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## The impact of an unexpected wage cut on corruption: Evidence from a "Xeroxed" exam

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# The Impact of an Unexpected Wage Cut on Corruption: Evidence from a “Xeroxed” Exam

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# The Impact of an Unexpected Wage Cut on Corruption: Evidence from a “Xeroxed” Exam

## Abstract

This paper aims to understand how corruption responds to an income loss. We exploit an unexpected 25% wage cut incurred in 2010 by all Romanian public sector employees, including the public education staff. We investigate a corruptible high-stake exam taking place shortly after the wage announcement. To measure corruption we compare changes in exam outcomes from 2009 to 2010 between public and private schools, as the latter were not affected by the policy. We find that the wage loss induced better exam outcomes in public than in private schools and we attribute this difference to increased corruption by public educators.

JEL-Code: I200, H700, J300.

Keywords: public educators, bribes, high-stakes exam.

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## 1. Introduction

The last decades have witnessed fast growing political and academic efforts to break down the phenomenon of corruption into causes and effects. To date, many puzzles still remain regarding the key causes and determinants of corruption (see Olken and Pande, 2012 for a recent review of developments in this area). Among these, the degree to which corruption responds to a wage change is an underexplored topic of particular interest to policy makers. This paper attempts to shed light on the effects of wages on corruption in the public sector, exploring a quasi-natural experiment generated by an unexpected 25% wage cut incurred by the public sector employees in Romania in 2010. Understanding the consequences of a wage loss, especially for corruption, is particularly relevant in the context of the recent waves of austerity measures that have swept over most of the EU countries.<sup>1</sup> To our knowledge, this is the first paper that identifies a causal relationship between a wage cut in the public sector and corruption activities.

The idea that financial compensation is a crucial factor in the decision of whether to engage in fraudulent action was first formalized in 1974 with Becker and Stigler's seminal work. The key prediction from their model was that increasing the remuneration of public servants above the market-clearing wage can reduce bribery, and thus reduce the prevalence of corruption. Subsequently, this hypothesis has been empirically tested, initially using macro-level data. For example, exploring a cross-section of developing countries, Van Rijkenghem and Weder (2001) show a negative, but rather small, association between civil service compensation and corruption measured by the ICRG index, while Rauch and Evans (2000) find no significant relationship between bureaucrats' wages and corruption, but show that salaries correlate negatively with the bureaucratic delay.

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<sup>1</sup> Similar measures regarding cuts in public sector wages have been proposed in other EU countries, e.g., Greece in 2011, Spain in 2012.

To date, few studies have used micro-level data to identify the deterrent effect that wages have on corruption. Di Tella and Schargrodsky (2003) exploit a crackdown on corruption in the procurement departments of Buenos Aires hospitals. They find that at higher levels of the staff's wages the crackdown is more effective in reducing the prices of hospital inputs when there is an intermediate level of monitoring. However, they also show that higher wages have no statistically significant effect when there is no monitoring or when monitoring is at a very high level. These results are consistent with the predictions of the Becker-Stigler model. Niehaus and Sukhtankar (2010) also find empirical support for the capacity of projected gains to reduce fraud. In this setting, however, the prospective rents are obtained from future opportunities to collect bribes that rely strictly on keeping the job, which leads to an inter-temporal substitution of fraud today for rent-extraction in the future.<sup>2</sup>

While these studies are centered on the effect of an *increase* in remuneration on dishonesty, it is not obvious that a *decrease* in wages would have a symmetric impact on corruption, i.e., that reduced financial compensation would necessarily spur corruption.<sup>3</sup> Gorodnichenko and Sabirianova Peter (2007), to our knowledge, is the only study that has analyzed corruption in direct relation to low wages. Using micro data from Ukraine, these authors show that the wage differential between the private and (the much lower-paid) public sector does not translate into a difference in consumption, and they conclude that bribery must account for

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<sup>2</sup>Armantier and Boly (2011) carry out a controlled field experiment on the receptiveness of exam graders to bribe-offering. The effect of higher wages on corruption tested in their experiment is ambiguous. This paper belongs to a growing experimental literature on corruption using controlled field experiments (see Olken, 2007, Bertrand et al., 2006), as well as lab experiments (see Frank and Schulze, 2000; Abbink, 2002; Schulze and Frank, 2003; Barr et al., 2009; Barr and Serra, 2009). The latter category also yields mixed evidence on the impact of a wage increase on corruption.

<sup>3</sup>From the standpoint of the wage-corruption relationship, our study is akin to the theoretical underpinnings of Becker and Stigler (1974). However, whereas the bribe in their model is exogenous, our analysis inquires into how wages can alter corruption intensity. In this respect, our findings relate more closely to Shleifer and Vishny (1993) who take bribes to be endogenous and analyze how they respond to the market structure of corruption.

the observed wage gap. In doing so, they document the role of corruption in explaining the prevalence of low-paid public jobs, rather than the reverse. Thus, the impact of a decrease in wages on the prevalence of corruption, the object of our study, remains an open empirical question.

In the spirit of the shirking model proposed by Shapiro and Stiglitz (1984), lower wages could trigger a switchover to rents from corrupt activities, as the civil servant attempts to compensate for his lost income. At the same time, a different mechanism, working in the opposite direction, holds the prospect of unemployment as a deterrent for shirking or, as applied to our case, corruption (Shapiro and Stiglitz, 1984). Thus, particularly in a depressed economic time, as in 2010, an income loss may potentially prompt more risk-averse public employees to refrain from corruption because they fear losing their job and their only source of income when the market cannot accommodate them. Yet, there is another possibility that supports this mechanism: when wages are lower, civil servants might be more reliant on future rents from corruption, which they might lose together with the job if they are caught, making them forego corruption today to preserve the potential for corruption in the future (Niehaus and Sukhtankar, 2010). Overall, these mechanisms convey an ambiguous effect of lower wages on corruption, and identifying their impact is essentially an empirical exercise.

In this paper we show that a large reduction in the wages of civil servants—in this case public school principals, together with teachers, and/or the administration personnel—can increase the incidence of corruption. Specifically, our study attempts to measure the effect of an exogenous 25% reduction in wages on corruption in the education sector in Romania. As part of an austerity plan, the Romanian public sector was hit by an unexpected wage cut announced on May 7<sup>th</sup> 2010, scheduled to take effect starting July 1<sup>st</sup> 2010. In June 2010, just between the announcement of the cut and its actual implementation, the annual national

high school-leaving exam—the Baccalaureate—took place in the usual manner, testing approximately 200,000 students. The prevalence of corruption at the Baccalaureate exams was notorious and was attributed to the high-stakes character of the exam (it accounts for up to 100% of the university/college admission score) and the poor remuneration of teachers in general. As it happened, the 2010 exam signaled an unprecedentedly high number of allegations of fraud and bribery by school principals connected with the Baccalaureate. The 2010 spike in court investigations revealed how batches of identical answers had been distributed to students (by public educators), earning the 2010 exam a special title: "*The Xeroxed exam*".<sup>4</sup>

Since we do not observe bribery and fraud directly, our strategy for understanding the impact of the wage cut on corruption is to compare the change in the Baccalaureate exam outcomes – mainly the school-level average grades and passing rates of the standardized Romanian language exam - from 2009 to 2010 between public and private schools, as the latter category was not affected by the policy.<sup>5</sup> The arguments in favor of interpreting the resulting change in exam scores as being due to changes in corruption are the following: 1) the timing between the announcement of the wage cut and the exam is far too short for other responses (for example, a change in the students' or in-class teachers' effort); 2) using county specific variation in corruption we are able to estimate placebo regressions and we find that our effects are indeed driven by the most corrupted counties, whereas we find no impact of the wage cut in counties with little or no corruption. Since we believe that exogenous shocks to private schools or responses in form of

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<sup>4</sup> This title given by the media refers to the fact that many students were found to have identical test answers (including in essay type exams), which is unlikely to happen without special interventions, given the complexity of the subjects. We will return to the mechanisms of corruption later in the paper.

<sup>5</sup> Because corruption is notoriously difficult to measure, many researchers resort to some indirect assessments, such as evaluating corruption through changes in the outcome of interest when moving into a treatment where corruption is more likely. A similar strategy has been, for example, employed in Olken (2007) or Bertrand et al. (2006).

effort are likely to have a similar impact in most and least corrupted counties, we are hence able to conclude that these confounders are unlikely to bias our baseline estimates; and 3) we also show that despite the wage cut, household expenditures did not decrease more for public teachers' households, relative to the households of private teachers. Overall, our findings seem to indicate the presence of non-reported compensation in the public sector.

Our results show a positive and significant change in the exam outcomes between public and private schools, which we attribute to an increase in incentives to engage in corrupt activities in 2010 relative to 2009. In particular, our results for the standardized Romanian written exam, a test which remained similar across years and is taken by all students, regardless of their track, indicate a wage cut-driven effect equivalent to about 0.17 SD increase in exam scores relative to the mean in 2010 (a 4% increase) and an increase in school-level Romanian exam pass rates by 6 percentage points. Results are quite similar for the overall pass rates, although this outcome is less comparable across years. We employ different falsification tests and sensitivity analysis to lend further credibility to our results.

While this study adds to the developing pool of knowledge about corruption in the education sector (see, for example, Duflo et al., 2010; Reinikka and Svensson, 2004, 2005; Ferraz et al., 2011; Muralidharan and Sundaraman, 2011; Glewwe et al., 2010), it also complements the findings in a related literature that investigates incentives for *teachers cheating*. Jacob and Levitt (2003) ingeniously show teacher cheating behavior in Chicago public schools and argue that this fraud is a by-product of the high-powered incentive schemes implemented in that system. The Romanian Baccalaureate exam is a high-stakes exam for students because it determines admission to college education and further professional training, or secures qualified-labor participation for students from the technological and vocational tracks. However, we show that having high-stakes exams favor the



increase in corruption among the educational staff (for more explanations on the corruption environment in Romanian education system see Section 2). In this respect, our paper also relates to the debate about high-stakes evaluation systems in education sparked by the legislation *No child left behind*, which was implemented in the US in 2001. Nichols and Berliner (2007) provide a critical discussion about the distorting effect this policy has on the quality of education.

The paper is structured as follows: Section 2 presents an overview of the Romanian context, explaining the wage cut policy, the educational system and the implications for corruption. Section 3 provides the details of our data, while. Section 4 outlines our empirical strategy and our main empirical findings. Section 5 provides some tests as to whether changes in exam scores following the wage cut can be interpreted as changes in corruption caused by the wage cut. Section 6 presents some additional results, while our conclusions are presented in Section 7.

## **2. Background**

### ***2.1 The 2010 Unexpected Public Sector Wage Cut***

The threat of recession posed by the unfolding international financial crisis in the fall of 2008 was largely overlooked by Romanian politicians, who confidently conveyed a disjunction between Romania and the world economy. The autumn 2008 Euro-barometer showed that more than 70% of Romanian respondents anticipated no change or even an improvement in the general economic situation of Romania.<sup>6</sup> Despite the IMF's prompting for moderation, upon preparing his 2009 electoral campaign and especially after winning the elections, the incumbent

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<sup>6</sup> [http://ec.europa.eu/public\\_opinion/cf/](http://ec.europa.eu/public_opinion/cf/): "What are your expectations for the year to come with respect to the economic situation of your country (Romania)."

president promoted greatly optimistic prospects: "(...) we expect significant growth in the first part of 2010".<sup>7</sup>

In this context, the austerity measure announced by the President on May 7<sup>th</sup>, 2010 involving a 25% cut in wages for all public sector employees, the elimination of some of their financial and in-kind incentives (which were accounting for an additional up to 15% of the monthly remuneration), and a 15% reduction in pensions and unemployment benefits was completely unexpected, generating social instability and political divergence. The austerity measure was introduced in an attempt to reach the 6.8% budget deficit target agreed upon with the IMF (for more details about the unexpected announcement and the political situation in Romania in 2010, see also Bejenariu and Mitrut, 2011). Soon after, the Finance Minister's declaration unraveled the government's misguided optimism concerning the country's economic status: "As a Finance Minister I am telling you that we could have lied six more months, (...) we could have arranged an accord with the IMF to give us six months and could have waited six months to see what happens. The fact that what we are doing entails a political risk that nobody imagined a month and a half ago shows a complete responsibility of this Government towards the Romanian citizens".<sup>8</sup> It was not long before he was dismissed.

Thus, following the May 7<sup>th</sup> announcement, on June 30<sup>th</sup>, the President promulgated the austerity law, which came in effect July 1<sup>st</sup>, with an initial duration of 6 months, until December 31<sup>st</sup>, 2010.<sup>9</sup> To date, the public sector wages have not been restored to their initial level.

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<sup>7</sup><http://www.evz.ro/detalii/stiri/basescu-romania-nu-va-fi-afectata-de-criza-837030.html> (in Romanian).

<sup>8</sup><http://www.hotnews.ro/stiri-politic-7350294-sebastian-vladescu-era-foarte-usor-mintim-continua-mai-imprumutam-vreo-sase-luni.htm> (in Romanian)

<sup>9</sup> The final provisions of the austerity law were as follows: (1) the gross quantum of wages, allowances and indemnities, including financial benefits and other income rights of all public sector employees were

## ***2.2 The Structure of education and the high school exam in Romania***

The standard design of the educational system in Romania is based on a division of three cycles, each containing four years: primary school (grades 1 to 4), middle school or gymnasium (grades 5 to 8), followed by a national exam which insures the admission into high schools (lyceums) on a: *i*) theoretical (or general) track - including the humanities and sciences profiles, *ii*) technological track - providing a technical profile, services profile and natural resources and environmental protection profile, *iii*) vocational track - including the arts, military, theology, sports and teacher training profiles (see NASFA Romanian Educational System, 2011 and Pop-Eleches and Urquiola, 2011 for comprehensive discussions about the Romanian education system). Upon completion of high school, students take the school-leaving exam, which is known as the Baccalaureate exam, following the French model of national evaluation. This nationwide standardized test is a mandatory condition to obtain the certificate of graduation from secondary school. Importantly, passing the Baccalaureate exam is a strict requirement for enrolling in tertiary education or for pursuing further professional training. At the very least, the degree obtained by passing this exam offers a basic qualification with the potential to earn the student a better placement in the labor market. Furthermore, the student's average grade on this exam plays a sizeable role in determining their chances of being admitted to university (it accounts up to 100% of the admission score), and in being granted exemption from tuition fees (each public university offers a limited number of tuition-free seats based on the admission score). Thus, passing this national examination is very important, and it is preferable to do so with high grades.

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diminished by 25%; (2) unemployment benefits were diminished by 15%; (3) the possibility of registration for early retirement or partial early retirement was suspended; (4) maternity leave benefits, in pay or forthcoming, were diminished by 15%.

The Baccalaureate consists of several standardized tests taken in oral and written form. The two oral exams assess the student's level of comprehension and spoken interaction in Romanian and in a foreign language. A second part consists of a series of written tests on different subjects, which are a combination of simple or multiple choice questions and tasks that require the student to write in elaborate answers and essays. First in this series is the Romanian language and literature exam, followed on specific days by track-specific and elective subject tests. These are graded on a scale from 1 to 10, and to pass the exam, a student should obtain a minimum score of 5 on each test and a minimum overall average score of 6. The tests are held in examination centers, where more high schools from the same locality are (randomly) concentrated. The organization of the exam in every center is the responsibility of the exam committee, which consists of a chairman (typically a university professor), one or two deputy-chairmen (typically public high school principals), a person specialized in IT management (for technical support), and a number of public school teachers whose duty is to monitor the exam. These teachers are unrelated to the subject under evaluation or to the students, and are randomly assigned in pairs of two in each classroom by the exam committee.

The format of the Baccalaureate has been standard for the last ten years with the two oral exams and four written tests, which take place over the course of two consecutive weeks toward the end of June every year. However, because of a few changes to the exam format applied in 2010 the overall pass rate is less comparable to earlier years.<sup>10</sup> The tests are standardized for all students ascribed

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<sup>10</sup> The oral exams were pushed ahead of the written ones, to February, and they were rendered irrelevant to the overall exam grade. Also, a new examination of *digital competencies* was added to the oral section of the exam, and one track-specific written test was eliminated. The assessment became qualitative, categorizing the students into: *experienced*, *advanced* or *average users*. This will probably negatively affect the overall grade/pass rate as the oral exams were recognized to be highly inflated. Also, before 2009, in preparation for the exam, the students had access to 100 published written exam models with full answers for each discipline,

to each education profile and track. However, the one test that is unique to *all* students regardless of profile and track is the written Romanian language exam. This, together with the fact that the conditions for this test have remained very similar across years makes it an ideal basis for comparison of student outcomes on the exam.<sup>11</sup>

As stated before, in 2010, the wage cut news arrived on May 7<sup>th</sup>, three weeks before the end of the school year. For the 12<sup>th</sup> graders, this time is mainly dedicated to the graduation ceremonies. Since the exam takes place in June, this close timing between the unexpected news and the exam reduces the possibility that the wage cut would have changed the test outcomes via increased effort by students, (parents) or teachers. Still, we will look into this in more depth in Section 5, where we perform a number of sensitivity analyses to rule out this and other alternative explanations for increased exam scores.

### ***2.3 The corruption environment***

The endemic post-communist corruption in the public sector has become proverbial among Romanians: a 2003 World Bank Report about corruption in Romania reveals that more than 67% of the respondents alleged that all or almost all public officials in Romania are corrupt, while more than 50% of the respondents believed that bribery is part of the everyday life in Romania.<sup>12</sup> This is particularly true in the education and health systems, where up to 66% of the respondents confirmed that they were paying the so-called *atentie* (unofficial

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one of which would have become the actual test. In 2010 the test would resemble, but not perfectly match the models. All in all, we expect these changes, if anything, to decrease the overall passing rate.

<sup>11</sup> We also claim that for this exam it is more difficult to cheat in class (as one possible confounder to corruption), since students need to develop ideas and write essay-like questions as part of the examination.

<sup>12</sup> A 2010 study on corruption in Romania shows about 80% of the respondents to agree that the Government and Central Institutions are corrupted to a large and very large extent, a finding that is in line with the idea that corruption has increased during the last years. (<http://www.agenda21.org.ro/download/Studiu%20perceptia%20cetatnilor%20asupra%20coruptiei%20din%20institutiile%20publice.pdf>, in Romanian)

payments or bribes).<sup>13</sup> More than a quarter of the students interviewed in the 2003 World Bank Diagnostic Survey of Corruption in Romania admitted to have provided some unofficial payments during the previous year.

Thus, one notable feature of the Romanian public schools that favors the propagation of corruption is the existence of a habitualized system of informal payments. These range from more innocuous forms such as the imposition of funds collected for covering school and classroom material expenses (*fondul scolii*, *fondul clasei*) all the way to bribes and gifts demanded by teachers in exchange for favors such as *not* failing the students in their subject or inflating their grades (see CEDU report, 2006). Overall, the frequency of such exchanges over the entire course of school/high school years sustains a dense clientelistic network. Unlike public schools, private units have tuition fees which makes gift-giving redundant and thus, arguably, the costs for private educators and students to enter a network of corruption are higher.

Among the most commonly invoked causes for dysfunctions in the public education system are: *i*) the poor remuneration of teachers in the public sector<sup>14</sup> and *ii*) the high-stakes of the high-school exit exam, particularly starting with the

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<sup>13</sup> Paying the so-called *atentie* is very common. The 2003 World Bank Diagnostic Survey of Corruption in Romania confirms that up to 66% of the respondents have paid an *atentie* during a hospital stay, while 27% of the respondents have given *atentie* to vocational school (teachers), 25% to the primary school (teachers), 21% in the high-school system and 17% in the University. However, these are lower bounds, especially for education: first, people do not like to admit they are bribing teachers, as that is a signal of insufficient ability; second, these numbers are from survey questions to all households, regardless of the age of the household members and whether or not they have kids in school. A recent survey among university students reveals that about 72% of the students and 68% of the university teachers were involved in corrupted activities in relation to school (our calculations using the 2007 PEIS data, Gallup Romania).

<sup>14</sup> In Romania, similar to other transition countries, wages of the educational staff in the public sector are highly centralized and there is little variation across teachers. While there are no official statistics, it is the case that public teachers earn, on average, up to two times less than their private counterparts.

year 2002 when increasing numbers of universities included the Baccalaureate exam score as part of the admission process.<sup>15</sup>

There is an overall consensus among the Romanian public that the Baccalaureate passing rates (anchored at approximately 80%, which is just slightly below the EU mean of approximately 82%) and the grades they rest on are artificially inflated and that what they reflect is not as much performance as it is corruption. The relatively high national average passing rates that exceeded other European countries show large discrepancies with other international tests (for example, PISA), where Romanian students earn (among) the lowest scores on all assessments.<sup>16</sup> This inconsistency is shown in Figure 2 where, for a sample of European countries, we plot the difference in ranking between the upper secondary graduation rate and the country rank for PISA tests. Among the listed countries, Romania stands out, with the greatest (negative) ranking difference. Moreover, the introduction of video surveillance in 2011 coincided with a drop in average pass rates to a staggering 44%, further confirming that the exam had for years been corrupt.

The 2010 exam earned a special reputation and the suggestive title “*The Xeroxed Baccalaureate*” after a large number of cases of corruption at the exam (150 defendants compared to essentially none previously) caused a media storm.<sup>17</sup> Without precedent, many teachers and especially school principals were investigated by the Romanian National Anticorruption Directorate (DNA), in connection with the 2010 Baccalaureate exam for having taken large amounts of

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<sup>15</sup> This practice has become increasingly common because the number of places in private universities, which charge tuition fees, has risen steadily from 2002 until 2009.

<sup>16</sup> See, for example, the 2009 PISA Executive Report: <http://www.oecd.org/dataoecd/34/60/46619703.pdf> and the 2009 OECD report Education at a Glance <http://www.oecd.org/dataoecd/41/25/43636332.pdf>.

<sup>17</sup> <http://www.pna.ro/faces/index.xhtml>.

money from students to help them pass or to raise their grades.<sup>18</sup> In particular, the school personnel was accused of arranging with committee members for selected papers corresponding to these students to be graded higher, partly changed or entirely replaced (*Xeroxed*) with correct answers. Some of these cases went to court and were finalized in 2011 and 2012 with prison sentences.<sup>19</sup> This evidence suggests that the exam in 2010 was characterized by an unusually high level of corrupt activity, which we explain through the additional incentives for fraud borne by the unexpected wage cut.

### ***2.3.1 Possible mechanisms of corruption***

As explained in the previous section, in Romania gift-giving and informal payments are very common in general, but particularly so in *public* institutions, especially in those providing health and education services (see CEDU Report, 2006; Corruption in Public Institutions, 2010).<sup>20</sup> This feature carries over into the Baccalaureate exam corruption.

The unofficial payments that would result in an inflation of the Baccalaureate grades can be, broadly, summarized as follows (see also PEIS, Gallup 2006):

- a) *Collective bribes* - the so-called “*protocols*”- are informal but commonly accepted funds (money) collected several times a year on different occasions (see PEIS Gallup, 2007; CEDU, 2006). Every year, the graduating students,

<sup>18</sup> <http://www.ziare.com/stiri/arestare/directori-de-liceu-arestati-pentru-fraude-la-bacalaureat-1029179>; [http://www.adevarul.ro/scoala\\_educatie/liceu/150-000\\_de\\_lei-frauda\\_record\\_la\\_Bacalaureat\\_0\\_292771226.html](http://www.adevarul.ro/scoala_educatie/liceu/150-000_de_lei-frauda_record_la_Bacalaureat_0_292771226.html) <http://www.ziare.com/scoala/bacalaureat/zeci-de-profesori-din-botosani-sunt-cercetati-pentru-frauda-la-bac-1031591> (in Romanian)

<sup>19</sup> Retrieved from [www.desteptarea.ro/zeci-de-condamnari-in-dosarul-spaga-la-bac.html](http://www.desteptarea.ro/zeci-de-condamnari-in-dosarul-spaga-la-bac.html) (in Romanian)

<sup>20</sup> Hallak and Poisson (2007) provide a comprehensive taxonomy of corruption in education. Note that the forms of fraud tackled in this paper are by no means restricted to the Romanian educational system. Many countries struggle with the informal payments and illegal actions connected with the assignment of grades in exams at various levels in the education cycle. Some examples regarding the secondary school in particular, come from Russia, Ukraine and Uzbekistan (Silova and Bray, 2006), where the sale of grades is common, and from India (Uttar Pradesh), where the high school exam annual pass rates dropped from 61% to 17% in 1992, when police forces were stationed at the examinations centers (Kingdon and Muzammil, 2009). For more illustrations regarding the fraud with admissions and grades, see Lewis and Pettersson (2009: 45).



shortly before the end of the school year (usually the end of May), collect the *protocol* contributions to “organize” the Bacalaureate exam. Informally, these funds are used at the examination centers to “grease the wheels” such that the proctors and other committee members turn a blind eye to cheating in the exam rooms (through innocuous copy aids, talk to other students, etc.). However, in-class cheating and thus, implicitly the *protocol*, is feasible to both public and private students, who are randomly and anonymously mixed in exam rooms, under the same surveillance. We will formally address this issue and rule out differential in-class cheating by public and private students in Section 5.

- b) *Individual bribes* - some students (individually or in small groups) may give extra *bribes* for *extra* favors during or especially after the exam.<sup>21</sup> These favors come in many forms: the distribution of the correct solutions during the exam for the contributing students, bribing the evaluators to score the selected or marked papers higher, cooperating with the exam committee to single out the marked papers and improve them or completely replace (*Xeroxed*) them with correct ones before sending them to the evaluation center. In particular, using the already developed informal network at the high-school level, students use the teachers/school principals’ channel to send their bribes to the exam committee members and/or the evaluators for higher grades. Although the composition of the exam committees is made public only 48 hours before the exam (according to the Romanian Bacalaureate Exam Methodology), the chairman of the examination committee and the IT people are known months

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<sup>21</sup> It was actually this form of bribe that led to the court cases in 2010 as mentioned in the above section. The 2010 Report of Activity of the National Anticorruption Court enumerates the investigated crimes related to this form of corruption at the 2010 Bacalaureate: bribe giving and taking; influence peddling; stealing, destruction and falsification of official documents. These individual transactions involve large amounts of money. The same report mentions that such individual bribes amount to 350 Euro for passing one written test and 500 Euro for passing the overall exam. The stipulated total value of the prejudice was at least 150,000 Euro. We do not have information about the number of students involved in individual bribing at the high school level, but the PEIS –Gallup 2006 data, 55% of the university students admitted to have been paid “gifts” to get higher exam grades (admittedly, these are low stake-exams).

in advance. The school principals have a very dense web of connections as basically, in different years, they are randomly allocated to be part of the exam committees formed around the Baccalaureate (each exam committee is formed by 2-3 school principals).

Overall, the individual bribes are somewhat more relaxed for the public students given the well-established informal networks in public schools.<sup>22</sup> However, let us also note that the existence of corruption in private high schools cannot be ruled out but, as private school principals are not in exam committees, the chain of events necessary for a bribe from a student to result in higher exam scores is less likely to be fulfilled for private school students. Thus, we ground our identification strategy in the conjunction of this form of corruption with this differentiation between public and private schools' access to a corrupted network.<sup>23</sup>

### **3. Data and descriptive statistics**

#### ***3.1 The data set***

In our empirical exercise we use two main sources of data. Firstly, we use administrative data for 2010 and 2009 (our main comparison years) and 2008 (our placebo year), essentially covering the universe of students enrolled in the final (standardized) exam at the end of high-school, with individual information about the following: their school, their personal specialization track (theoretical/general, technological or vocational), and their scores on the exams. For each student, we

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<sup>22</sup> Note that there is a cost associated with engaging in corrupt activities for educators – the risk of getting caught and losing future earnings. Although no official sources detail on the monitoring and detection process, the 2010 Report of Activity of the National Anticorruption Court reveals that most cases of corruption at the exam have been detected as a consequence of reporting of the crime by some party involved in the corrupt deal (usually students). This gives a good indication that the larger the portfolio of clients a public educator serves, the larger is the private benefit, but also the higher is his risk of getting caught.

<sup>23</sup> In our sensitivity analysis we attempt to isolate the collective bribe channel from the individual bribes by controlling for exam center.

know whether they have passed the exam, what final grade they earned, and what scores they received on all written and oral tests. From these scores we will construct our main outcomes of interest. Additionally, we know whether the student was present at the exam, and whether the student was expelled from the exam room due to in-class cheating.<sup>24</sup>

Our second source of data is the 2010 Study Performance in High School (SPHS) data, which is collected by Statistics Romania twice a year: at the beginning and at the end of the academic year. The SPHS records information on a broad set of high school characteristics for essentially all high schools in the country. Specifically, the SPHS data include the following: the high school name and a unique identification code; the address of the school (locality and county); the type of school (whether private or public); and detailed information about the number of students by gender and ethnicity, the number of teachers and school principals by gender, type of employment contract, and their age structure. We can thus match these data with the administrative students' records at the final exam by the school's unique identification code to construct our working sample. The key information for our empirical strategy is whether the student comes from a private or a public school. Overall, among the 1,198 Romanian high schools, only approximately 3.35% are private. In what follows we only consider counties that have both private and public schools (19 out of a total of 42 counties). Thus, for the main analysis we are left with a panel of 825 schools for each academic year (about 205,000 students); among them 48 (approximately 6%) are private schools (about 5,000 students).<sup>25</sup>

### ***3.2 Descriptive statistics***

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<sup>24</sup> With our data, we only observe students that have been registered for the Bacalaureate.

<sup>25</sup> Our main results when using the entire sample are overall similar to those in the main analysis but less precisely estimated. Additionally, we will also show some results at the examination center for all centers with at least one private school and where the share of private students is about 30%.

Summary statistics for our main variables of interest, separately for 2009 and 2010 (our comparison years) and for 2008 (our placebo year) are found in Table 1. For our main working sample, the overall distribution of schools is as follows: 26.7% (or 220) are theoretical or general schools, 7.8% (or 65) are vocational schools, and the rest of 66.2% (or 540) are technological or mixed schools (technological with some theoretical classes).

We show descriptive statistics for exam scores and pass rates (for the Romanian written exam and for the overall exam) at the school level, where we have weighted each school by the number of students taking the tests in the exam. Table 1 shows an increase in the average grade at the written Romanian test in 2010 relative to 2009. This test is directly comparable across years as its format has remain similar in 2010 relative to earlier years and all students, regardless of their profile, track or ethnicity, need to pass this standardized exam. This makes it an ideal basis for comparison of student outcomes across years. Thus, in what follows, the school-level average grades for the written Romanian exam and the share of students (at the school level) passing the written Romanian exam are our main outcomes of interest. Additionally, we will consider the overall passing rate (school-level average). Interestingly, while the written Romanian exam shows a significant increase in 2010, the overall passing rate is dropping from a fairly high and stable 81% average (80.5% in 2008 and 81.6% in 2009, respectively), to 71.7% in 2010. The main explanation for this drop is the overall change in the Baccalaureate exam in 2010 (see Section 2). We will provide further discussions and explanations in our results section below.

Finally, it is important to note that private and public schools differ substantially in the levels of our key outcomes. Throughout the entire period, private schools consistently exhibit average passing rates and average Romanian grades below those of public schools. This indicates an overall lower performance of private

schools relative to public schools, which is related to the selection of lower achieving students into private high schools in the 9<sup>th</sup> grade, a common occurrence in Romania.<sup>26</sup> This is why later in the paper we 1) perform falsification tests where we estimate the impact of being a student in a public school on exam scores in 2008-2009, before the wage-cut announcement, and 2) conduct estimation on a matched sample of public and private schools, with similar levels and trends in exam scores, and on type of track (and on other characteristics), prior to the wage cut in 2010.

## 4. Estimation strategy and baseline results

### 4.1 Identification strategy

We attempt to understand whether an income loss led to changes in corruption behavior, measured through a change in exam outcomes. Specifically, the policy we evaluate is the May 7<sup>th</sup>, 2010 unexpected wage cut for all public sector employees, affecting more than 90% of the Romanian education staff. The intuition is as follows. Before the 2010 exam, we assume exam outcomes to be inflated, for both public and private schools.<sup>27</sup> Additionally, it is reasonable to assume that the incentives and level of corruption intensity for private schools should stay constant.<sup>28</sup> As we have argued before, a substantial wage loss for the

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<sup>26</sup> This is true on average, as a small number of private high schools select and train top students. For a description of the selection of Romanian students into the 9<sup>th</sup> grade see Pop-Eleches and Urquiola (2011).

<sup>27</sup> A natural test of the validity of this assumption is actually the Bacalaureate exam in 2011. Following different anti-cheating initiatives and threats (for example, installing video cameras in schools during the exam, threatening the staff with dismissal), over half of the students taking the exam failed. This policy would be the subject of another paper. Additionally, preliminary evidence seems to indicate that public students were more affected by this policy than the private students suggesting that they were more likely to make use of corruption (and cheating).

<sup>28</sup> While we assume that corruption in private schools did not change after the 2010 wage cut announcement, one may argue that this policy impacted indirectly the private teachers' labor market, making them potentially less inclined to take bribes for fear of getting fired. Thus, this could have generated lower exam scores in private schools, due to less corruptible private school teachers. We hereby work under the assumption that corruption (if any) in private schools stays constant between 2009 and 2010, or that the alternative labor market situation is equally affected for private and public school teachers. We will also run several sensitivity analyses in Section 5.

public school staff has, ex-ante, unclear implications for corruption: on the one hand, teachers may attempt to compensate for their forgone income by increasing the prevalence of bribing and corruption; at the same time, an income loss may potentially prompt teachers to refrain from corruption because they fear losing their job and their only source of income when the market cannot accommodate them.

Our main empirical strategy to assess the impact of a change in corruption incentives caused by an unexpected wage cut is a simple difference-in-difference (DD) specification. In particular, we will compare school-level exam outcomes for the public and private schools in 2010 and 2009. Because private and public students are alphabetically mixed in exams rooms and subject to the same examinations, the private school students constitute a natural control group. If the wage cut has caused an increase in corrupt behavior of the school principals in the public schools, we expect to see an increase in exam scores in public school, relative to private schools.

Our richest specification is the following equation:

$$y_{sct} = \alpha + \beta_1 Public_s + \beta_2 yr2010_t + \beta_3 Public_s \times yr2010_t + \gamma' X_{sc} + \theta_c + \varepsilon_{sct} \quad (1)$$

where  $s$  indexes a school in county  $c$  at year  $t$ .  $y_{sct}$  is one of our two main outcomes of interest: 1) the school-level average grade for the standardized written Romanian language exam and 2) the school-level share of students passing the standardized written Romanian language exam;  $Public_s$  is an indicator that equals 1 if school  $s$  is a public school and 0 if it is a private school;  $yr2010_t$  is an indicator that equals 1 if it is for the 2010 final exam and 0 if it is for the 2009 final exam.  $X_{sc}$  includes two indicators for the track of the school:

theoretical and technological (the base is vocational).<sup>29</sup>  $\theta_c$  includes 19 county dummies. Our key coefficient is  $\beta_3$ , the DD-estimand, which measures the change in outcomes in 2010, after the abrupt wage cut, relative to 2009, for public relative to private schools. We weight all of the regressions with the number of (per school) students taking the exam.<sup>30</sup> Furthermore, in all of the regressions, we cluster the standard errors at the school level.<sup>31</sup>

In Section 5, we investigate a number of potential threats to our identification strategy and to the interpretation of our results. There are two important conditions that are necessary for  $\beta_3$  to capture the effect of a sizable wage cut on corrupted exam scores. First, we need the following assumption to hold:  $Cov(\varepsilon_{sct}, Public_s \times yr2010_t | Public_s, yr2010_t, X_{sc}, \theta_c) = 0$ . In our sensitivity analysis section, we investigate a number of potential threats to this assumption. In section 5.1, we perform a falsification exercise comparing test scores in 2009 and 2008, to investigate if differential pre-policy trends affect our results, as well as conducting estimations using matched samples. In Section 5.2, we estimate placebo versions of equation (1) using variation in corruption at the county level. Second, the outcome measure should reflect changed exam scores that are due to corruption and  $Public_s \times yr2010_t$  should be interpretable as a roughly quantifiable

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<sup>29</sup> We do not include other school related characteristics since we only have this information for the year 2010. We will, however, perform some tests using this information in Section 6.

<sup>30</sup> The estimates are very similar if we estimate un-weighted regressions.

<sup>31</sup> The difficulty in estimating correct standard errors in DD models where a policy changes only for a small number of groups is discussed in Conley & Taber (2011). Their argument is that unless the number of treated groups is large, standard methods for inference are inappropriate. With geographical clusters as units of treatment, their critique is not relevant for this study, as we have treated and control units represented in all the 21 counties. Of course, one can also think of their critique as being relevant for non-geographical dimensions (such as all public schools being one unit of treatment and all private schools being one unit of control). However, we think it is very unlikely that there are important specific shocks (unrelated to the wage cut) that affects public schools but not private schools. This assertion get additional support from the facts that a) we get similar sized standard errors whether or not we cluster the standard errors at the school, the locality or at the county level, something which can be reconciled with the Conley & Taber argument being valid here only in the unlikely case of shocks hitting public and private schools differently between but not within counties, and b) we do not find that exam scores evolve differently in public and private school prior to the wage cut, hence supporting the claim that observed differences in outcomes between public and private schools are not due to group-specific shocks.

change in wages. Thus, in Section 5.2, we conduct separate regressions for the most vs. the least corrupted counties together with several additional tests in an attempt to rule out confounding factors that can bias our interpretation of the baseline estimates. As we lack a direct measure on teachers' wages when we estimate (1) in Section 5.3 we use a secondary data source on wages to confirm that the wage change between public and private sectors is sizable (up to around 30%).

#### **4.2 Results from baseline estimations for the Romanian written exam**

In this section, we present the basic findings from estimating equation (1). Table 2 displays the DD estimation results from our chosen baseline specification featuring the average grade and the pass rate on the written Romanian exam as our main outcomes of interest. For the average grade, column (1) presents the unconditional DD estimates, while columns (2) and (3) add control variables for track choice and county fixed effects, respectively. The structure is similar for the pass rate in columns (4)-(6).

We note already in column (1) that the unconditional DD estimate of the wage cut is positive and statistically significant at the 1% level. When we add additional explanatory variables, in columns (2) and (3), the coefficient drops in magnitude but is robust to the specification in column (1).<sup>32</sup> We therefore infer that the 25% wage cut caused an expansion in the average grades in the public schools relative to the private schools. Using the interaction-estimate reported in column (3), the effect size is equivalent to about a 0.17 SD increase in scores on the Romanian exam relative to the mean in 2010. This amounts to a 4% increase.<sup>33</sup>

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<sup>32</sup> If we replace  $Public_s$  by fixed effects for each school, the standard error for  $Public_s \times yr2010_t$  typically becomes slightly smaller.

<sup>33</sup> The calculation of effect sizes are always based on the student-level distribution in exam outcomes. In 2010, these S.D.:s are 1.674 for the grade score in, 0.250 for passing the Romanian test and 0.47 for passing



Next, we look at the average pass rate of the Romanian written exam as the dependent variable (columns 4-6). In column (4) the DD estimate of the impact of the wage cut is significant at the 5% level when no controls are included. When controls are added, the magnitude of the effect decreases slightly, but the coefficient remains significant at conventional significance levels. It is noteworthy that, on average, the wage cut causes an additional 6% of students to pass the exam, indicating that, for example, in an average public high school with 500 12<sup>th</sup>-graders and a pass rate of 80% in 2009, approximately 24 more students would find support with their principal in exchange for bribes, and in this illicit manner, would pass an exam that they would otherwise have failed. In SD units, the effects for the pass rate are slightly higher than for the exam scores: about 0.23 SD from the 25% wage cut, relative to the average pass rate in 2010.

The results shown in Table 2 are based on students in all high-school tracks, i.e., theoretical, technological and vocational tracks. The theoretical tracks are the first choice for skilled students in the admission to secondary education and there is a more pronounced difference in 2009 exam outcomes for theoretical students in public and private schools, than what is the case for non-theoretical tracks. Because of this, one might suspect the wage cut have a differential impact across school tracks. We therefore also performed estimations separately, for theoretical schools and for non-theoretical schools, which include the technological, vocational and mixed schools. As it turns out, the theoretical and non-theoretical high schools have a similar-sized contribution to the wage cut effect, even though the effects for theoretical schools are imprecisely estimated.

## 5. Sensitivity analysis

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overall. If we instead express them in terms of the S.D.-units reported in Table 1 (which is based on S.D: from school-level exam outcomes), effects sizes are larger.

Because our identification strategy is based on observational data it deviates in different ways from the ideal setting of a randomized experiment. Even though our baseline estimates are from difference-in-differences models, where we control for constant year and group effects, we might still worry about the credibility of these estimates. We therefore perform some additional analysis where we attempt to gauge the sensitivity of our results to the fact that we are using private schools as the control group, to eliminate some confounding factors and to rule out some other potential behavioral responses to the wage-cut announcement.

### ***5.1 Are the treatment and control groups similar enough?***

There are reasons to suspect that private schools are not an ideal control group to public schools. Most importantly, the average exam scores and pass rates in 2008 and 2009 differs significantly between public and private schools. Additionally, although probably of less importance, the control group of private schools is much smaller than the treated group of public schools (48 versus 777). To check if these issues are likely to bias our baseline estimates we perform some sensitivity checks.

#### ***5.1.1 The existence of pre-treatment trends***

Identifying a causal effect of the wage cut on corruption through the DD estimate hinges crucially on the parallel trend assumption. If exam scores would have increased more in public schools than in private schools, even in the absence of the wage cut, our DD estimates would be too high. To test this we perform a falsification exercise, whereby we assume that the wage cut took place in 2009. Essentially, we compare the change in high school outcomes in 2009, one year *before* the abrupt wage cut, relative to 2008, for public schools relative to private schools. The estimation results for the average grade and the share passing the

written Romanian exam are outlined in Table 3.<sup>34</sup> The structure of the table is the same as for Table 2.

For the average grade score (columns 1-3) we notice that the false DD estimates are insignificant for all specifications. This lends support to our prediction that the change in grades in public schools relative to private schools in 2010 relative to 2009 is a distinctive event, one not driven by different trends in the performance of the two types of schools, and it is exclusively related to the wage cut through the increased incidence of corruption. For the share of students passing (columns 4-6), however, the false DD estimates are statistically significant. But since the sign is negative, it suggests that our DD estimates reported in Table 2 for this outcome are probably too low.

Given the negative estimates from our falsification estimations using data for 2008-2009 reported in Table 3, one might worry that there is a dip in 2009, that make the basic DD-estimates being overestimate of the true effects. As we have data on exam scores and information of whether a school is private or public also for 2006 and 2007 (but lack data on track) we stack the data for 2006-2010 and estimate a less elaborate version of model (1), where we have added additional year dummies and the term  $Public_s \times trend_t$ , which is the public dummy interacted with a linear time trend, but where we do not control for track.<sup>35</sup> In this way, we are able to directly control for the trend in exam outcomes stemming from the years 2006-2009, so that  $\beta_3$  captures now the additional effect not due to pre-treatment trends. We report robust standard errors, instead of standard errors clustered at the school level, since we are not able to link schools for 2006-2007 with schools for later years. Results are reported in Table 4. We first note that the

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<sup>34</sup> The number of schools used in the falsification tests is somewhat smaller compared to the baseline estimations, because outcomes are not available for all schools in 2008.

<sup>35</sup> The model we estimate is:  $y_{sct} = \alpha + \beta_1 Public_s + \beta_{21} yr2007_t + \beta_{22} yr2008_t + \beta_{23} yr2009_t + \beta_{24} yr2010_t + \beta_3 Public_s \times yr2010_t + \beta_4 Public_s \times trend_t + \theta_c + \varepsilon_{sct}$ .

estimates for the linear trend interacted with the Public-dummy are small and enters negatively (and is only marginally significant in column 4). The DD estimates are highly significant and very similar to our baseline DD-estimates.

### ***5.1.2 Evidence from matched samples***

Next, we take the analysis a step further and perform estimations using samples matched on pre-treatment characteristics. This may also answer potential concerns on the fact that the public schools included in the treatment group might not have comparable private schools. To shed light on this issue we attempt to match public to private schools using exam scores in 2008 and 2009 (to capture both the levels and the trend), track and county.<sup>36</sup> We use nearest neighborhood and 1-to-1 matching (without replacement) to match a public to each private school. Results are reported in Table 5. The estimates without additional controls are quite similar to our baseline DD-estimates (although the former is less precise), suggesting that matching techniques add little to our baseline parametric estimates. In column (2) we add a dummy for theoretical track and also some variables capturing student composition in class: gender and ethnical composition of students and number of students per teacher.<sup>37</sup> Here, we see that estimates are almost unchanged, suggesting that pre-treatment exam scores already capture most of the differences between students in public and private schools. In column (3) we add pre-treatment exam scores which, as expected, have no impact on the estimates.

### ***5.1.3 Examination centers with both private and public schools***

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<sup>36</sup> We use the `psmatch2` command in STATA (Leuven and Sianesi, 2003)

<sup>37</sup> As these variables are only available for 2010, we did not include them as controls in the baseline regressions.

Finally, we limit the sample to schools in examination centers where there was at least one private school and estimate regressions similar to our baseline.<sup>38</sup> These results are reported in the Appendix (Table A1) and are in line with our main results in Table 2. When we also include examination center indicators to control for unobservables at the center level (location, size – related to the number of schools and, implicitly, to the collective bribe). Although the same school might be assigned to a different exam center every year, controlling for the time-invariant characteristics of the exam center could potentially rule out collective bribe for schools assigned to the same exam center. That estimates do not change with the inclusion of examination fixed effects, suggests that individual bribes are the main mechanism for why we find the wage cut to increase the corrupted exam scores.

Overall, from these estimations we conclude that our baseline estimates are not driven by differential pre-reform trends in outcomes between public and private schools and are not sensitive to using subsamples of public schools that are more similar in pre-policy change characteristics to the private schools.

## ***5.2 Confounders, mediators and measurement issues***

In this section we attempt to address some further potential difficulties of our baseline estimations that could lead to biased estimates. *Firstly*, one concern is related to other possible exogenous shocks between 2009 and 2010 that may differentially affect public and private schools and that, in turn, would impact the exam scores. For example, if the economic climate disproportionately affected private schools (prior to May 2010), which led to a cut in private school resources or that private school pupils' parents and teachers were differentially affected.

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<sup>38</sup> For this exercise, we have identified on a case-by-case basis the school composition of centers to which at least one private school was assigned each year. The percentage of private school students in this sample is about 30%.

*Secondly*, students, parents, teachers, proctors and/or exam committee members may respond to the wage cut announcement in ways that are actually unrelated to corruption, but that can nevertheless impact scores on the exam taken in June. In particular, possible responses to the wage cut that could generate an upward bias in our baseline estimates are: *i*) an increased effort levels of students in public schools which may lead to an increase in exam scores through improved students achievement, and *ii*) more in-class cheating by public schools students, which might raise their exam scores, due to a (differential) increase in cheating during the exam by public students or by *iii*) a decrease in the effort levels by proctors when monitoring the exam as a result of lower wages. Additionally, *iv*) there may be a change in the effort level as a result of the wage decrease by the exam committee members and/or the evaluators who may become less/more strict in enforcing exam rules and pass/fail more marginal students in 2010 vs. 2009. Finally, teacher's effort as educators could also be affected. We dismiss the latter channel because the courses are already finished at the time of the wage cut announcement, this should not have an impact on student learning. Moreover, if anything, a lower teacher wage would likely lead to lower student achievement, which would mean that we would underestimate our main effect estimates. Below we discuss the other threats.

### ***5.2.1 Placebo regressions***

One ideal setting to test these concerns would be to estimate equation (1), for the same time period, in a counterfactual setting where there is no corruption in education, but where circumstances are otherwise identical. As it turns out, we are able to run placebo regressions by using the fact that corruption varies greatly between counties in Romania. This can be seen in Figure 2, where we show the distribution of the *share on informal network* at the county level (our proxy for

corruption) using the 2007 Romanian Barometer of Public Opinion (RBPO).<sup>39</sup> Using this indicator we rank counties into two groups: the most and the least corrupted, where the division is at the mean of corruption.<sup>40</sup> We then estimate our model (1) separately for these two groups in an attempt to check whether the wage cut impact is differential across counties. The argument is that exogenous shocks to private schools or responses in form of effort (or cheating) are likely to have a similar impact in the most and least corrupted counties. If we were to only find positive effects in the most corrupted counties, we would feel confident that these confounders are unlikely to bias our baseline estimates.

In Table 6, Panel A for the average grade at the written Romanian exam and Panel B for the share of students passing the written Romanian exam we find that indeed our positive interaction effects are driven by effects in the most corrupted counties, while the estimates in the least corrupted counties are smaller and never statistically significant.<sup>41</sup> Overall, we find strong evidence against confounding

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<sup>39</sup> To our knowledge there is no county-level official measure of corruption for Romania. Thus, we use the latest data available from the 2007 RBPO and construct a proxy - the *share* of people having an *informal network* in total respondents, at the county level. In particular, we use the question on whether *There is anyone (i.e., informal network) that could "help" you solve (i.e., informally): issues in court/trials, medical problems, city hall, police, or issues related to the local authorities*. Alternatively, we consider three other measures: 1) we construct a proxy for the county-level of corruption in education from the Life in Transition Surveys II (2010). We aggregate the scores assigned to responses to the question "In your opinion, how often do people like you have to make unofficial payments or gifts in these situations?", considering only the situations regarding the receipt of public education. We divide counties into more and less corrupt if they situate above/below the median value of the proxy (see the Appendix, Table A2, for results); 2) one indicator that equals one if the county has introduced video cameras in 2011 (the policy lead to self-selection) and 3) we construct a proxy from the 2003 Transfers and Social Capital Survey (source: MMT) – in particular we use the share of households that have paid "gifts" in different situations (same as above *to solve issues in court/trials, medical problems, city hall, police, or issues related to the local authorities*). The results using these alternative specifications are largely in line with the ones using our informal network proxy, especially for the average Romanian grade.

<sup>40</sup> Similar results if we use the median.

<sup>41</sup> Here we note that results differ between theoretical and non-theoretical track schools. For non-theoretical schools, our placebo regression results are strengthened: estimates for the group of more corrupted regions are always positive and statistically significant, whereas estimates for the group of less corrupted regions are always small and statistically significant. For theoretical schools the pattern is much less clear, although this is much due to imprecise estimates.

factors such as exogenous shocks, changed effort or cheating behavior as confounders.<sup>42</sup>

### ***5.2.2 Additional evidence on effects through changed effort and cheating***

Still, a critical reader might argue that in the most corrupted counties, responses to the wage cut announcement in the forms of higher effort and especially more cheating are less likely, since bribing teachers and principals to get higher exam scores is a viable option. However, for two reasons we do not think this is a problem for the interpretation of our results. Firstly, effort levels and/or cheating of students should actually *increase* even more in less corrupted counties, as bribing is more difficult/less common, so we would actually underestimate our main effects in Table 2. Secondly, we are also able to perform some further tests, suggesting that any potential bias from these (and other additional) issues it is negligible.

For instance, one potential confounding story in disentangling (teachers) corruption from (students) cheating is whether the proctors, as a result of the wage cut, decreased their effort, resulting in more students cheating during the exam in 2010 when compared to 2009. However, since students from public and private schools take the exam at the same time, in the same building, randomly mixed in class (in alphabetic order), we expect them to be affected, on average, in a similar manner. Yet, students from private and public schools might differ in some unobservable characteristics, such as cheating norms, and thus, if the proctors

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<sup>42</sup>Alternatively, we have also considered a triple DD and used both our corruption index as a binary variable and as a continuous variable. The main coefficient of interest has the same positive sign, and it is statistically significant only for the non-theoretical schools. We have also tested for the existence of pre-treatment trends separately for the most and least corrupted counties. For both the average score and the share of students passing the Romanian written exam we find that the interaction estimates are negative and statistically significant for the most corrupted counties (but smaller in magnitude than the main interaction estimates reported in Table 6a and 6b) and statistically insignificant for the group of the least corrupted counties.



decrease their effort, this may have a stronger effect, on average, on the public students, if they are more predisposed to cheating.

To shed light on this issue, we employ our main strategy on a measure of the share of students caught cheating (in class) and expelled from the exam, from the total number of students taking the exam (at the school level). The interaction term between the public and the year indicators is never significant in Table 7, which seems to support that, indeed, what we measure is a change in corruption and not a change in in-class cheating.

In the same line, another potential confounder concerns the evaluators, who could arguably have also decreased their assessment effort in 2010 in response to the wage cut. One could reason that if there were proportionally more students on the verge of passing in public schools relative to private schools, a generally less stringent assessment could favor the public students, driving them to the observed average difference in outcomes. We address this concern by showing the distribution of individual grades in the Romanian written exam in 2009 and 2010 separately for public and private students in Figure 3. The figure displays a lower spike at the threshold mark 5 for the public relative to private students in both years, suggesting an opposite situation to the one claimed above. Moreover, we note that the private students' grade distribution remains virtually unchanged from 2009 to 2010, while the grade distribution of public students visibly shifts to the right, lending further support to the corruption-inflated grades hypothesis. It is interesting to note that there is a relative increase in public student shares that attain grades between 6 and 8 in 2010 relative to 2009. Furthermore, while the spike at grade 5 decreases for public students, a new spike at 6 arises in 2010 for these students, which is concomitant with a decrease in the share of students situated just below 6 (i.e., the percentage gap between students just below and just above 6 increases). This is well in line with the requirement that students attain a

minimum average grade of 6, which in 2010 is more pressing, given the reduced number of opportunities to score high marks (oral exams no longer count).

The finding that effort and cheating responses are irrelevant is not particularly surprising to us. As previously mentioned, the time frame from the announcement of the wage cut to the exam period is very short.<sup>43</sup>

### 5.2.3 *The share of exam takers*

Finally, we should rule out a differential 2009-2010 evolution in the share of public and private students taking the Baccalaureate as the driver behind our results. Albeit far from perfect, our proxies for the share of 12<sup>th</sup> grade students enrolled in the final exam show a larger increase in this share in private than in public schools.<sup>44</sup> This is unlikely to have happened on grounds of the wage cut announced on May 7<sup>th</sup> in 2010, since the exam registration period was before May 2010. However this would be a problem for our estimates if marginal students were of lower ability: we might suspect exam scores could decrease more in private than in public schools between 2009 and 2010, partly because of changed composition of students. However, including proxies for the school share of exam takers in the regression equation (1), we actually find that the DD-estimate ( $\hat{\beta}_3$ )

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<sup>43</sup> One reason for the student effort to evolve differently between the public and private school students is if the parents of these students are affected differently by the wage cut. This would be the case of public school students are more likely to have parents employed in the public sector. However, even if this is the case, it is not obvious in what direction this would affect our estimates. On the one hand, parents affected by the wage cut might be more willing to pay bribes in order to avoid future university fees for their children (which are lower for students with higher exam scores). On the other hand, lower incomes means there are less available resources to be spent on bribes. Because we are lacking data on the occupations of the parents, we are not able to investigate this issue empirically.

In addition to the issue about student effort, if, for example, students fear that the evaluators will be more demanding in 2010 as a behavioral reaction to the wage cut because both public and private students are graded by public teachers, their level of awareness should be the same. Thus, their incentives to invest in marginally more preparation, either individual or through potential private tutoring, should not differ.

<sup>44</sup> Our preferred proxy suggests that the share of exam takers has increased from 0.89 to 0.91 in public schools and 0.68 to 0.81 in private schools. Note that we are getting that the share of exam takers are above 100% for about 10 percent of the schools (we have then restricted these schools to have a share equal to one). Also note that this preferred proxy likely is of lower quality in 2009 compared to 2010.

increases in magnitude for both our exam outcomes.<sup>45</sup> Although the share of exam registers is endogenous, this lends support to that our main estimates are not upward biased because of a changed composition of students taking the exam.

Overall, we conclude that it is unlikely to have confounding factor driving our positive effects estimates, indicating that the unexpected public sector wage cut generated an increase in corruption, most likely through public school teachers reacting to the cut by taking more bribes to influence students' exam scores.

### ***5.3. Additional estimations: The expenditures, wages and income from households with private and public educators***

If the 25% wage cut translates into a similar-sized decrease of household expenditures for the public school staff, but not for their private counterparts, then bribes are probably not the main explanation for our results. However, if despite the wage cut, we find household expenditures to evolve similarly for the public and the private school staff, we may infer that this is because of more and/or higher bribes received by the public education staff.<sup>46</sup> We are able to investigate this issue in some detail using the 2009 and 2010 Romanian Household Budget Survey data, which contains detailed socio-economic information for about 30,000 households each year and is the main tool of assessing population consumption and expenditures by Statistics Romania.

In particular, our approach here is to compare changes in expenditures before (January – June) and after (July- December) the actual wage cut in July 2010 for households where at least one member is employed in the public and the private

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<sup>45</sup> As we want to capture effects of the change in the share of students registering for the exam between 2009 and 2010, we include this variable both as a main variable ( $shexam_s$ ) and as a variable interacted with year10 ( $shexam_s \times yr2010_t$ ) to equation (1). However, only  $shexam_s$  enters statistically significant in these regressions. The estimates (standard errors) of  $\beta_3$  changes from 0.276 (0.118) to 0.396 (0.122) for the exam score and from 0.057 (0.018) to 0.071 (0.018) for the pass rate of the Romanian written exam.

<sup>46</sup> This approach of inferring corruption from data on household expenditures is related to Gorodnichenko and Sabirianova Peter (2007).

education sector.<sup>47</sup> We do this in a DD empirical strategy, similar to the one where we analyze the exam scores. More specifically, we estimate the following equation:

$$E_{ht} = \delta_0 + \delta_1 Public_h + \delta_2 after\_cut_t + \delta_3 Public_h \times after\_cut_t + \pi X_{ht} + \theta_t + \varepsilon_{ht}$$

where  $h$  indexes a household at month  $t$ .  $E_{ht}$  is the log of one of the following outcomes:<sup>48</sup> *a*) total household expenditures, *a1*) consumption expenditures, *a2*) investment expenditures or *a3*) expenditures on services; *b*) total income; *b1*) income from wages (excluding in-kind transfers);  $Public_h$  is an indicator that equals 1 if household  $h$  contains a public school personnel and 0 if it contains a private school personnel;  $after\_drop_t$  is an indicator that equals 1 after July 2010 survey and 0 before July 2010;  $X_{ht}$  represent controls for household size, respondent is a male and urban indicators, and  $\theta_t$  includes a set of monthly dummies, which we include because of possible seasonal variation in the outcome variables. Our key coefficient is  $\delta_3$ , the DD estimand, which measures the change in household expenditures after the cut in July 2010 relative to before the cut, for public relative to private education personnel. In all our regressions, we cluster the standard errors at the county level.

We present these findings in Table 8, Panel A for the year 2010 while in Panel B we show results from a falsification exercise, using the 2009 period. The results, without and with additional control variables, are reported as follows: *total expenditures* in columns (1)-(2), *consumption expenditures* in columns (3)-(4), *investment expenditures* in columns (5)-(6), *services expenditures* in columns (7)-

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<sup>47</sup> In particular, we restrict our sample to households where at least one member is employed in education. However, we cannot distinguish here between primary, secondary, tertiary level teachers, other consultants in education (*specialisti in invatamant*) and the administrative personnel.

<sup>48</sup> Households' income and expenditures are registered on a monthly base.

(8), *total household income* in columns (9)-(10) and finally *income from wage* in the last two columns.

In Panel A we observe that for all measures of expenditures, regardless of whether we add control variables, the DD estimates are always statistically insignificant. From these results we may infer that the wage cut caused no differential response in household expenditures for private and public educators. If we relate the interaction estimates to the means (approximately 3,000RON for total expenditure) we can infer that the coefficient estimates are small in size: the conditional estimate in column (2) is interpreted as a 4 percent decrease in total consumption for public educators (relative to private educators), before and after the wage cut. Results in Panel B for 2009 show a similar pattern, which means that differential consumption patterns for workers in the public and private education sectors are no different in 2009 compared to 2010.<sup>49</sup>

In the last four columns we show DD-estimates from regressions using total income and wage as outcome variables. Interestingly, we indeed find that the wage cut resulted in significantly lower wages (of about 30%) for household with members employed in the public vs. private education. However, although estimates are negative, we do not find any statistically significant effect on total income. The difference in the effects for total income and wages could be due total income involving income also from bribes or from increased work in the informal sector for public sector workers. Admittedly, the estimates are fairly imprecisely estimated. Lastly, we note that the effects for total income and wages for 2009 are statistically insignificant.

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<sup>49</sup> Additionally, we have also looked at savings and in-kind transfers and we have not seen any significant changes. However when we consider changes in consumption pattern for all household with members in public vs. private sectors, regardless on the sector of employment, we find significant changes in services expenditures.

## **6. Further results**

### ***6.1 Effects for the overall pass rate***

While passing the Romanian written exam is a necessary condition for qualifying for an overall exam pass, it represents only one third of the total grade. Hence, the outcome that holds the highest stake in future studies or employment is the overall exam pass. However, as explained before, a few changes to the exam format were applied in 2010 that would, most likely, negatively affected the overall pass rate. Still, finding a significant impact of the wage cut on the average pass rates would lend further credence to our hypothesis.

If we analyze the effects on the overall pass rate, the results are qualitatively similar to the results for the pass rate on the Romanian written exam. In regressions of equation (1) we find that the interaction estimate is about 50 percent larger than for the pass rate on the Romanian written exam: estimates range between 0.091 and 0.115 and are statistically significant (although much less precisely estimated). For this outcome we have also employed similar sensitivity analysis as for our two main outcomes in Section 5. The placebo 2008 vs. 2009 regressions shows small and insignificant effects for the interaction term, while looking separately at the most vs. the least corrupted counties we show that, similar to our two main outcomes of interest, this outcome has also been improved only in the most corrupted counties. Results show the expected pattern when we look at the examination center and matching estimations, even though for the latter specification the results are not always statistically significant.

### ***6.2. Heterogeneous effects***

In this section, we explore whether corruption responds to the wage cut in distinct ways across high schools with different characteristics. In particular, we look at

DD estimates in schools with different proportions of female students (Panel A of Table 9), different ethnic compositions (Panel B), varying shares of teachers paid by the hour (Panel C) and, different age of the school principal (Panel D).

The most interesting findings are the following:

- a) The DD estimates are significant only for high schools with a minority population of female students, suggesting that male dominated schools are more prone to appeal to corruption especially when the financial incentives are accentuated. While this does not exclude milder forms of fraud, such as increased male to female student cheating in the exam rooms, this finding is also consistent with an outward shift in demand for illegal grades meeting the increased supply by didactic staff, where male students are dominant.
- b) The impact of the wage cut is significant in ethnically mixed high schools (defined as having the share of Romanians less than 1), which is true both for the average pass and for the average grade in the Romanian written exam.
- c) Schools with a higher prevalence of teachers working part time (i.e., the share of teachers paid by the hour is larger than the mean=11%) are more responsive to monetary incentives. This might indicate that less organized schools or teachers who have loose ties to the teacher labor market (by being hired on a temporary contract), are more easily influenced by principals to be involved in corruptive behavior. However, it should be noted that very few schools have a high proportion of part-time teachers. If we exclude the few schools with more than 50% of teachers paid by the hour, we get positive and statistically DD-estimates that are in line with our baseline estimates.
- d) Schools with a younger school principal (i.e., smaller than the mean age=48) are more responsive to monetary incentives. This might be in line with the

increase in corruption in schools over time in Romania, so that older principals were used to working in a system of less corruption.

## **7. Discussion and conclusion**

This study responds to the imperative call for diagnosing the causes of corruption, which is a pandemic disorder particularly in developing and transition countries. Despite the advances and innovations of recent research in measuring and understanding the determinants and consequences of this phenomenon, little is known about the effects of civil servants' financial incentives on their proclivity to engage in corrupt practices.

We exploit an unexpected wage cut of 25%, which occurred in 2010 in Romania and affected the entire public sector, to investigate the causal relationship between wage loss and the intensity of corruption. We base our analysis in the educational system, which was largely affected by the reduction in wages. Using data from the national Romanian Baccalaureate exam, we implement a DD estimation of the effect of the wage cut on exam outcomes in the public schools, by comparison with private schools, which did not experience any wage shock. Our estimates show that the wage cut caused a disproportionate change in average grades and passing rates in public high schools relative to private ones between 2010 and 2009. We attribute the estimated positive difference in exam outcomes between public and private schools to an intensification of corrupt activity by public school staff that is strictly related to the wage loss. Our conclusion is also supported by falsification tests where we find no impact on exam scores between 2008 and 2009 and placebo tests where we use variation in corruption at the county level. These results are further supported by the finding that household expenditures for private and public educators, respectively, did not have a differential evolution between 2009 and 2010.



Overall, our finding of increased exam outcomes for public school students because of the exogenous wage cut of public schools personnel, in a set-up of imperfect monitoring and non-zero risk of punishment, seem to support to the key prediction of the Becker-Stigler model.

Our results provide a snapshot of the undesired impact the policies of budget contraction had on the illicit behavior of affected agents, which is of particular relevance in the context of the recent adoption of austerity measures by post-crisis financially distressed EU members. Such drastic types of reductions in public spending are particularly dangerous in vulnerable environments that are already predisposed to corruption.

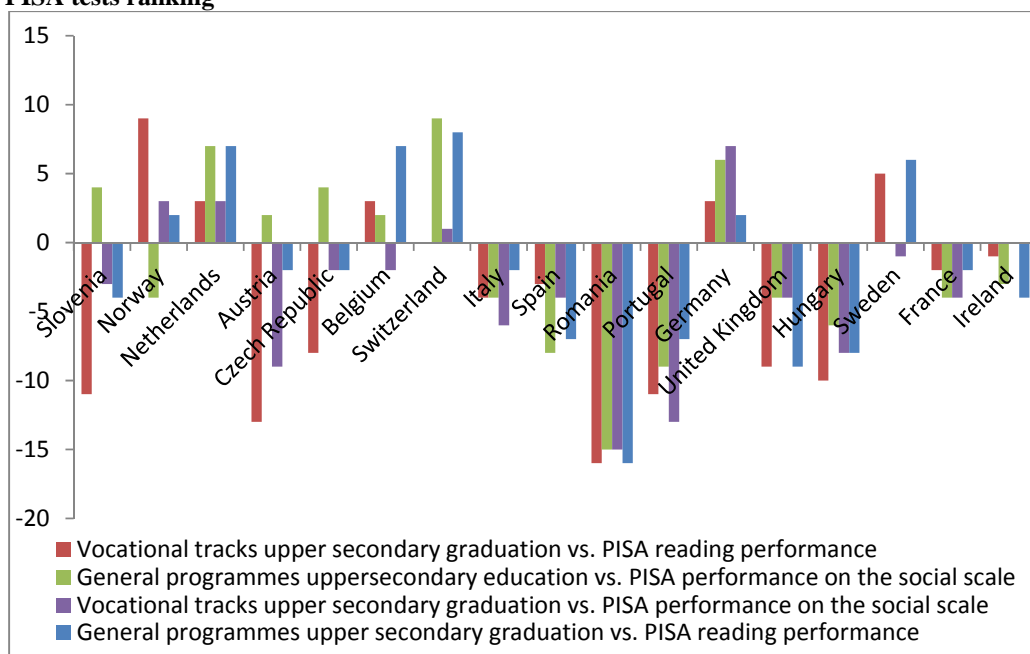
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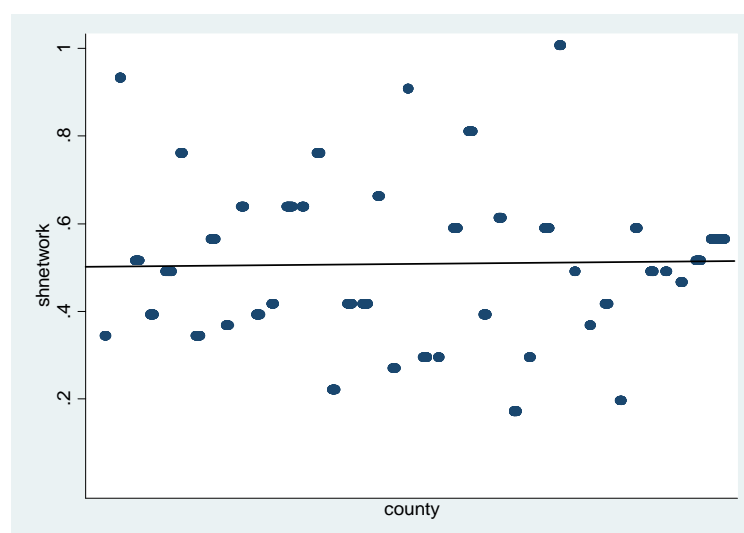
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**Figure 1. Country rank: the difference of upper secondary school graduation ranking vs. PISA tests ranking**



*Notes:* We consider a sample of European countries and compute their ranking based on: (1) the 2009 percent of students graduating from upper secondary education (separately for the general and vocational tracks) and (2) the 2009 PISA test scores in reading and the social scale performance. The figure shows that difference in these rankings: (1)-(2). Source: Authors' calculations using and [www.oecd.org/dataoecd/62/3/48630687.pdf](http://www.oecd.org/dataoecd/62/3/48630687.pdf).

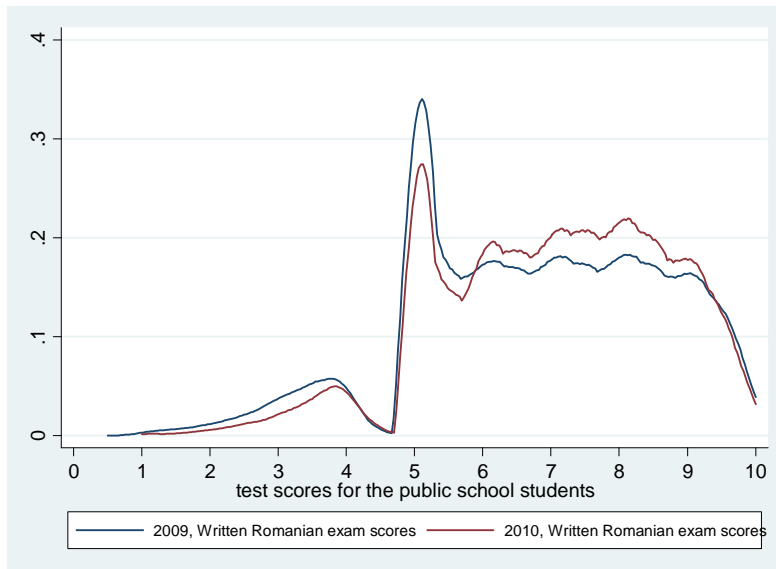
**Figure 2. Share of informal networks across Romanian counties**



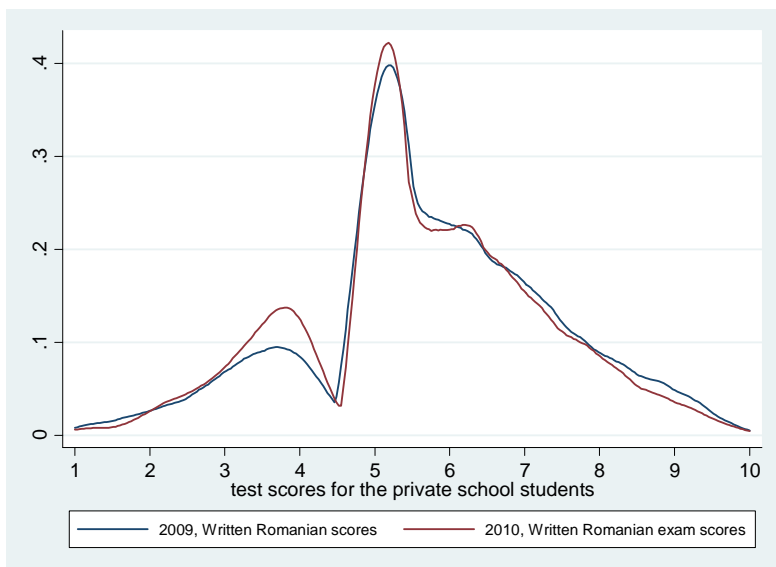
*Source:* our calculations using the 2007 Public Opinion Barometer, Soros.

**Figure 3.**

**a. Distributions of average grades in the Romanian written exam, public school students 2009-2010**



**b. Distributions of average grades in the Romanian written exam, private school students 2009-2010**



**Table 1: Descriptive Statistics**

<b><u>2010 (N=825)</u></b>		Mean	S.D.	Min	Max
All schools	Public schools	0.942	0.234	0	1
	Theoretic track	0.267	0.442	0	1
	Vocational track	0.079	0.270	0	1
	Technologic and mixed tracks	0.655	0.476	0	1
	Average Grade Romanian written exam	7.010	1.054	4.103	9.421
	Average Pass Rate Romanian written exam	0.940	0.086	0.471	1
	Average Pass Rate Overall exam	0.717	0.301	0	1
Private	Average Grade Romanian written exam	5.606	0.798	4.103	8.606
	Average Pass Rate Romanian written exam	0.802	0.116	0.471	1
	Average Pass Rate Overall exam	0.405	0.260	0	0.985
Public	Average Grade Romanian written exam	7.095	1.032	4.367	9.421
	Average Pass Rate Romanian written exam	0.946	0.074	0.521	1
	Average Pass Rate Overall exam	0.717	0.295	0	1
<b><u>2009 (N=825)</u></b>					
All schools	Public schools	0.942	0.234	0	1
	Theoretic track	0.267	0.442	0	1
	Vocational track	0.079	0.270	0	1
	Technologic and mixed tracks	0.655	0.476	0	1
	Average Grade Romanian written exam	6.771	1.171	3.593	9.327
	Average Pass Rate Romanian written exam	0.913	0.111	0.333	1
	Average Pass Rate Overall exam	0.816	0.207	0.076	1
Private	Average Grade Romanian written exam	5.746	0.784	3.878	8.325
	Average Pass Rate Romanian written exam	0.840	0.114	0.533	1
	Average Pass Rate Overall exam	0.625	0.243	0.111	1
Public	Average Grade Romanian written exam	6.854	1.183	3.593	9.327
	Average Pass Rate Romanian written exam	0.918	0.102	0.333	1
	Average Pass Rate Overall exam	0.822	0.197	0.076	1
<b><u>2008 (N=809)</u></b>					
All schools	Public schools	0.947	0.224	0	1
	Theoretic track	0.269	0.444	0	1
	Vocational track	0.080	0.272	0	1
	Technologic and mixed tracks	0.650	0.477	0	1
	Average Grade Romanian written exam	6.975	1.113	3.688	9.322
	Average Pass Rate Romanian written exam	0.929	0.098	0.36	1
	Average Pass Rate Overall exam	0.805	0.228	0	1
Private	Average Grade Romanian written exam	5.834	1.079	3.688	8.26
	Average Pass Rate Romanian written exam	0.816	0.143	0.36	1
	Average Pass Rate Overall exam	0.612	0.264	0.04	1
Public	Average Grade Romanian written exam	7.036	1.076	3.768	9.322
	Average Pass Rate Romanian written exam	0.934	0.084	0.483	1
	Average Pass Rate Overall exam	0.809	0.213	0	1

Notes: Average Grade Romanian written exam - the average grade in the Romanian written exam at school level; Average Pass Rate Romanian written exam – the share of students per school who passed the Romanian written exam; Average Pass Rate Overall exam – the share of students per school who passed the overall exam; Note: The changes in the calculation of overall exam pass rates in 2010 relative to earlier years makes comparison of these numbers difficult.

**Table 2: Effects on the standardized written Romanian exam, 2010 vs. 2009 academic years**

Dependent variable:	Average grade score			Share of students passing exam		
	(1)	(2)	(3)	(4)	(5)	(6)
Public	1.107*** (0.144)	1.111*** (0.219)	1.068*** (0.188)	0.078*** (0.020)	0.074*** (0.022)	0.072*** (0.018)
yr10	-0.140 (0.122)	-0.095 (0.131)	-0.044 (0.116)	-0.038** (0.018)	-0.035* (0.018)	-0.030* (0.018)
public x yr10	0.381*** (0.125)	0.338** (0.133)	0.276** (0.118)	0.066*** (0.019)	0.064*** (0.019)	0.057*** (0.018)
Theoretic		1.229*** (0.091)	1.310*** (0.079)		0.054*** (0.007)	0.060*** (0.006)
Technologic		-0.455*** (0.086)	-0.449*** (0.082)		-0.034*** (0.008)	-0.035*** (0.008)
County FE	NO	NO	YES	NO	NO	YES
Observations	1,650	1,650	1,650	1,650	1,650	1,650
R-squared	0.053	0.381	0.486	0.070	0.194	0.338

Notes: All regressions are weighted with the number of (per school) students taking the exam. The standard errors, shown in parentheses, are clustered at the school level. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 3: Effects on the standardized written Romanian exam, 2009 vs. 2008 academic years**

Dependent variable:	Average grade score			Share of students passing exam		
	(1)	(2)	(3)	(4)	(5)	(6)
Public	1.201*** (0.193)	1.253*** (0.266)	1.188*** (0.209)	0.118*** (0.027)	0.118*** (0.028)	0.113*** (0.022)
yr09	-0.064 (0.101)	-0.053 (0.102)	-0.110 (0.119)	0.028 (0.019)	0.028 (0.019)	0.024 (0.020)
public x yr09	-0.114 (0.103)	-0.139 (0.104)	-0.088 (0.121)	-0.043** (0.020)	-0.044** (0.019)	-0.041** (0.020)
Theoretic		1.225*** (0.091)	1.309*** (0.076)		0.063*** (0.006)	0.068*** (0.006)
Technologic		-0.433*** (0.092)	-0.428*** (0.080)		-0.030*** (0.009)	-0.032*** (0.008)
County FE	NO	NO	YES	NO	NO	YES
Observations	1,618	1,618	1,618	1,618	1,618	1,618
R-squared	0.030	0.343	0.523	0.031	0.166	0.345

Notes: All regressions are weighted with the number of (per school) students taking the exam. The standard errors, shown in parentheses, are clustered at the school level. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 4: Effects on the standardized written Romanian exam, 2006-2010 academic years**

Dependent variable:	Average grade score		Share of students passing exam	
	(1)	(2)	(3)	(4)
Public	1.158*** (0.145)	1.107*** (0.117)	0.129*** (0.026)	0.124*** (0.022)
yr07	0.166* (0.095)	0.156* (0.0807)	0.041*** (0.013)	0.041*** (0.011)
yr08	0.503*** (0.149)	0.478*** (0.117)	0.070*** (0.024)	0.069*** (0.020)
yr09	0.342* (0.207)	0.301* (0.158)	0.071** (0.035)	0.069** (0.028)
yr10	0.208 (0.179)	0.213 (0.152)	0.037 (0.031)	0.039 (0.027)
public x yr10	0.395* (0.224)	0.327* (0.181)	0.080** (0.033)	0.074*** (0.028)
public x trend	-0.019 (0.072)	-0.006 (0.056)	-0.017 (0.012)	-0.016* (0.010)
County FE	NO	YES	NO	YES
Observations	4,142	4,142	4,142	4,142
R-squared	0.058	0.148	0.057	0.182

Notes: All regressions are weighted with the number of (per school) students taking the exam. Robust standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 5. Matching private and public schools**

**Panel A: Average grade for the standardized written Romanian exam**

Public	0.068** (0.024)	0.065** (0.024)	0.064*** (0.017)
Controls	NO	YES	YES
Pre-reform outcome	NO	NO	YES
Observations	86	86	86
R-squared	0.088	0.206	0.515

**Panel B: Average pass rate for the standardized written Romanian exam**

public	0.233 (0.158)	0.237 (0.207)	0.268* (0.146)
Controls	NO	YES	YES
Pre-reform outcome	NO	NO	YES
Observations	86	86	86
R-squared	0.026	0.133	0.484

Notes: All regressions are weighted with the number of (per school) students taking the exam. The standard errors, shown in parentheses, are clustered at the school level. Controls include a theoretic dummy, the shares at the school level of: female students, Romanians, teachers per student. Pre-reform outcome is the lag outcome from 2008 and 2009. \*\*\* p<0.01, \* p<0.1



**Table 6. Corruption at the county level****Panel A: Average grade written Romanian exam 2009-2010, by county level of corruption**

	(1)	(2)	(3)	(4)	(5)	(6)
	<u>Most corrupt counties</u>			<u>Least corrupt counties</u>		
Public	1.064*** (0.152)	0.978*** (0.258)	0.844*** (0.244)	1.154*** (0.274)	1.330*** (0.405)	1.420*** (0.273)
yr10	-0.189 (0.116)	-0.127 (0.128)	-0.107 (0.122)	-0.0004 (0.260)	-0.077 (0.302)	-0.012 (0.281)
public x yr10	0.496*** (0.120)	0.439*** (0.131)	0.412*** (0.126)	0.145 (0.263)	0.215 (0.304)	0.140 (0.283)
Theoretic		1.337*** (0.121)	1.356*** (0.108)		1.184*** (0.121)	1.267*** (0.113)
Technologic		-0.253** (0.108)	-0.391*** (0.106)		-0.671*** (0.138)	-0.540*** (0.129)
County FE	NO	NO	YES	NO	NO	YES
Observations	988	988	988	662	662	662
R-squared	0.064	0.398	0.484	0.038	0.385	0.483

**Panel B: Share of students passing written Romanian exam 2009-2010, by county level of corruption**

	(1)	(2)	(3)	(4)	(5)	(6)
	<u>Most corrupt counties</u>			<u>Least corrupt counties</u>		
Public	0.081*** (0.022)	0.075*** (0.026)	0.063*** (0.024)	0.067** (0.034)	0.071* (0.039)	0.082*** (0.027)
yr10	-0.039* (0.022)	-0.036 (0.022)	-0.033 (0.022)	-0.027 (0.030)	-0.030 (0.031)	-0.024 (0.030)
public x yr10	0.072*** (0.023)	0.069*** (0.023)	0.066*** (0.022)	0.048 (0.030)	0.052 (0.031)	0.044 (0.030)
Theoretic		0.067*** (0.009)	0.067*** (0.008)		0.042*** (0.007)	0.050*** (0.007)
Technologic		-0.021* (0.011)	-0.036*** (0.011)		-0.045*** (0.012)	-0.030*** (0.011)
County FE	NO	NO	YES	NO	NO	YES
Observations	988	988	988	662	662	662
R-squared	0.076	0.199	0.323	0.058	0.200	0.348

Notes: All regressions are weighted with the number of (per school) students taking the exam. The standard errors, shown in parentheses, are clustered at the school level. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 7. Share of expelled students (caught cheating)  
from the exam, 2010 vs. 2009 academic year**

	(1)	(2)	(3)
public	-0.004*	-0.004*	-0.0035*
	(0.002)	(0.002)	(0.002)
year10	0.003	0.003	0.003
	(0.006)	(0.006)	(0.006)
public x y10	-0.0038	-0.0038	-0.0037
	(0.006)	(0.006)	(0.006)
theoretic		-0.001**	-0.001***
		(0.000)	(0.000)
technologic		0.001	0.0003
		(0.000)	(0.000)
County FE	NO	NO	YES
Observations	1 650	1 650	1 650
R-squared	0.028	0.037	0.061

*Notes:* The standard errors, shown in parentheses, are clustered at the school level.\*\*\* p<0.01,\*\* p<0.05,\* p<0.1. In 2010, the mean share of expelled students is 0.0013 and the S.D. is 0.0083.

**Table 8. Total household expenditures, income and wages for household with at least one member employed in the education system**

	<u>total expenditures</u>		<u>consumption expenditures</u>		<u>investment expenditures</u>		<u>services</u>		<u>total income</u>		<u>income from wage</u>	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
<b><i>Panel A: 2010- Households with publicly and privately employed members in education</i></b>												
public	-0.250***	-0.162***	-0.204***	-0.093**	-0.113	-0.113*	-0.271***	-0.159*	-0.203***	-0.203***	-0.391***	-0.395***
	(0.032)	(0.036)	(0.020)	(0.027)	(0.066)	(0.057)	(0.057)	(0.072)	(0.050)	(0.050)	(0.051)	(0.080)
after_drop	-0.062	-0.031	-0.050	-0.067	-0.081	0.046	0.068	0.092	-0.079	-0.079	-0.450	-0.308
	(0.059)	(0.046)	(0.063)	(0.073)	(0.223)	(0.134)	(0.085)	(0.098)	(0.202)	(0.202)	(0.278)	(0.286)
public*after_drop	-0.037	-0.043	-0.027	-0.039	0.163	0.165	-0.008	0.001	-0.085	-0.086	-0.300**	-0.300**
	(0.050)	(0.054)	(0.053)	(0.059)	(0.204)	(0.208)	(0.071)	(0.062)	(0.053)	(0.053)	(0.101)	(0.105)
monthly dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
controls	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	NO
Observations	1,046	1,046	1,046	1,046	1,046	1,046	1,046	1,046	1,046	1,046	1,046	1,046
R-squared	0.083	0.159	0.067	0.174	0.009	0.014	0.057	0.153	0.136	0.136	0.086	0.091
<b><i>Panel B: 2009 - Households with publicly and privately employed members in education</i></b>												
public	-0.243***	-0.158**	-0.204***	-0.091**	-0.036	-0.055	-0.238***	-0.089	-0.147*	-0.147*	-0.409***	-0.371***
	(0.047)	(0.049)	(0.029)	(0.038)	(0.074)	(0.088)	(0.052)	(0.067)	(0.064)	(0.064)	(0.093)	(0.096)
after_drop	0.034	0.006	0.251***	0.209***	-0.151	-0.154	-0.107	-0.140	-0.025	-0.025	0.116	0.115
	(0.055)	(0.046)	(0.065)	(0.053)	(0.122)	(0.129)	(0.116)	(0.077)	(0.061)	(0.062)	(0.088)	(0.111)
public*after_drop	0.064	0.045	-0.028	-0.045	0.103	0.101	0.100	0.078	-0.018	-0.018	-0.193	-0.223
	(0.064)	(0.069)	(0.053)	(0.056)	(0.135)	(0.134)	(0.058)	(0.062)	(0.107)	(0.107)	(0.212)	(0.223)
monthly dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
controls	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
Observations	1,119	1,119	1,119	1,119	1,119	1,119	1,119	1,119	1,119	1,119	1,119	1,119
R-squared	0.050	0.134	0.073	0.179	0.009	0.017	0.035	0.156	0.125	0.125	0.099	0.121

NOTES: All outcomes are in logs. The sample includes all households where at least one member is employed in the public or the private education (CAEN Rev 2, activity code 16=education). We cannot differentiate here between the teachers - primary, secondary, high school or university teachers, consultants in education (*specialisti in invatamant*), or the administrative personnel. Total household expenditures is the (deflated) consumption, investment, production and services; total income is the (deflated) total income in the household (including in-kinds transfers, wage income, property related income, etc.); finally, income from wage includes the gross wage without the in-kind transfers. Standard errors clustered at the county level.

**Table 9. Heterogeneous effects: gender, ethnic composition, teacher and management composition, all outcomes, 2010 vs. 2009 academic years**

	Average Grade Romanian Exam				Average Passing Rate Romanian Exam			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<b><u>Panel A</u></b>	<b><u>I. Female share &lt;0.5</u></b>		<b><u>II. Female share &gt;0.5</u></b>		<b><u>I. Female share &lt;0.5</u></b>		<b><u>II. Female share &gt;0.5</u></b>	
public	0.286*	0.508***	1.971***	1.921***	0.011	0.017	0.161***	0.156***
	(0.171)	(0.174)	(0.211)	(0.318)	(0.024)	(0.020)	(0.029)	(0.029)
yr10	-0.256*	-0.153	0.072	0.067	-0.053**	-0.042**	-0.009	-0.005
	(0.136)	(0.119)	(0.278)	(0.313)	(0.022)	(0.020)	(0.032)	(0.032)
public x yr10	0.534***	0.418***	0.143	0.142	0.091***	0.079***	0.031	0.026
	(0.141)	(0.125)	(0.280)	(0.314)	(0.023)	(0.021)	(0.033)	(0.033)
County FE	NO	YES	NO	YES	NO	YES	NO	YES
Observations	752	752	898	898	752	752	898	898
R-squared	0.041	0.474	0.069	0.422	0.049	0.361	0.133	0.327
<b><u>Panel B</u></b>	<b><u>I. Share Romanians=1</u></b>		<b><u>II. Share Romanians&lt;1</u></b>		<b><u>I. Share Romanians=1</u></b>		<b><u>II. Share Romanians&lt;1</u></b>	
public	1.301***	0.789***	0.836***	0.982***	0.100***	0.050	0.046*	0.057**
	(0.176)	(0.293)	(0.197)	(0.255)	(0.024)	(0.033)	(0.026)	(0.024)
yr10	0.064	0.108	-0.304*	-0.186	-0.006	-0.001	-0.065***	-0.057***
	(0.153)	(0.159)	(0.165)	(0.154)	(0.026)	(0.026)	(0.022)	(0.021)
public x yr10	0.175	0.104	0.546***	0.423***	0.042	0.035	0.092***	0.083***
	(0.163)	(0.168)	(0.168)	(0.156)	(0.026)	(0.027)	(0.023)	(0.021)
County FE	NO	YES	NO	YES	NO	YES	NO	YES
Observations	406	406	1,244	1,244	406	406	1,244	1,244
R-squared	0.104	0.531	0.033	0.489	0.121	0.416	0.047	0.327
<b><u>Panel C</u></b>	<b><u>I. Share part-time&lt;=0.11</u></b>		<b><u>II. Share part-time&gt;0.11</u></b>		<b><u>I. Share part-time&lt;=0.11</u></b>		<b><u>II. Share part-time&gt;0.11</u></b>	
public	1.324***	1.224***	0.886***	0.996***	0.110***	0.095***	0.053**	0.056**
	(0.205)	(0.447)	(0.185)	(0.203)	(0.022)	(0.031)	(0.025)	(0.023)
yr10	0.024	0.146*	-0.205	-0.096	-0.002	0.004	-0.051**	-0.041*
	(0.104)	(0.087)	(0.162)	(0.151)	(0.024)	(0.023)	(0.023)	(0.021)
public x yr10	0.205*	0.081	0.470***	0.339**	0.028	0.021	0.085***	0.073***
	(0.108)	(0.091)	(0.167)	(0.156)	(0.024)	(0.024)	(0.023)	(0.022)
County FE	NO	YES	NO	YES	NO	YES	NO	YES
Observations	1,036	1,036	614	614	1,036	1,036	614	614
R-squared	0.033	0.502	0.077	0.493	0.048	0.347	0.091	0.334
<b><u>Panel D</u></b>	<b><u>I. Principals' age&lt;48</u></b>		<b><u>II. Principals' age&gt;=48</u></b>		<b><u>I. Principals' age&lt;48</u></b>		<b><u>II. Principals' age&gt;=48</u></b>	
public	1.038***	1.011***	1.275***	1.141***	0.0761***	0.070***	0.088***	0.078***
	(0.201)	(0.256)	(0.203)	(0.220)	(0.025)	(0.023)	(0.032)	(0.029)
yr10	-0.287**	-0.130	0.102	0.079	-0.059***	-0.048**	-0.005	-0.003
	(0.132)	(0.124)	(0.221)	(0.232)	(0.020)	(0.019)	(0.033)	(0.033)
public x yr10	0.482***	0.319**	0.179	0.190	0.083***	0.071***	0.037	0.034
	(0.137)	(0.129)	(0.223)	(0.234)	(0.021)	(0.020)	(0.033)	(0.033)
County FE	NO	YES	NO	YES	NO	YES	NO	YES
Observations	798	798	852	852	798	798	852	852
R-squared	0.065	0.510	0.046	0.502	0.100	0.375	0.054	0.344

Notes: All regressions are weighted with the number of (per school) taking the exam and the standard errors, shown in parentheses, are clustered at the school level. We always control for track. We show: in Panel A – schools with different shares of female students; in Panel B – ethnically homogenous and non-homogenous schools; Panel C – shares of teachers paid by hour contract (0.11=mean); Panel D – average age of schools' management (48 years=mean). \*\*\*p<0.01, \*\*p<0.05, \*p<0.1

## Appendix: Not intended for publication

**Table A1. Outcomes at the examination center, 2010 vs. 2009 academic years**

**Panel A: Average grade for the standardized written Romanian exam**

	(1)	(2)	(3)	(4)	(5)
public	1.316*** (0.183)	1.316*** (0.226)	1.158*** (0.174)	1.288*** (0.160)	1.242*** (0.192)
yr10	-0.140 (0.123)	-0.103 (0.129)	-0.0849 (0.125)	0.0216 (0.126)	-0.140 (0.148)
public x yr10	0.300** (0.151)	0.319** (0.150)	0.286* (0.146)	0.166 (0.150)	0.336* (0.186)
theoretic		1.162*** (0.178)	1.040*** (0.154)	0.876*** (0.178)	0.573** (0.280)
technologic		-0.253 (0.196)	-0.361** (0.168)	-0.433*** (0.151)	-0.594*** (0.219)
County FE	NO	NO	YES	NO	YES
Center FE	NO	NO	NO	YES	YES
Observations	324	324	324	324	184
R-squared	0.224	0.476	0.623	0.794	0.782

**Panel B: Average pass rate of the standardized written Romanian exam**

public	0.091*** (0.021)	0.087*** (0.023)	0.076*** (0.012)	0.080*** (0.017)	0.082*** (0.020)
yr10	-0.037** (0.018)	-0.035* (0.018)	-0.032* (0.018)	-0.027 (0.017)	-0.042** (0.021)
public x yr10	0.062*** (0.020)	0.063*** (0.020)	0.055*** (0.019)	0.050** (0.019)	0.065*** (0.024)
theoretic		0.045*** (0.011)	0.037*** (0.011)	0.029** (0.014)	0.0030 (0.020)
technologic		-0.031* (0.016)	-0.040*** (0.015)	-0.054*** (0.016)	-0.072*** (0.020)
County FE	NO	NO	YES	NO	YES
Center FE	NO	NO	NO	YES	YES
Observations	324	324	324	324	184
R-squared	0.236	0.331	0.484	0.674	0.658

Notes: Regressions at the examination center. Column (5) includes only examination centers with at least two private schools. All regressions are weighted with the number of (per school) students taking the exam. The standard errors, shown in parentheses, are clustered at the school level. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table A2. Corruption at the county level (corruption level division based on data from LiTS II)**

**Panel A: Average grade written Romanian exam 2009-2010, by county level of corruption**

	(1)	(2)	(3)	(4)	(5)	(6)
	<u>Most corrupt counties</u>			<u>Least corrupt counties</u>		
Public	1.016*** (0.150)	0.986*** (0.299)	0.945*** (0.255)	1.316*** (0.306)	1.197*** (0.286)	1.189*** (0.259)
yr10	-0.169 (0.106)	-0.161 (0.137)	-0.110 (0.112)	0.129 (0.311)	0.217 (0.309)	0.236 (0.309)
public x yr10	0.494*** (0.112)	0.479*** (0.141)	0.409*** (0.117)	0.081 (0.313)	0.005 (0.311)	-0.012 (0.311)
Theoretic		1.214*** (0.132)	1.335*** (0.113)		1.305*** (0.138)	1.298*** (0.129)
Technologic		-0.360*** (0.127)	-0.337*** (0.121)		-0.483*** (0.126)	-0.547*** (0.119)
County FE	NO	NO	YES	NO	NO	YES
Observations	834	834	834	660	660	660
R-squared	0.070	0.376	0.486	0.039	0.398	0.473

**Panel B: Share of students passing written Romanian exam 2009-2010, by county level of corruption**

	(1)	(2)	(3)	(4)	(5)	(6)
	<u>Most corrupt counties</u>			<u>Least corrupt counties</u>		
Public	0.062*** (0.021)	0.057* (0.030)	0.055** (0.025)	0.125*** (0.043)	0.118*** (0.042)	0.116*** (0.036)
yr10	-0.046** (0.021)	-0.046** (0.022)	-0.040* (0.020)	0.008 (0.037)	0.012 (0.036)	0.015 (0.036)
public x yr10	0.086*** (0.021)	0.085*** (0.022)	0.077*** (0.021)	0.013 (0.037)	0.009 (0.037)	0.006 (0.036)
Theoretic		0.062*** (0.010)	0.072*** (0.009)		0.051*** (0.010)	0.048*** (0.009)
Technologic		-0.030** (0.013)	-0.029** (0.013)		-0.031** (0.012)	-0.038*** (0.011)
County FE	NO	NO	YES	NO	NO	YES
Observations	834	834	834	660	660	660
R-squared	0.087	0.216	0.345	0.059	0.172	0.327

Notes: All regressions are weighted with the number of (per school) students taking the exam. The standard errors, shown in parentheses, are clustered at the school level. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1