Working Paper Series

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ECINEQ WP 2012 – 270

ECINEQ 2012 – 270
October 2012

www.ecineq.org

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Abstract

In the face of past ambiguous results on growth effects of education when measured through school attainment, some papers suggest that some countries may be unable to use productively their schooling output because of the scope of cronyism. We dig deeper and demonstrate that, in a stylized model, cronyism in the labour market, e.g. the ability to exert influence to gain high wage positions without merit, may impact heavily on the relationship between schooling inputs and cognitive skills, due to incentive effects. We then use a two-stage DEA approach to identify factors affecting inefficiency in education performance of OECD countries when the output is proxied by PISA scores.

Along with other well known factors, a measure of corruption, our chosen proxy for cronyism, explains a substantial fraction of the inefficiency. This result suggests that, as in our model, in the presence of cronyism, incentives to cognitive skills acquisition are dampened. Analogously to developing countries but for different reasons, the best way to improve the education system performance in OECD countries may well be to fight corruption and increase transparency in labour access.

Keywords: education, corruption, technical efficiency, DEA.

JEL Classification: C14, C61, D73, I21.

1 Introduction

Being educated in high schools in southern Italy, both authors of this papers vividly remember that accademic performance was not necessarily believed to be a good predictor of professional success among their peers. The prevailing idea was instead that social connections, activated mainly through family and therefore depending on one's background, were a prevailing influence on success, and this was routinely linked to widespread unfairness in access to labour positions, particularly (but not only) in the public sector. This phenomenon is not exclusive of Italy of course. For example in the US a wide literature by now has documented the importance of networks to explain individuals' success in the labour market (for comprehensive surveys see Ioannides and Datcher-Loury, 2004 and Jackson and Zenou, 2012).[1] However this strand of the literature explains the difference in performance of different groups with the existence of job information networks, where the privilege is only in terms of access to information. Our personal experience instead suggests that what may be missing is a level playing field and that some positions may be available only under some conditions. In this view networks restrict access to valuable positions to influential members of society, irrespective from school performance or cognitive skills. The extent to which these phenomena are widespread, tolerated and perceived as normal in different societies may have profound effects on incentives to acquire education and, even more, to perform in education. The consequence is that the perception of the relevance of the cronyism factor must have an impact on the performance of different educational systems, other things equal. In the end this must impact on human capital accumulation, productivity and finally growth (Lucas, 1988, Romer, 1990).

A huge amount of work has been devoted to test the relationship between education and growth with some work focussed on cross-country evidence. Starting with the work of Hanushek and Kimko (2000) and Lee and Barro (2001) direct comparable measures of cognitive skills, measures of the quality of schooling achievement, have been used to proxy human capital and a more stable and strong relationship between these measures and growth has emerged. This result establishes that education is productive only insofar as it produces increases in cognitive skills and therefore explains why educational systems spending comparable sums of money and achieving comparable average years of education may attain completely different results in terms of growth. In particular some work, focusing on the effects of changes of schooling, surprisingly find a weak effect of schooling (Benhabib and Spiegel, 1994; Pritchett, 1996).

[1] A stylized fact that is the basis for every analysis is that surveys reveal unambigously that a varying, but always large proportion of jobs have ben found through social contacts (Calvo-Armengol and Jackson, 2007).

There may be however several reasons why certain countries cannot use productively their education expenditure. One interesting explanation has been put forward in a paper by Rogers (2008) who finds that, when excluding from regression countries on the basis of a high level of a corruption index, a strong relationship between education expenditure and growth emerges. Rogers (2008) suggests that this may be due to the inability of some countries to exploit the product of their education systems, because of corruption. However the relationship between cognitive measures of human capital and growth suggests that the problem may run even deeper than that, as we will argue here. Corruption in particular may affect the link between expenditure in education and cognitive skills attainment irrespective of the formal schooling attainment. We present a stylized model of cognitive skill acquisition in which the incentive to put on effort to increase one's productivity, may be dampened if cronyism allows the allocation of high-salary labour positions to certain 'influential' individuals. We will assume that the influence one can exert is an exogenous feature of individuals stemming from their social position[2]. We show that more cronyism certainly leads to less effort in skills acquisition. cronyism therefore reduces productivity both directly and through reduced incentives for would-be workers.

We then test the hypothesis that cronyism decreases incentives to skill acquisition by use of a proxy, an index of perceived corruption, focusing on the comparative efficiency of educational systems. Following the results in Hanushek and Kimko (2000) and the wider availability of comparable cross-country measures of school performance at the OECD (PISA), many researchers explored the relationship between education expenditure and cognitive skills. Several papers tried to measure inefficiencies in education provision through the use of the DEA technique (see for example Verhoeven et al., 2007; Afonso and St. Aubyn, 2006). This last paper in particular used the DEA measures of inefficiency to explore the factors that may explain cross country differences. The analysis is performed by the double bootstrap approach, a technique pioneered by Simar and Wilson (2007), which allows to obtain unbiased results of coefficients. In this paper we use the same technique but change substantially the specification by using different measures of output and input, in order to answer our research question. In the second stage we explain the 'inefficiency' variable by use of supply and demand side factors, or, in other terms, the education industry and the general environment factors. On the supply side we find some evidence of effects of the structure of the education sector, in particular in the amount of class hours. On the demand side instead we find that the performance of the education system is heavily influenced by environment factors, such as the share of immigrant parents and more generally the education attainments of parents. But the most interesting result is that an appropriately chosen measure of corruption (the Gallup Corruption Index) is

[2] Of course it is possible to model it as a rent seeking process,(as for example in Acemoglu,1995; Aidt, 2003; Aidt and Hillman, 2008) without affecting substantially the results.

always significant in different specifications. We interpret this as evidence that an important driver of the performance of the education system is the incentive system underlying. When positions are awarded on the basis of influence, the real return on education may be poor. This may not appear in traditional measures of private returns on education because a formal attainment may still be required for access to some positions, but this doesn't mean that they are really awarded on the basis of real education performance[3]. An indirect signal that this route may be appropriate can be found in general in the literature on meritocracy, family background and equality of opportunity (see for example Arrow et al., 2000; Bowles and Gintis, 2002; Bowles et al., 2008) and more specifically in Checchi et al. (2007)[4] who observe that lower educational attainment in individuals with lower education parents can be partly explained with lower real returns from education and find that wages for graduates in Italy are positively correlated with the fathers' education.[5] The likely explanation is the availability of parents' networks that open doors to different opportunities, other things equal. The existence and the scope of this channel dampens incentives to skill acquisition both for the privileged and for the rest.

Several papers, besides Rogers (2008), investigate the effect of corruption on education and health provision (Gupta et al., 2000; Gupta et al., 2002; Reinikka and Svensson, 2005; Björkman 2006; Schütz et al, 2008; Suryadarma, 2012;). Gupta et al. (2002) in particular examine the impact of corruption on some quantitative indicators of education provision and finds a strong effect. The result is interpreted on the basis of Shleifer and Vishny (1993). In this setting corruption increases the cost of education provision, decreases its quality and volume for a given expenditure due to outright theft or illegal payments required by officials (bribes), and perverse systems of recruitment, rewards and promotions for teachers. While we do not rule out entirely these channels, they seem to be more appropriate to explain the phenomenon in developing or underdeveloped countries than OECD countries. For example Gupta et al. (2000) report evidence that access to universal education may in fact be rationed on the basis of bribes in some countries. This appears unlikely to happen in any advanced OECD country. The impact of corruption on cognitive skills in OECD countries is much more likely to stem from reduced incentives to acquire those skills, than from corruption in education provision. To control for sectorial effects of corruption however in the second stage of the analysis, we included also some variables of school accountability, that turn

[3] It is generally possible in most country to gain degree without much effort form a poor reputation institutions, without much effort.

[4] Checchi D., Fiorio, C.V., Leonardi, M., 2007. Intergenerational persistence in educational attainment in Italy. Mimeo.

[5] Bowles and Gintis (2002) provide another example on earnings inheritability. They observe that there is sufficient evidence that "the estimated direct (eg not going through education) effect of parental incomes on offspring earnings has turned out to be remarkably robust. .....These results just reaffirm that .....more than two-fifths of the intergenerational transmission coefficient is unaccounted for".

out to be insignificant.

The contribution of this paper is two-fold. First, we present a stylized model of education and labour with cronyism which demonstrates that the presence and extent of cronyism decreases incentives to acquire cognitive skills. Second we demonstrate empirically that corruption has a significant effect on the inefficiency of educational systems.

The remainder of the paper is structured as follows: Section 2 presents the theoretical model, which provides testable implications for subsequent analysis. Section 3 discusses the empirical methodology. Section 4 describes the data. Section 5 discusses empirical evidence. Section 6 reports policy implication and conclusions.

2 A stylized model of cronyism in labour market and its effect on education

To illustrate the possibility that corruption and cronyism may dampen incentives to acquire cognitive skills, we will present a stylized model with more than one element of realism. Suppose that in a certain economy, positions are allocated on the basis of influence and ability. Ability is in practice cognitive skills (s) both primitive (a) and acquired through education (ϵ). Primitive ability a is randomly and uniformly distributed in the population of workers between 0 and 1.The two terms interact in such a way that a higher primitive ability also increases the gains from education, that is education increases cognitive skills (and productivity) of high primitive-skill workers more than less gifted ones. Hence $s = f(a, \epsilon)$, with $s_a > 0$; $s_\epsilon > 0$; $s_{a\epsilon} > 0$. The education cognitive skills (ϵ) can be acquired with effort by individuals in the population at a fixed monetary-equivalent cost c, and for simplicity takes only two values, e^* and 0. Note that the acquisition of the educational skill does not correspond to the formal acquisition of a degree, but requires additional effort. The cognitive skill level is perfectly observable by the recruiter/selector in the labour market but it is not verifiable. Cognitive skills and therefore education increase lifetime overall productivity, ρ. Hence education is productive contrary to Spence (1973). From society point of view, education for a generic type a worker is productive if:

$$\rho(s(a, e*)) - \rho(s(a, 0) > c \tag{1}$$

Considering the interaction between a and ϵ, the gains in productivity from educational skills are increasing in a. Based on this, we make the implicit additional hypothesis that there is a cutoff level for a^*such that education is only profitable for $a > a^*$.[6]

[6] This in practice corresponds to the hypothesis that education's net returns are positive

Suppose the whole risk-neutral population can also exert influence but with different intensity. The influence intensity parameter r is distributed in the population uniformly [0, 1] and independently from the primitive ability parameter in the population (a)[7]. This means in practice that primitive ability is distributed independently from social and economic conditions, hence talent is distributed randomly in the population.

The selector in the labour market is perfectly able to observe individual parameter s, but acts as an agent of some principal and its incentives cannot be perfectly aligned to the principal's. We will assume that work positions are awarded, other things equal, on the basis of influence, that is, given the level of cognitive skills, s, they will be offered to those exerting more influence (higher r). A certain proportion β of fixed lifetime high wage, w_H, positions will be anyway offered to those exerting the highest influence, even when exerting no effort (and therefore not gaining the positive education excellence signal) or possessing no primitive ability. This assumption may appear strange, but in most economies- certainly in the public sector but also, to a lesser degree, in the private sector- individual success is a function of the individual's ability to nurture and exploit a network of influential people. This is done by offering influential people the possibility to 'appoint' someone in a high wage position, irrespective from her ability. Therefore incentives to hire the most able candidate are never perfect. The β parameter is then a measure of the strength of the cronyism factor in different economies.

Suppose also that:

$$w_H > s(1, e^*) - c \tag{2}$$

that is once considering the cost of acquiring educational skills, even the individual with the highest ability and hence the highest gain from education always prefers the high wage granted to high-influence types with no effort. Under these conditions, the β proportion of highest-r types will certainly not exert effort in any case.

Other (non-influential) workers are paid an overall salary equivalent to a fraction $\gamma < 1$ of their lifetime productivity, because of the need to finance the cross subsidy for the high-influence types. In this case a generic type a worker is paid a salary:

$$w_a = \gamma\rho(s(a, \epsilon)) \tag{3}$$

The fraction $(1 - \gamma)$ is therefore a 'cronyism tax'. Now a generic type - a individual has an incentive to acquire education skills if:

only for a fraction, rather than the all, of the population.

[7] Although this is not necessary for our results

$$\rho(s(a, e*)) - \rho(s(a, 0)) > \frac{c}{\gamma} \tag{4}$$

Now comparing [5] and [2] it is apparent that the actual cutoff level of a for which a worker acquires the educational skill is higher than the optimal one a^*, and the divergence is a negative function of γ. But $(1-\gamma)$, the cronyism tax, depends on the overall subsidy that needs to be paid to high - salary/high-influence types S:

$$(1-\gamma)(1-\beta)\rho^* = \beta(w_H - \rho^*_\beta) \tag{5}$$

where ρ^* is the average productivity of workers not gaining access to w_H, taking into account their education choice, and ρ^*_β is the average productivity of workers gaining access to w_H. Now differentiating [5] we find that γ decreases with β, and therefore, considering [4], it increases the threshold level of a for which education skills are profitable and decreases overall average education skills aquisition in the economy.

Now we have two channels through which an increase in β decreases the acquisition of educational skills:

a) on one side, high influence types never have an incentive to acquire skills. Hence, when β increases, a larger share of the population (including some high skill individuals for which it would be otherwise be optimal) have no incentive to acquire skills;

b) on the other side, and more importantly, an increase in β increases the necessary subsidy and decreases other workers' salary relative to productivity. Through this channel it decreases the incentive to acquire educational skills (and average productivity as well). The consequences of this simple model are clear and expected.

Testable proposition: cronyism in the labour market decreases the incentive to acquire educational cognitive skills both directly and because it diminishes private returns from education.

A notable consequence of the model is that, aside from adverse distributional impact, cronyism decreases through both channels also the productivity of many workers and therefore output (growth). In the next sections we will try to test this proposition by explaining the relative inefficiency of education systems, among other factors, with a measure of cronyism. Of course we don't have data directly measuring cronyism in the labour market in the sense stated above, as the use of influence for gaining labour positions without merit. We will however use general, sufficiently wide, comparative measures of corruption as a proxy, in the belief that correlation between this two dimensions must be very high.

3 A Simple Test

In order to test the theoretical model described in section 2, we used a two-stage semi-parametric procedure. In the first part, output efficiency scores were estimated by solving a non parametric methodology, known as Data Envelopment Analysis (DEA) applied for the first time by Debreu (1951) and Farell (1957) and consolidated in terms of economic efficiency by Charnes et al. (1978). In the second part, the efficiency scores obtained from the DEA in the first step are corrected with a bootstrap procedure introduced by Simar and Wilson (2007) and explained in a truncated regression with discretionary inputs as independent variables. The algorithms implemented by Simar Wilson (2007) are based on a measure of technical efficiency defined as the inverse of the output increasing efficiency score. For this reason all the scores generated in this study are interpreted in terms of inefficiency.

DEA measures efficiency by estimating a "best practice" and evaluating the relative inefficiency of different units of analysis, traditionally called Decision Making Unit (DMUs, in this case 28 OECD Countries) . In past decades the DEA has become the dominant approach to efficiency measurement in Education system and others economic sectors (Bates, 1997; Kirjavainen and Loikkanen, 1998; Bifulco and Bretshchneider 2001; Grosskopf and Mountray 2001; Johnes, 2006; Alexander et al. 2010; Kempkes and Pohl, 2010; Wolszczak-Derlacz and Parteka, 2011) also thanks to the fact that it does not require special assumptions about the distribution of the efficiency or the functional form of the production function (It requires only the general assumption of monotonicity, convexity, and homogeneity).

Usually in the context of education, output-orientation seems to be the best choice to measure the school performances of students. An educational system is considered more efficient if its producers (in terms of educational attainment) make the best possible use of available inputs (in this case, per capita spending in secondary education). Consequently, we suppose that DMUs can be characterized by technological set Ψ defined as:

$$\Psi = \left\{(x, y) \in \Re^N \times \Re^M \mid x \ \textit{can produce}\ y\right\} \tag{6}$$

where x represents a vector of N inputs and y the vector of M outputs. Taking each OECD Country as the unit of observation, we measure inputs in terms of total spending per student in secondary education (2007-2008 years) , while the output is measured by the performance of 15-year-olds on the OECD PISA reading, mathematics and science tests in 2009. The efficient transformation of inputs into output depends on different endogenous or exogenous

factors. In this study we use a Farrell/Debreu-type output-oriented technical efficiency measure:

$$\delta_j\ (x,y) = \max_{\theta} \{\theta : (x, \theta y) \in \Psi\} \tag{7}$$

where θ measures the maximum possible increase in output y, given that inputs x remain constant. Note that, technical inefficiency scores are bounded between unity and infinity, with $\delta_j \rangle 1$, the DMU is inside the frontier (i.e. the Country is inefficient), while if $\delta_j = 1$, the DMU lies on the frontier (i.e. the Country is efficient).

The Farrell measure of technical inefficiency may be estimated under the assumption of a production frontier characterized by either constant returns to scale (CRS) or variable returns to scale (VRS). In this study, we assume variable return to scale (VRS), given the set of input and output selected, therefore our model can be derived for the *i-th* Country by solving the following linear programming:

$$\hat{\delta}_i = \max_{\gamma} \left\{ (x,y) \in \Re^N \times \Re^M : \sum_{i=1}^{n} \gamma_i y_i \geq y\ ; \sum_{i=1}^{n} \gamma_i y_i \leq x\ ;\ \textit{such that}\ \gamma_i \geq 0,\ i = 1, ..., n \right\} \tag{8}$$

where γ is a I $\times 1$ vector of constants.

In the second stage, to capture what determine this inefficiency, we use the DEA scores (calculated in the first step) as the dependent variable ($\hat{\delta}_i$) regressing them on potential exogenous variables:

$$\hat{\delta}_i = \mathbf{z}_j \beta + \varepsilon_j, \qquad\qquad j = 1, ...n \tag{9}$$

where z_i is a vector of structural and environmental variables that is expected to affect the inefficiency of OECD countries under consideration and β refers to a vector of parameters with some statistical noise ε_i.

Until a few years ago, in the DEA standard technique for estimating equation (10) was the Tobit-estimator . However, Simar and Wilson (2007) have emphasized two possible problems stemming from applying Tobit in this context. First, the results may be biassed in the presence of serial correlation between variables at the two stages. Second, the efficiency scores may be biased in finite samples. To obtain unbiased beta coefficients with valid confidence intervals, we follow the double-boostrap procedure suggested by Simar

and Wilson (2007), where DEA scores are bootstrapped in the first stage to achieve bias corrected inefficiency scores and explained in a bootstrapped truncated regression with discretionary explanatory variables. The parameters of the model (10) are estimated simultaneously using the maximum likelihood estimator.

4 Data

The countries included in the analysis are 28[8] Members of OECD: New Zealand, Finland, Korea, Estonia, Switzerland, Japan, Canada, Hungary, Netherlands, Poland, Australia, Slovak Republic, Czech Republic, Belgium, Germany, Norway, United States, Slovenia, Denmark, Ireland, United Kingdom, Iceland, Sweden, France, Portugal, Austria, Italy, Spain.

Data on education systems were collected from the report "Education at Glance 2011", annually conducted by OECD (OECD, 2011a). Data on Corruption were gathered from the "Society at Glance: social indicators" (OECD 2011b). The descriptive statistics are reported in table 1.

In line with previous studies (Afonso and St. Aubyn, 2006; Verhoeven et al., 2007), the output is measured by the performance of 15-year-olds from the last "Programme for International Student Assessment" in 2009 (PISA_2009), while inputs are the total spending per student in secondary education (2007-2008 years). The spending is measured in equivalent U.S. dollars using GDP purchasing power parity (PPP) to compensate for unit cost differences across countries in the education sector. Previous work conducted on PISA, has mainly used the ratio of aggregate education expenditure to GDP as an input variable. In our opinion this choice is distorsive among countries with different demographic structure. Since PISA scores are per-capita measures of attainment, we believe that the input variable must be appropriately scaled as well.

In the second stage, we consider several factors that may influence school performances such as: Parents' educational attainment proxied by the percentage of population aged 35–44 that has attained at least upper secondary education[9]; Immigrant status measured as the percentage of students from im-

[8] The OECD countries excluded from the analysis did not provide data on inputs and/or outputs selected. We also excluded from the analysis Luxembourg because the small size of the country could bias the results, given its size and the use of a per-capita measure of cost in the presence of a small fixed cost of education provision. Results however are unaffected by its exclusion.

[9] The relationship between educational attainment and performance with parents' education background has been extensively proved both at an individual level (see for example Lee and Barro, 2001, and Holmlund et al., 2011) and at aggregate level (see for example Afonso and St. Aubyn, 2006, Brunello and Checchi, 2005, for Italy).

migrant background; labour-market indicators like differential unemployment rate with secondary education and relative earnings of the population with income from employment. To test the effect of cronyism on school performance, we chose to use the Gallup Corruption Index (GCI), reported by Gallup World Poll in 2010. The Gallup World Poll is conducted in over 140 countries around the world based on a common questionnaire, translated into the predominant language of each country (OECD 2011b). The GCI is based on a binary question of whether corruption is widespread in business and government. This index of corruption has been frequently used in other contexts (Treisman, 2000; Krupavicius 2007; Clausen et al., 2011). Although this variable is not the one directly measuring cronyism for access to labour positions without merit, we believe that the determinants of both are basically the same: the underlying set of values prevailing in a certain country and the extent of transparency and control on discretional choices by officials. There exist of course several potential alternative measures of corruption we could use (for a useful survey see Knack, 2007). The most popular is the Corruption Perceived Index (measured by Trasparency international), a composite index based on several sources. Most of the source databases of the Trasparency index result from surveys or opinion from international observers (either business or experts). Of course this may lead to cultural biases in the assessment as the sample of surveyed business is going to over-represent some countries. A perception index based on surveys of the public of each country is definitely more appropriate for our purposes. The Corruption Perceived Index is frequently criticized for the use of different databases (even a different number of databases for each country) with different methodological features for different countries. In fact the Corruption trasparency index, is built on databases that do not cover the whole of the countries included and hence it is the product of heterogenous data for different countries. The Gallup index overcomes this problems as it is based on a nationally representative sample[10] of resident population aged 15 years and over in the entire country, including rural areas (OECD 2011b). Moreover the perception of the population (households) is more appropriate for our purpose, because it is a credible measure of the likely order of magnitude of the β parameter in the model in section 2.[11] Also important is the fact that it measures corruption not only in the public sphere but also in business.

In addition to socio-economic variables we control for features of the education system, such as the number of students per class; Teaching time, defined as the number of teaching days per year multiplied by the number of hours. Furthermore we included two dummy variables to control for the presence of the national examination and inspection in education system. National examinations are standardised tests that have formal consequences for students, such as an impact upon a student's eligibility to progress to a higher level

[10] Sample sizes vary between around 1 000 and 4 000, depending on the country.

[11] Indeed the incentive effects are likely to be linked more to perception than actual corruption, although the various measures of corruption are generally highly correlated.

of education. A school inspection is a formal process of external evaluation with the aim of holding schools accountable. The practice of school inspections varies considerably among and within countries (OECD 2011a). Both these variables are intended as checks for the presence of other, non-incentive, channels through which corruption may impact on the education performance.

Table 1. Descriptive statistics

Variables	Mean	Std.Dev.	Min.	Max.	Source
MATH_PISA2009	505	17.9161	482	546	OECD_2011a
READ_PISA2009	500	16.8059	470	540	OECD_2011a
SCIEN_PISA2009	510	17.5571	488	554	OECD_2011a
SPENDING_2007	8196	2467	3219	13981	OECD_2011a
SPENDING_2008	9138	2820	3956	17825	OECD_2010
CORRUPTION	53.99	20.81	14.86	83.52	Gallup corruption index
EDUC_PARENTS	79.48	14.51	28.7	93.9	OECD_2011a
IMMIGR	21.81	12.48	2.5	44.5	OECD_2011a
CLASS_SIZE	23.56	4.18	19.6	35.31	OECD_2011a
TEACHING_TIME	665	143	377	1051	OECD_2011a
REL_EARNING	18.28	9.49	1	39	OECD_2011a
UNEM	6.7	3.31	1.7	15.4	OECD_2011a

5 Results

Figure 1 plots the PPP per-student expenditure on secondary education and school performance as measured by the latest results of the PISA test. Note that, there is a little evidence of a correlation between increased spending and educational outcomes in the sample of countries. Therefore expenditure in education is not necessarily the way out of a low-competitiveness trap (for a similar opinion see for example Hanushek, 1996 and 2008).

In table 2 we reported the efficiency scores obtained with a DEA output-oriented analysis, assuming variable return to scale (VRS). The efficiency scores were corrected by the bootstrap procedure suggested by Simar and Wilson (2007). In line with previous studies (Afonso and St. Aubyn, 2006), countries such as New Zealand, Finland and Korea are located on the efficient frontier. By contrast countries such as Italy and Spain appear to be the most inefficient with 1.1091 and 1.1178 inefficiency scores respectively.

Table 2. Dea results (output oriented)

Countries	Eff. Scores (VRS)	Eff. Bias-Corrected
Australia	1.0419	1.0567
Austria	1.0977	1.1073
Belgium	1.0977	1.0731
Canada	1.0279	1.0472
Czech Republic	1.0491	1.0692
Denmark	1.0835	1.0953
Estonia	1.0000	1.0309
Finland	1.0000	1.0243
France	1.0884	1.0987
Germany	1.0562	1.0753
Hungary	1.0143	1.0476
Iceland	1.0791	1.0977
Ireland	1.0832	1.0961
Italy	1.1091	1.1249
Japan	1.0228	1.0386
Korea	1.0000	1.0299
Netherlands	1.0376	1.0473
New Zealand	1.0000	1.0210
Norway	1.0737	1.0825
Poland	1.0000	1.0504
Portugal	1.0858	1.1069
Slovak Republic	1.0000	1.0599
Slovenia	1.0686	1.0878
Spain	1.1178	1.1307
Sweden	1.0866	1.0976
Switzerland	1.0245	1.0330
United Kingdom	1.0800	1.0972
United States	1.0786	1.0871
Mean	**1.0559**	**1.0732**

Note: VRS TE – variable returns to scale technical efficiency with bias corrected (1000 rep.)

Estimates are made using FEAR 1.15

In order to determine the inefficiency scores, we present in table 3 the estimation results from the double bootstrap procedure as described in section (3). The dependent variable is Farrell's bias-corrected efficiency score of the *i-th* countries derived from DEA estimates. Table 3 reports coefficients

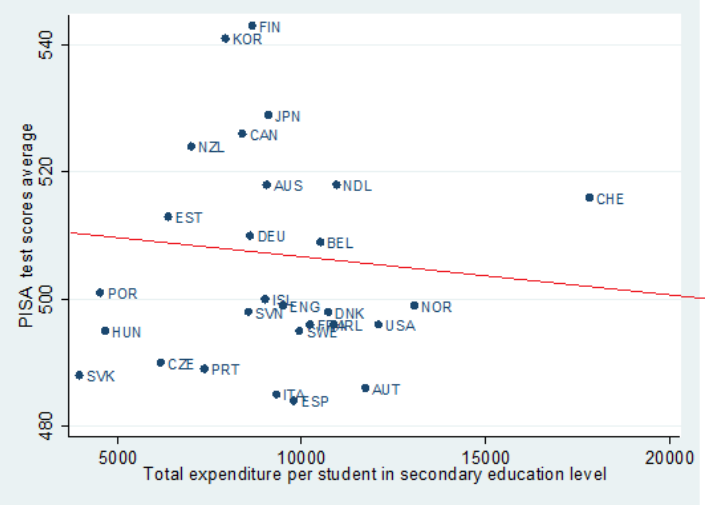

Figure 1: Total expenditure on secondary education and education atteinment

and standard error of three different specification models. We started form a general model with all listed demand and supply side variables (Model A). Several variables proved to be highly not significant, therefore we proceeded with progressive deletion of two dummies in model B, still including some non significant variables, notably relative earnings, unemployment rate and class size. Finally we test a parsimonious model (Model C). All these specifications generate remarkably consistent results on the relationship between socio-economic variables and inefficiency scores.

Specifically, parents'educational attainment has a negative and significant impact on inefficiency. This results appears in line with Afonso and St. Aubyn (2006); Brunello and Checchi (2005). It suggests that there may be persistence in differentials across nations and that some nations could actually be caught in under-education traps unless active policies promoting education for young people with disadvantaged background are implemented. In addition, immigrant status impacts negatively on efficiency. As pointed out by the OECD Education at a Glance 2011 report, students with an immigrant background are socioeconomically disadvantaged, and this explains their average worse performance (OECD 2011a). Of course this is not a reason for adopting a restrictive immigration policy, but it helps interpreting the relative score of some country.

We found in all specifications a negative impact of teaching time on inefficiency. To our knowledge this result is novel in the literature. In most countries, teachers are formally required to work a specified number of hours

per week, including teaching and non-teaching time. This result suggests that increasing classroom time, other things equal, can improve the performance of educational systems. Boosting teaching time without increasing costs is, of course, difficult but it could be done in principle by modifying the apportionment of teachers' time among different tasks. The policy suggestion here seems to be that a heavy load of administrative and non-classroom duties on teachers may indirectly impact negatively on the efficiency of education systems and should be therefore limited as far as possible.

Finally in every specification we found a positive and significant relationship of our corruption variable with the inefficiency score[12]. This is entirely consistent with the predictions of our theoretical model. Corruption decreases incentives to skill acquisition and hence decreases PISA performance, given expenditure.

The effect of unemployment rate, relative earnings and dummy variables are not statistically significant.

Table 3 Truncated boostrapped second stage regression

	Model A	**Model B**	**Model C**
CGI	0.0006^{*} (0.0003)	0.0010^{***} (0.0003)	0.0006^{***} (0.0002)
EDUC_PARENTS	-0.0009^{***} (0.0003)	-0.0008^{**} (0.0003)	-0.0012^{***} (0.0002)
IMMIGR	0.0024^{***} (0.0007)	0.0022^{***} (0.0006)	0.0014^{**} (0.0005)
TEACHING_TIME	-0.0001^{***} (0.00009)	-0.0002^{***} (0.00007)	-0.0001^{***} (0.00003)
CLASS_SIZE	-0.0026 (0.0022)	-0.0025 (0.0022)	
REL_EARNING	-0.0003 (0.0009)	-0.0008 (0.0008)	
UNEM	0.0001 (0.0014)	0.0009 (0.0016)	
DUMMY_EXAM	-0.0204 (0.0182)		
DUMMY_INSP	-0.0045 (0.0209)		
CONSTANT	1.2608 (0.0835)	1.2483 (0.0558)	1.2126 (0.0392)

Table report coefficients and standard error (in parentheses)

***,**, *: statistically significant al 1%,5% and 10% respectively

[12] We also controlled for other corruption indices such as Global corruption Barometer and World Value Survey. In both cases the coefficient is confirmed as statistically significant.

6 Concluding remarks

Education expenditure fails to explain the large differences in PISA scores among OECD countries. In the past the literature on explanatory variables for these differences focused on productive efficiency, looking mainly at the education sector features, but with scant results. No one has, so far, linked performance in cognitive skill acquisition to appropriate incentives on the demand side (the students). However recently Zingales (2012), referring to Italy, observed that:

'Cronyism represses freedom of speech, eliminates the incentive to study, and jeopardizes careers opportunity. It has robbed my home country of much if its potential to grow'

In this work we presented a theoretical model and an empirical test to demonstrate that the presence of cronyism in the society may impact heavily on the relationship between schooling input and cognitive skills in OECD countries. In the spirit of Rogers (2008), we developed a stylized model of cognitive skill acquisition with cronyism/corruption in the labor market. We found that the presence of cronyism decreases the incentive to acquire educational cognitive skills, because it decreases private return from education. In particular the job positions are allocated on the basis of cronyism, even when a formal schooling achievement is required. Furthermore, in order to test the theoretical model we used a two-stage semi-parametric analysis with boostraps procedure (Simar-Wilson, 2007) to identify factors affecting inefficiency in secondary education provision when the output is proxied by the Programme for International Student Assessment (PISA_2009) in 28 OECD countries. Empirical results suggest that cronyism, proxied by the Gallup corruption index, explains a substantial fraction of inefficiency. Other factors that appear to have an important role are the parents' educational attainment (as in many previous work, see for example Shuetz et al., 2008), the immigration background and time spent in classroom by teachers. Taking the evidence as a whole, our result suggest that competitiveness (that is low skill acquisition) in the education sector depends more on external, structural society's factors rather than sectorial efficiency problems. With the important exception of teaching time, no supply side variable proved to be significant in any specification. Given the difficulty of impacting with economic policies on the other factors found to be relevant, notably the average education attainment of the parents population, the cronyism factor becomes central to policies to improve the education system performance in some OECD countries. Even far reaching education reform may be disappointing if the causes of reduced incentives to acquire educational skills are not removed. The most effective reforms for improving the performance of education systems may well be those improving transparency and accountability, reducing discretionality and punishing arbitrary behaviour in recruitment, especially in the public sector.

Finally note that this result presents strikingly analogies with the results of existing analyses of developing countries where governance issues and cronyism specifically seem to be more important than the amount of funds spent in education (see for example Gupta et al, 2002; Reinikka and Svensson, 2005; Bjorkman, 2006; Suryadarma, 2012). However the explanation provided in those contexts, bribes and illegal appropriation of education funds, hardly applies to OECD countries. Incentives are the most likely explanation. Considering the tantamount importance of education for human capital formation, we add an additional important channel through which the performance of economic systems can be explained by prevailing value systems (the degree to which the use of influence for gaining positions is tolerated) and the degree of transparency.

Acknowledgement: *The authors wish to tank Daniele Checchi, Laura Serlenga, Claude D'Aspremont, Francois Maniquet, Massimo Morelli, Claudio Zoli and paricipants to VI workshop of the GRASS Social Choice Research Group held at LUISS University, for useful comments and s*uggestions.

References

[1] Acemoglu, D.,1995. Reward structures and the allocation of talent European Economic Review 39, 17-33.

[2] Afonso, A., St. Aubyn, M., 2006. Cross-country efficiency of secondary education provision: A semi-parametric analysis with non-discretionary inputs. Economic Modelling. 23, 476-491.

[3] Aidt, T., 2003. Economic analysis of corruption: a survey. Economic Journal 113, F632-F652.

[4] Aidt, T., Hillman, A.L., 2008. Enduring rents. European Journal of Political Economy 24, 545–553.

[5] Alexander, W.R.J., Haug, A.A., Jaforullah, M., 2010. A two-stage double-bootstrap data envelopment analysis of efficiency differences of New Zealand secondary schools. Journal of Productivity Analysis 34, 99–110.

[6] Arrow, K., Samuel B., Durlauf S., 2000. Meritocracy and Economic Inequality*?*. Princeton, N.J.: Princeton University Press.

[7] Bates J.M., 1997. Measuring local education authority performance: a frontier approach. Economics of Education Review 10, 19–27.

[8] Benhabib, J., Spiegel, M., 1994. The role of human capital in economic development: evidence from aggregate cross-country data. Journal of Monetary Economics 34, 143-173.

[9] Bifulco, R., Bretschneider, S., 2001. Estimating school efficiency A comparison of methods using simulated data. Economics of Education Review 20, 417–429.

[10] Bjorkman, M. 2006. Does Money Matter for Student Performance? Evidence from a Grant Program in Uganda. IGIER Working Paper n. 326.

[11] Bowles, S., Gintis, H., 2002. The Inheritance of Inequality. Journal of Economic Perspectives 16, 3-30.

[12] Bowles, S., Gintis, H., Osborne Groves, M., 2008. Introduction to Unequal Chances: Family Background and Economic Success. Introductory Chapters, in: Unequal Chances: Family Background and Economic Success. Princeton University Press.

[13] Brunello, G. Checchi, D., 2005. School quality and family background in Italy. Economics of Education Review 24, 563-77.

[14] Calvo-Armengol, T., Jakson, M.O., 2007. Networks in Labor Markets: Wage and Employment Dynamics and Inequality.The Journal of Economic Theory 132, 27-46.

[15] Charnes, A., Cooper W.W., Rhodes, E.,1978. Measuring the efficiency of decision making units. European Journal of Operations Research 2, 429 444.

[16] Checchi, D., 2006. The Economics of Education. Cambridge University Press.

[17] Clausen. B., Kraay.A., Nyiri, Z., 2011. Corruption and Confidence in Public Institutions: Evidence from a Global Survey. The World Bank Economic Review 25, 212-249.

[18] Debreu, G., 1951. The coefficient of resource utilization. Econometrica 19, 273-292.

[19] Farrell, M.J., 1957. The measurement of productive efficiency. Journal of the Royal of Statistical Society Series *A* 120, 253-281.

[20] Grosskopf, S., Moutray, C., 2001. Evaluating performance in Chicago public high schools in the wake of decentralization. Economics of Education Review 20, 1–14.

[21] Gupta, S., Davoodi, H., Tiongson, E., 2000. Corruption and the provision of health care and education. IMF Working Paper 00/116, Washington, DC.

[22] Gupta, S., Verhoeven, M., Tiongson, E.,R., 2002. The effectiveness of government spending on education and health care in developing and transition economies. European Journal of Political Economy 18, 717–737.

[23] Hanushek, E.A., 1996. Measuring Investment in Education. Journal of Economic Perspectives 10, 9-30.

[24] Hanushek, E.A., Kimko, D.D., 2000. Schooling, Labor-Force Quality, and the Growth of Nations. American Economic Review 90, 1184-1208.

[25] Hanushek, E.A., 2008. Incentives for Efficiency and Equity in the School System. Perspektiven der Wirtschaftspolitik 9, 5-27.

[26] Holmlund, H., Lindahl, M., Plug, E., 2011. The Causal Effect of Parents' Schooling on Children's Schooling: A Comparison of Estimation Methods. Journal of Economic Literature 49, 615-651.

[27] Ioannides, Y., Datcher Loury, L., 2004. Job Information Networks, Neighborhood Effects, and Inequality. Journal of Economic Literature 42, 1056-1093.

[28] Jackson, M.O., Zenou, Y., 2012. Economic Analyses of Social Networks. Edward Elgar Publishing, forthcoming.

[29] Johnes, J., 2006. Data envelopment analysis and its application to the measurement of efficiency in higher education. Economics of Education Review 25, 273–288.

[30] Knack, S., 2007. Measuring Corruption: A Critique of Indicators in Eastern Europe and Central Asia. Journal of Public Policy 27, 255-291.

[31] Kempkes, G., Pohl, C., 2010. The efficiency of German universities: Some evidence from nonparametric and parametric methods. Applied Economics 42, 2063–2079.

[32] Kirjavainen, T., Loikkanen, H. A., 1998. Efficiency differences of Finnish senior secondary schools: An application of DEA and tobit analysis. Economics of Education Review 17, 377–394.

[33] Krupavicius, A., 2007. Lithuania. European journal of political research 46, 1019-1031.

[34] Lee, J.W., Barro, R. J., 2001. Schooling Quality in a Cross-Section of Countries. Economica 68, 465-488.

[35] Lucas, R. E., 1988. On the Mechanics of Economic Development. Journal of Monetary Economics 22, 3-42.

[36] OECD, 2010. Education at a Glance: OECD Indicators 2010 (OECD-Paris).

[37] OECD, 2011a. Education at a Glance: OECD Indicators 2011 (OECD-Paris).

[38] OECD, 2011b. Society at a Glance*:OECD* Social Indicators 2011 (OECD-Paris).

[39] Pritchett, L., 1996. Population growth, factor accumulation, and productivity Policy Research. Working Paper Series 1567. The World Bank.

[40] Reinikka, R., Svensson, J. (2005). Fighting corruption to improve schooling: evidence from a newspaper campaign in Uganda. Journal of the European Economic Association. 3(2–3),259–267.

[41] Rogers, M. L., 2008. Directly unproductive schooling: How country characteristics affect the impact of schooling on growth. European Economic Review 52, 356-385.

[42] Romer, P., 1990. Endogenous Technological Change. Journal of Political Economy 98, 97-103.

[43] Shleifer, A., Vishney, R., 1993. Corruption. Quarterly Journal of Economics 108, 599-617.

[44] Schutz, G., Ursprung, H.W., Woessmann, L., 2008. Education Policy and Equality of Opportunity. Kyklos 61, 279-308.

[45] Simar L., Wilson, P.W., 2007. Estimation and inference in two-stage, semiparametric models of production processes. Journal of Econometrics 136,31-64.

[46] Spence, M.,1973. Job Market Signaling. The Quarterly Journal of Economics 87, 355-374.

[47] Suryadarma, D., 2012. How corruption diminishes the effectiveness of public spending on education in Indonesia. Bulletin of Indonesian Economic Studies 48, 85-100.

[48] Treisman, D., 2000. The causes of corruption: a cross-national study. Journal of Public Economic 76, 399–457.

[49] Wolszczak-Derlacz, J., Parteka, A., 2011. Efficiency of European public higher education institutions: a two-stage multicountry approach. Scientometrics 89, 887–917.

[50] Verhoeven, M., Gunnarsson,V., Carcillo, S., 2007. Education and Health in G7 Countries: Achieving Better Outcomes with Less Spending IMF-Working Paper 07/263, (Washington: International Monetary Fund).

[51] Zingales, L., 2012 'A Capitalism For The People' Basic Books, New York