction they faced fierce opposition, that can be rationalized only as a sign of low levels of trust towards the centralized authority administering the tests and as lack of adherence to the rule of law - in other words, as a lack of civic capital, as defined by Guiso, Sapienza, and Zingales (2011). In particular, we show that cheating is negatively related to measures of universalistic values, while being positively associated to measures of particularistic values (de Blasio, Scalise, and Sestito, 2014). We also show that social capital can partly act as a substitute for the presence of an external monitor. A policy implication of such finding is that it would be cost-effective to concentrate (costly) monitoring in low-social capital areas.

Second, we have highlighted how the school system could be failing in transmitting more appropriate norms of social behavior, as long as cheating can be interpreted as a teacher-induced phenomenon.

Finally, we added to the rapidly growing literature that, starting from the seminal contribution of Jacob and Levitt (2003), analyzes cheating behavior in standardized tests; in particular, a number of recent papers have focused on the Italian context, given the availability of very rich data (Angrist, Battistin, and Vuri, 2013; Bertoni, Brunello, and Rocco, 2013; Ferrer-Esteban, 2012; Lucifora and Tonello, 2012; Newman, 2012). We confirm results from previous studies that have investigated the determinants of cheating behavior: in particular, we find that cheating is less common in more fractionalized classes, and is more common in classes in which official marks are more inflated. Furthermore, we found that cheating is negatively associated to class size in primary school, while it is positively associated to class size in 8th grade. Given that in 8th grade tests are high-stakes for the students involved, this lends suggestive evidence in favor of the hypothesis that, in 8th grade, cheating is mainly driven by students' behavior (in this scenario, larger classes are clearly more difficult for the teachers to monitor), while in primary schools teachers' behavior is likely to be more relevant. This hypothesis is partly confirmed by the empirical specifications that control for teachers' characteristics like the municipality of origin or the type of contract.

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Figures

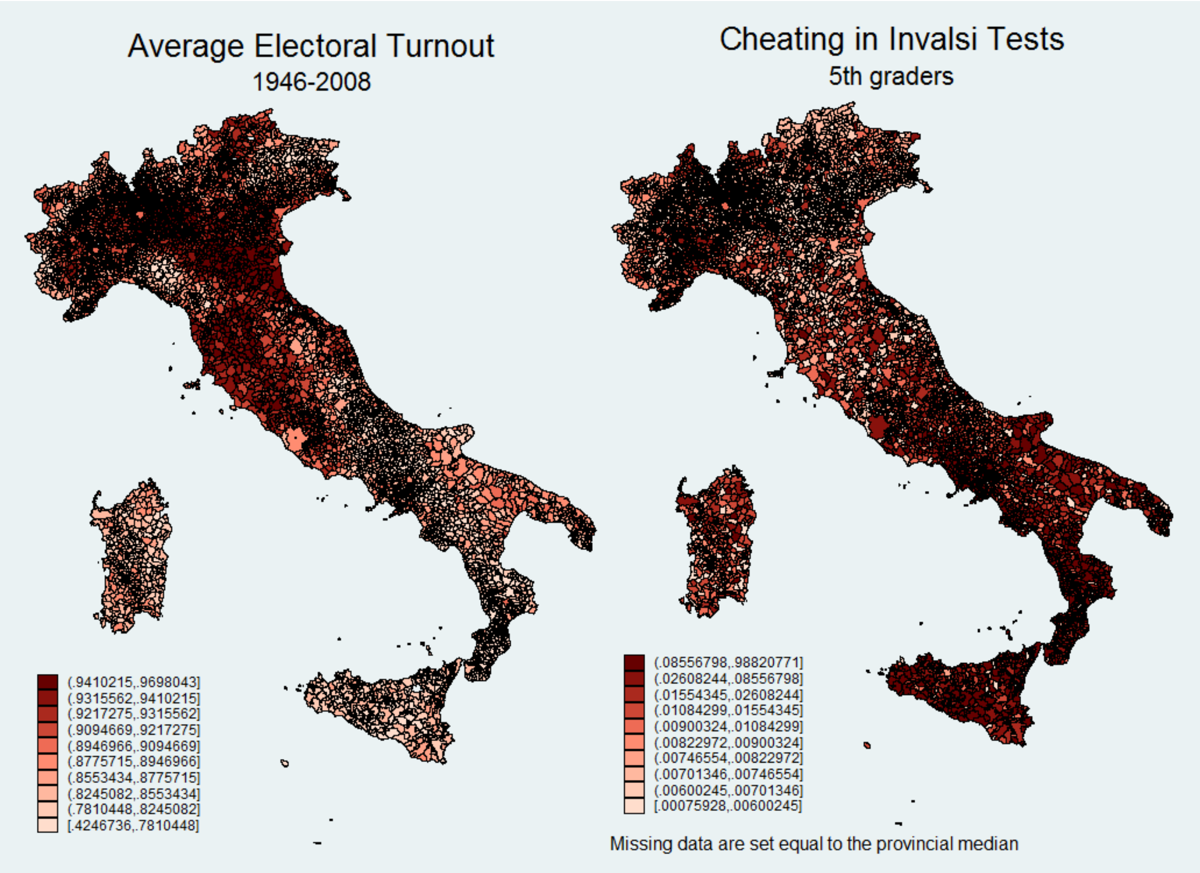

Figure 1: Cheating and social capital

Tables

Table 1: Students' Descriptive Statistics

	2nd grade		5th grade		6th grade		8th grade	
	Italian	Math.	Italian	Math.	Italian	Math.	Italian	Math.
Cheating	0.064	0.074	0.070	0.069	0.080	0.024	0.067	0.066
	(0.190)	(0.211)	(0.201)	(0.199)	(0.185)	(0.093)	(0.169)	(0.166)
School mark[a]	7.78	7.90	7.46	7.56	6.54	6.61	-	-
	(0.618)	(0.618)	(0.597)	(0.593)	(0.591)	(0.636)		
Raw test scores	65.73	62.61	69.84	64.89	60.85	51.47	64.65	55.66
	(13.00)	(14.13)	(10.31)	(12.27)	(7.41)	(9.11)	(8.79)	(10.36)
% Female	49.073	49.026	49.346	49.280	48.330	48.336	49.319	49.339
% Italian	90.893	90.816	91.036	90.942	90.027	90.014	92.813	92.838
No. Students	492,687	488,672	498,382	491,421	520,841	520,759	499,905	498,884
No. schools	7,558	7,554	7,542	7,541	5,825	5,824	5,733	5,734
No. classes	29,527	29,502	29,830	29,811	26,725	26,716	25,923	25,923
Avg. Class size	17.41		17.24		19.55		19.33	
	(5.348)		(5.435)		(4.490)		(4.530)	

[a] On a scale from 1 to 10.

Table 2: Descriptive Statistics - Social Capital

	Mean	Standard Deviation	1st quartile	3rd quartile
	Across Municipalities			
Turnout at national elections	87.54	6.72	84.20	92.67
	Across Provinces			
Turnout at national elections	88.74	4.53	85.84	92.42
Turnout at referenda	80.80	8.24	74.00	87.00
Turnout at divorce referendum	88.34	7.25	83.00	94.00
Blood Donations	0.029	0.022	0.010	0.046
Trust (WVS)	0.305	0.160	0.216	0.366
Universalistic Civic Awareness	0.395	0.086	0.331	0.453
Particularistic Civic Awareness	-0.779	0.174	-0.912	-0.654
Universalistic Social Participation	0.175	0.073	0.122	0.215
Particularistic Social Participation	-0.055	0.052	-0.087	-0.019

Table 3: Cheating and Social Capital in Primary Schools

	2nd grade			5th grade		
	[1]	[2]	[3]	[4]	[5]	[6]
Avg. turnout (1946-2008)	-0.006***	-0.003***	-0.001**	-0.005***	-0.002***	-0.001*
	[0.000]	[0.001]	[0.000]	[0.001]	[0.000]	[0.001]
School mark-Test Score[a]	0.013***	0.019***	0.025***	0.018***	0.019***	0.022**
	[0.003]	[0.003]	[0.003]	[0.002]	[0.002]	[0.002]
Monitored Class	-0.044***	-0.045***	-0.040***	-0.041***	-0.043***	-0.036***
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
Monitored School[b]	-0.019***	-0.019***	-0.014***	-0.018***	-0.018***	-0.012***
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
Ethnic Fractionalization	-0.092***	-0.048***	-0.040***	-0.099***	-0.044**	-0.029*
	[0.020]	[0.018]	[0.017]	[0.020]	[0.018]	[0.017]
ESCS Fractionalization	-	-	-	-0.029***	-0.027***	-0.025***
				[0.009]	[0.009]	[0.009]
Class size	-0.003***	-0.003***	-0.003***	-0.002***	-0.002***	-0.002***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Females	0.005	0.004	0.003	0.023***	0.025***	0.023***
	[0.008]	[0.008]	[0.008]	[0.009]	[0.009]	[0.008]
Italians	-0.025	0.015	0.032	-0.035	0.002	0.019
	[0.026]	[0.025]	[0.022]	[0.025]	[0.022]	[0.021]
Municipality characteristics	YES	YES	YES	YES	YES	YES
Macro-regions dummies	NO	YES	NO	NO	YES	NO
Region dummies	NO	NO	YES	NO	NO	YES
R squared	0.073	0.081	0.095	0.071	0.080	0.093
Observations	55,427	55,427	55,427	56,028	56,028	56,028

All regressions are weighted by the number of students in the class and include a dummy for tests on mathematics. Standard errors are clustered at the municipality level.

[a] Difference between standardized school mark and predicted test score

[b] Dummy equal to 1 for unmonitored classes in monitored schools.

Table 4: Cheating and Social Capital in Lower Secondary Schools

	6th grade			8th grade		
	[1]	[2]	[3]	[4]	[5]	[6]
Avg. turnout (1946-2008)	-0.000	-0.000	-0.000	-0.005***	-0.004***	-0.001***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
School mark-Test Score[a]	0.001	0.000	0.0002	-	-	-
	[0.002]	[0.002]	[0.002]			
Monitored Class	-0.012***	-0.012***	-0.010***	-0.014***	-0.043***	-0.008***
	[0.003]	[0.003]	[0.003]	[0.004]	[0.003]	[0.004]
Monitored School[b]	-0.001	-0.002	0.000	-0.000	-0.000	-0.000
	[0.002]	[0.002]	[0.002]	[0.003]	[0.003]	[0.003]
Ethnic Fractionalization	-0.135***	-0.141***	-0.140***	-0.112***	-0.086***	-0.088***
	[0.014]	[0.015]	[0.015]	[0.021]	[0.020]	[0.019]
ESCS Fractionalization	-0.089***	-0.090***	-0.087***	-	-	-
	[0.012]	[0.012]	[0.012]			
Class size	-0.001**	0.001**	-0.001***	0.001**	0.001**	0.001**
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Females	0.040***	0.040***	0.040***	0.060***	0.060***	0.058***
	[0.007]	[0.007]	[0.007]	[0.007]	[0.007]	[0.007]
Italians	-0.016	-0.020	-0.017	-0.049*	-0.033	-0.037
	[0.017]	[0.018]	[0.017]	[0.029]	[0.028]	[0.027]
Municipality characteristics	YES	YES	YES	YES	YES	YES
Macro-regions dummies	NO	YES	NO	NO	YES	NO
Region dummies	NO	NO	YES	NO	NO	YES
R squared	0.074	0.074	0.077	0.059	0.062	0.077
Observations	49,673	49,673	49,673	51,638	51,638	51,638

All regressions are weighted by the number of students in the class and include a dummy for tests on mathematics. Standard errors are clustered at the municipality level.

[a] Difference between standardized school mark and predicted test score

[b] Dummy equal to 1 for unmonitored classes in monitored schools.

Table 5: Alternative measures of Social Capital (5th graders)

	Turnout (national elections)	Turnout (all referenda)	Turnout (divorce referendum)	Blood Donations	Trust (WVS)
Social Capital	-0.002***	-0.005***	-0.006***	-0.265	-0.043**
	[0.001]	[0.001]	[0.001]	[0.197]	[0.024]
School mark-Test Score[a]	0.019***	0.019***	0.021***	0.019***	0.021***
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
Monitored Class	-0.042***	-0.042***	-0.042***	-0.042***	-0.040***
	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]
Monitored School[b]	-0.017***	-0.017***	-0.017***	-0.017***	-0.016***
	[0.004]	[0.003]	[0.003]	[0.003]	[0.003]
Ethnic Fractionalization	-0.039**	-0.032**	-0.040**	-0.037**	-0.032*
	[0.017]	[0.016]	[0.016]	[0.017]	[0.017]
ESCS Fractionalization	-0.025**	-0.025**	-0.027**	-0.027**	-0.025**
	[0.011]	[0.010]	[0.011]	[0.011]	[0.011]
Class size	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Females	0.024***	0.024**	0.024**	0.025***	0.022**
	[0.009]	[0.009]	[0.009]	[0.009]	[0.009]
Italians	0.004	0.006	0.001	0.005	0.013
	[0.021]	[0.019]	[0.019]	[0.021]	[0.020]
Macro-Regions Dummies	YES	YES	YES	YES	YES
Province characteristics	YES	YES	YES	YES	YES
Observations	56,056	55,646	55,484	55,646	49,936
R squared	0.082	0.087	0.089	0.081	0.083

All regressions are weighted by the number of students in the class and include a dummy for tests on mathematics. Standard errors are clustered at the provincial level.

[a] Difference between standardized school marks and predicted test score.

[b] Dummy equal to 1 for unmonitored classes in monitored schools.

Table 6: Universalistic and Particularistic Social Values (5th graders)

	Civic Awareness			Social Participation		
Universalistic	-0.232***	-	-0.210***	-0.242***	-	-0.239***
	[0.057]		[0.063]	[0.057]		[0.057]
Particularistic	-	0.081**	0.028	-	0.080	0.010
		[0.032]	[0.034]		[0.086]	[0.078]
School mark-Test Score[a]	0.020***	0.019***	0.019***	0.019***	0.019***	0.019***
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
Monitored Class	-0.040***	-0.040***	-0.040***	-0.040***	-0.041***	-0.040***
	[0.005]	[0.005]	[0.006]	[0.006]	[0.006]	[0.006]
Monitored School[b]	-0.016***	-0.016***	-0.015***	-0.016***	-0.017***	-0.016***
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
Ethnic Fractionalization	-0.035**	-0.039**	-0.035**	-0.037**	-0.039**	-0.037**
	[0.017]	[0.018]	[0.017]	[0.017]	[0.018]	[0.017]
ESCS Fractionalization	-0.026**	-0.027**	-0.026**	-0.028**	-0.027**	-0.028**
	[0.011]	[0.011]	[0.011]	[0.011]	[0.011]	[0.011]
Class size	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Females	0.024***	0.025***	0.024***	0.025***	0.025***	0.025***
	[0.009]	[0.008]	[0.009]	[0.009]	[0.009]	[0.009]
Italians	0.006	0.003	0.005	0.005	0.005	0.005
	[0.021]	[0.021]	[0.021]	[0.021]	[0.021]	[0.021]
Province characteristics	YES	YES	YES	YES	YES	YES
Macro-regions dummies	YES	YES	YES	YES	YES	YES
Observations	55,646	55,646	55,646	55,646	55,646	55,646
R-squared	0.082	0.082	0.084	0.084	0.081	0.084

All regressions are weighted by the number of students in the class and include a dummy for tests on mathematics. Standard errors are clustered at the provincial level.

[a] Difference between standardized school marks and predicted test score.

[b] Dummy equal to 1 for unmonitored classes in monitored schools.

Table 7: Social Capital and Teachers' characteristics in primary schools

	2nd graders		5th graders	
Avg. turnout (1946-2008)	-0.002**	-0.002***	-0.001*	-0.001*
	[0.001]	[0.001]	[0.000]	[0.000]
% Teachers born in diff. mun.[a]	-0.025**	-	-0.021*	-
	[0.012]		[0.012]	
% Teachers with temp. contract[a]	-	-0.051***	-	-0.036***
		[0.011]		[0.012]
School mark-Test Score[b]	0.018***	0.017***	0.024***	0.024***
	[0.003]	[0.003]	[0.002]	[0.003]
Monitored Class	-0.035***	-0.035***	-0.032***	-0.032***
	[0.003]	[0.003]	[0.003]	[0.003]
Monitored School[c]	-0.007**	-0.007**	-0.006**	-0.006**
	[0.003]	[0.003]	[0.003]	[0.003]
Ethnic Fractionalization	-0.036*	-0.033*	-0.020	-0.017
	[0.018]	[0.019]	[0.018]	[0.018]
ESCS Fractionalization	-	-		
	-0.018*	-0.018*		
	[0.010]	[0.010]		
Class size	-0.003***	-0.003***	-0.002***	-0.002***
	[0.000]	[0.000]	[0.000]	[0.000]
Females	0.015*	0.016*	0.020**	0.019**
	[0.009]	[0.009]	[0.010]	[0.010]
Italians	0.004	0.006	0.024	0.026
	[0.026]	[0.026]	[0.022]	[0.022]
Municipality characteristics	YES	YES	YES	YES
Regional dummies	YES	YES	YES	YES
R squared	0.082	0.082	0.088	0.088
Observations	47,500	47,500	48,097	48,097

All regressions are weighted by the number of students in the class and include a dummy for tests on mathematics. Standard errors are clustered at the municipal level.

[a] Measured at the school level.

[b] Difference between standardized school mark and predicted test score. For 8th graders, it is just the predicted test score, since we don't have information on school marks.

[c] Dummy equal to 1 for unmonitored classes in monitored schools.

Table 8: Social Capital and Monitoring - Interaction Effects

	2nd graders	5th graders
Avg. turnout - 1st quartile	0.025***	0.022***
	[0.007]	[0.008]
Avg. turnout - 2nd quartile	0.017***	0.018***
	[0.006]	[0.005]
Avg. turnout - 3rd quartile	0.001	0.001
	[0.006]	[0.002]
Monitored Class	-0.015***	-0.011***
	[0.002]	[0.002]
Monitored Class*1st quartile	-0.076***	-0.061***
	[0.007]	[0.007]
Monitored Class*2nd quartile	-0.032***	-0.035***
	[0.006]	[0.007]
Monitored Class*3rd quartile	-0.004	-0.008**
	[0.003]	[0.004]
School mark-Test Score[a]	0.025***	0.022***
	[0.003]	[0.002]
Monitored School[b]	-0.014***	-0.012***
	[0.003]	[0.003]
Ethnic Fractionalization	-0.041**	-0.030*
	[0.017]	[0.017]
ESCS Fractionalization	-	-0.026***
		[0.008]
Class size	-0.003***	-0.002***
	[0.000]	[0.000]
Females	0.0003	0.024***
	[0.008]	[0.009]
Italians	0.029	0.017
	[0.023]	[0.021]
Municipality characteristics	YES	YES
Regional dummies	YES	YES
R squared	0.097	0.094
Observations	55,539	56,140

All regressions are weighted by the number of students in the class and include a dummy for tests on mathematics. Standard errors are clustered at the municipal level.

[a] Difference between standardized school mark and predicted test score.

[b] Dummy equal to 1 for unmonitored classes in monitored schools.

Appendix

The Fuzzy K-Means Approach

The *fuzzy k-means* approach is a fuzzy version of the non-overlapping partition model *hard k-means*, based on the generalized fuzzy variance criterion:[26]

$$J_{FKM} = \sum_{i=1}^{c} \sum_{j=1}^{n} u_{ij}^{m} \left\| x_j - v_i \right\|^2 \tag{A-1}$$

where $u_{ij} \in [0,1]$ represents the degree of membership of object j in group i, $V = [v_1, v_2, ..., v_c]$, $v_i \in [\Re^n]$ is a vector of clusters centroids, and $\|x_j - v_i\|^2$ is the Euclidean norm between x_j and v_i. The following three conditions hold: (i) $\sum_{i=1}^{c} u_{ij} = 1$; (ii) $1 \leq j \leq n$; (iii) $1 \leq i \leq c$.

A weight m, with $1 \leq m \leq \inf$, named *fuzziness factor*, characterizes the approach. If $m = 1$, the procedure delivers a non-overlapping partition. As $m \rightarrow \inf$, the values for the degree of membership for each object (classes, in our specific application) tend to $1/c$. Pal and Bezdek (1995) argue that the fuzzy k-means tends to perform best with m in the range 1.5-2-5.

The cluster centroids and the respective membership functions that solve the minimization problem of the J_{FKM} function are, respectively:

$$v_i = \frac{\sum_{j=1}^{n} u_{ij}^{m} x_j}{\sum_{j=1}^{n} u_{ij}^{m}} \quad , 1 \leq i \leq c \tag{A-2}$$

and

$$u_{ij} = \left[\sum_{k=1}^{c} \left(\frac{\|x_j - v_i\|^2}{\|x_j - v_k\|^2} \right)^{1/(m-1)} \right]^{-1} \quad , 1 \leq i \leq c, 1 \leq j \leq n \tag{A-3}$$

The optimization of the classification strategy in divided in five steps:

1. Determinining the number of clusters c and the fuzziness parameter m;
2. Calculating the group centroids v_i, as in equation A-2;
3. Constructing a new fuzzy partition matrix using equation A-3. If an object j keeps a distance 0 from the centre of cluster i, the value of u_{ij} is set equal to 1 and the membership values of j towards the remaining clusters is set equal to 0;
4. Calculating the group centroids the group centroids associated to the partition determined in step 3 ;
5. If the improvement in J_{FKM} is less than a certain threshold (e), steps 3 and 4 are iterated.

A key stage of the whole procedure is the fuzzy clustering calibration, i.e. the choice of the fuzzy clustering parameters: the number of clusters (c) and the fuzziness level (m). The calibration strategy employed by Castellano, Quintano, and Longobardi (2009) consists of two steps: (i) the optimal number of clusters is established by computing some validity measures; (ii) m is determined by analyzing the sensitivity of the final results from the FKM algorithm (the correction weight assigned to each class) to variation in the level of fuzziness.

[26] This section borrows heavily from Castellano, Quintano, and Longobardi (2009).

The validity measures computed to assess th goodness of the fuzzy partitions and to obtain the optimum number of clusters are the *fuzziness performance index* (FPI), the *normalized classification entropy* (NCE), and the *separation index* (S). The values of these indices are calculated for m equals to 1.5, 2.0 and 2.5, in order to check if any difference exists in the general structure of the indices for different fuzziness parameters.

The FPI is defined as in Roubens (1982):

$$FPI = 1 - \frac{cPC}{c-1} \tag{A-4}$$

where PC is the partition coefficient proposed by Bezdek (1974) to measure the amount of overlap between clusters:

$$PC = \frac{1}{n}\sum_{i=1}^{c}\sum_{j=1}^{n} u_{ij}^2 \tag{A-5}$$

The NCE (Roubens, 1982) is defined as:

$$NCE = \frac{PE}{\log c} \tag{A-6}$$

where PE is the partition entropy (Bezdek, 1981):

$$PE = -\frac{1}{n}\sum_{i=1}^{c}\sum_{j=1}^{n} u_{ij}\log u_{ij} \tag{A-7}$$

The FPI and the MPE are used to evaluate the fuzziness of the solution: the lower FPI and MPE are, the more suitable is the corresponding solution.

The third measure is the separation index S (Xie and Beni, 1991):

$$S = 1 - \frac{\sum_{i=1}^{c}\sum_{j=1}^{n} u_{ij}^2 \left\|x_j - v_i\right\|^2}{n \min_{ij} \left\|v_i - v_j\right\|^2} \tag{A-8}$$

where the numerator denotes the compactness by the sum of squared distances within clusters, and the denominator denotes separation by the minimal distance between clusters. The smaller the value of S, the better the compactness and separation between clusters.

The optimal number of clusters is thus established on the basis of the minimization of FPI, NCE and S.

Once the optimal number of clusters has been determined, the second step consists of choosing the fuzziness index m, which is determined by analyzing the sensitivity of the results from the FKM algorithm to variation in the level of fuzziness. The final results are examined by varying m from 1.1 to 2.5, wiht increments of 0.1. Castellano, Quintano, and Longobardi (2009) show that low values of m change the distribution of test scores and make it more similar to a Normal distribution; however, values of m below 1.6 would assign a weight very close to zero (lower than 0.001) to more than 15% of classes located in the South. As a consequence, in their specific application, m was set at 1.7.

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