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The incremental effect of education on corruption: evidence of synergy from lifelong learning

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Abstract

Education as a tool in the fight against corruption has been subject to much debate in academic and policy making circles. This note extends what we know on this nexus in a threefold manner: namely, in terms of: incremental, lifelong learning and synergy effects. Four main findings are established. First, education is a powerful tool in the fight against corruption. Second, there is evidence of an incremental effect in the transition from secondary to tertiary education. Third, lifelong learning defined as knowledge acquired during primary, secondary and tertiary education negatively affects corruption. Fourth, there is evidence of a 'synergy effect' because the impact of lifelong learning is higher than the combined effects of various educational levels. The empirical evidence is based on 53 African countries for the period 1996-2010. Two main policy implications are derived. First, encouraging education through the tertiary level enhances the fight against corruption. Second, the drive towards a knowledge economy by means of lifelong learning has 'corruption mitigating' benefits.

JEL Classification: I20; I28; K42; O10; O55
Keywords: Lifelong learning; Corruption; Development; Africa

1. Introduction

The debate over the effect of education on corruption has been mixed, at best, in the theoretical and empirical literature. On the one hand, a first strand of studies support the role of education in negatively affecting corruption via, *inter alia*, channels of legal behavior, social responsibility and, improved social cohesion (Heyneman, 2002, 2008a; Beets, 2005; Oreopoulos and Salvanes, 2009). A position that is supported by cross-country studies (Lederman et al., 2005; Cheung and Chan, 2008). On the other hand, a second stream of studies suggests that education increases participation in corrupt activities (Kaffenberger, 2012; Mocan, 2008; Truex, 2011). Kaffenberger (2012) has recently confirmed the positive nexus between education and corruption postulated and empirically validated by Mocan (2008). This is broadly consistent with Truex (2011) who earlier established that education is a primary determinant of the corruption. On a general note, exploratory studies (Hyneman, 2004, 2008b) are consistent on the subject of the high economic cost of corruption (Heyneman et al., 2007).

Corruption and knowledge economy (KE) are two roots of African development because, while the former is the third most important development concern (after poverty and unemployment), the knowledge index of the continent is substantially lower than the rest of the world (Anyanwu, 2009). Given the key role of KE in twenty first century development, investigating the incidence of lifelong learning on corruption in the continent has substantial policy relevance. However, as far as we are aware, the KE-corruption nexus remains a missing strand in the corruption literature[1].

In light of the above, this Note contributes to the existing literature by introducing the notion of lifelong learning in this education-corruption nexus. After exploring a plethora of studies in the education and lifelong learning literature, Tuijnman (2003) concluded that an all-

[1] The growing stream of KE-related studies has focused on, *inter alia*, broad views on KE (Aubert, 2005; Rooney, 2005; Lin, 2006; Anyanwu, 2012; Makinda, 2007); indigenous knowledge systems (Raseroka, 2008; Lwoga et al., 2010); information and communication technologies (Maurer, 2008; Jonathan and Camilo, 2008; Ondiege, 2010; Chavula, 2010; Aker and Mbiti, 2010; Merritt, 2010; Butcher, 2011; Demonbynes and Thegeya, 2012; Thacker and Wright, 2012; Penard et al., 2012; Asongu, 2014a, 2013a); education (Kamara et al., 2007; Ford, 2007; Weber, 2011; Wantchekon et al., 2014; Amavilah, 2009); innovation (Carisle et al., 2013; Oyelaran-Oyeyinka and Sampath, 2007); economic incentives and institutional regime (Cogburn, 2003; Nguena and Tsafack, 2014; Andrés and Asongu, 2013a; Saxegaard, 2006; Letiche, 2006); intellectual capital and economic development (Preece, 2013; Wagiciengo and Belal, 2012); research and development (Sumberg, 2005; German and Stroud, 2007); intellectual property rights (Zerbe, 2005; Lor and Britz, 2005; Myburgh, 2011; Asongu, 2013b, 2014b; Andrés and Asongu, 2013ab; Andrés et al., 2014); KE in space transformation (Moodley, 2003; Maswera et al., 2008); spatiality in the production of knowledge (Bidwell et al., 2011; Neimark, 2012); KE related to financial development (Asongu, 2013c, 2014cd) and KE catch-up with respect of the East Asian miracle (Kim et al., 2012; Lucas, 1988, 1993; Andrés et al., 2014; Bezmen and Depken, 2004; Andrés and Asongu, 2013ab; Asongu, 2014e, 2015, 2013de).

inclusive indicator for lifelong learning could only be comprehensively derived in the distant future: "*But given the current state of play of the social sciences, and in particular of survey practice and indicator measurement, the time when a holistic and comprehensive framework of lifelong learning indicators can be proposed lies far in the future*" (p.471). Moreover, "*To date only two macro level studies, i.e. the European Lifelong Learning Indicators (ELLI) instrument developed by the EU (2010) and the Composite Learning Index (CLI) instrument developed by the Canadian Council on Learning (undated.), have dealt with this issue*" (Luo, 2015, p.19). Whereas the ELLI exclusively applies to European countries, the CLI is Canada's measure of advancement in lifelong learning. These two indicators entail dimensions of 'learning to know', 'learning to do', 'learning to live together' and 'learning to be'. However, there are at least two shortcomings in the application of these indicators to African countries: (i) they are exclusively for European countries and Canada and (ii) as far as we know, only data on the 'learning to know' dimension is available for African countries. Lifelong learning is defined in this study as the combined knowledge acquired during primary, secondary and tertiary education levels. Moreover, by assessing the independent effects of the educational levels on corruption, we also investigate if there is an incremental impact of education on corruption. The Note also extends a growing stream of literature on using learning activities (Nyarko, 2013a) or existing lessons and success strategies in achieving development (Babatunde, 2012; Lee and Kim, 2009; Wa Gĩthĩnji and Adesida, 2011; Lee, 2009; Fosu, 2013a)[2]. The remainder of the Note is organized in the following manner. Data and methodology are discussed in Section 2, empirical results are covered in Section 3 and Section 4 provides concluding remarks.

2. Data and Methodology

2. 1 Data

We examine a panel of 53 African countries using annual data from World Bank Development Indicators for the period 1996-2010. The period of study begins from 1996 because

[2] From past lessons (Fosu, 2010), Fosu (2012, 2013a) has recently documented interesting literature on lessons and strategies for achieving development success. The plethora of lessons are drawn from: the emerging Asian giants of China and India (Singh, 2013; Yao, 2013; Santos-Paulino, 2013); East Asia and the Pacific (Lee, 2013; Jomo and Wee, 2013; Warr, 2013; Thoburn, 2013; Khan, 2013); Latin America and the Caribbean (De Mello, 2013; Solimano, 2013; Trejos, 2013; Pozo et al., 2013; Cardoso, 2013); the Middle East and North Africa (Looney, 2013; Baliamoune-Lutz, 2013; Nyarko, 2013b; Drine, 2013) and; sub-Saharan Africa (Robinson, 2013; Subramanian, 2013; Lundahl and Petersson, 2013; Fosu, 2013b; Naudé, 2013).

the corruption dependent variables are only available as from this date. The choice of Africa as the scope of study is consistent with the continent's relatively higher levels of corruption and declining knowledge index (Anyanwu, 2009). In accordance with recent corruption literature (Asongu, 2012a), the dependent variables are the corruption perception and corruption control indices. As shown in Table 1, the corruption perception index (CPI) is an aggregation of perceived corruption levels as determined by opinion surveys and expert investigations, while, the corruption control index (CC) captures perceptions of the extent to which public power can be used for private rewards, including both grand and petty types of corruption as well as capture of the state by private interests and elites. The CPI is disclosed in decreasing order such that countries with higher values enjoy lower levels of corruption, whereas CC is disclosed in increasing order with higher values representing countries with higher levels of corruption-control. Hence, in the interpretation of estimated coefficients, a positive sign from estimated parameters on the CPI (CC) is considered as evidence of decreasing (increasing) corruption (corruption-control). From low to high values, the CPI ranges from 0 to 10 whereas the CC ranges from -2.5 to 2.5[3]. The independent variable of interest is measured as the first principal component of primary, secondary and tertiary education. This principal exogenous indicator is complemented with its constituent variables in order to assess incremental evidence in the education-corruption nexus. Moreover, in order to fully appreciate a synergy effect, independent effects of the constituent indicators are needed. The principal component analysis (PCA) employed to calibrate the lifelong learning indicator is presented below.

In line with the corruption literature, we control for economic prosperity (in terms of GDP growth), trade openness and inflation. Economic growth could increase corruption (Asongu and Jellal, 2013, p. 2196; Asongu, 2013f, p. 63) and mitigate the control of corruption (Asongu, 2013g, p. 44). This assertion also holds for per capita economic prosperity (Asongu, 2013h, p. 16). Based on intuition, stable and low inflation are conducive for the control of corruption due to economic certainty since high inflation rates (owing to rapidly rising foods prices) could compel citizens to resort to more corrupt means of making ends meet. Trade openness broadly decreases

[3] We compare two countries to further articulate measurement and interpretation insights, namely: Cameroon which has twice been ranked as the most corrupt country in the world and Botswana which is usually considered as one of the least corrupt countries in Africa. In 1998, 2001, 2004, 2007 and 2010, the average CPI (CC) of Botswana is respectively 6.1, 6.03, 6.03, 5,63 and 5.73 (0.61, 0.73, 0.88, 0.97 and 0.93) whereas the corresponding values for Cameroon respectively are 1.40, 1.83, 2.03, 2.30 and 2.23 (-1.13, -1.09, -1.01, -1.05 and -0.93). Hence, while higher CPI values for Botswana do not represent higher corruption levels, her higher CC values denote higher corruption-control levels.

this scourge on society (Asongu, 2012a) because globalization has been documented as a strong tool in the fight against corruption (Lalountas et al., 2011; Asongu, 2014f).

Variable definitions, summary statistics and the correlation analysis are presented in Appendix 1, Appendix 2 and Appendix 3 respectively. The descriptive statistics inform us that the variables are comparable. Thus, based on the extent of variations we can be confident that some reasonable estimated relationships will emerge. The correlation analysis provides some feelings on the expected signs.

2.2 Methodology

2.2.1 Principal Component Analysis (PCA)

There is currently no consensus on how lifelong learning should be measured because it is a multidimensional and complex phenomenon (Kirby et al., 2010). This is principally because it entails the process of learning from birth to death. Within the framework of this Note, lifelong learning is defined as the process of formal education that encompasses primary, secondary and tertiary school levels. Therefore, the phenomenon is calibrated as the combined knowledge acquired during the course of these three levels of education.

Consistent with the above intuition and narrative, we employ PCA analysis to appreciate the combined knowledge acquired. The PCA technique is a common statistical method used to reduce a higher set of correlated variables into a smaller set of uncorrelated indicators that represent a significant proportion of variability or information in the constituent or combined indicators. The Jolliffe (2002) and Kaiser (1974) criteria are employed to select the principal indicator. It requires the retention of principal components that have an eigenvalue higher than the mean or one. In this light, as presented in Table 1 below, the first principal component (PC) accounts for over 65% of the combined information and has an eigenvalue of 1.955. The index we create through PCA is called *Educatex*, which is the indicator of lifelong learning. This indicator has been recently employed by Asongu and Nwachukwu (2016) in assessing the role of lifelong learning in political stability and non-violence.

As we highlighted in the introduction, *Educatex* is different from the two existing macroeconomic indicators of lifelong learning in at least two respects. It focuses on (i) a set of developing countries and (ii) the 'learning to know' dimension of the ELLI and CLI for European countries and Canada respectively.

Table 1: Principal Component Analysis for an educational index (Educatex)

	Component Loadings				Cumulative	
	PSE	SSE	TSE	Proportion	Proportion	Eigen value
First PC	0.443	0.659	0.607	0.651	0.651	1.955
Second PC	0.868	-0.147	-0.474	0.267	0.918	0.801
Third PC	-0.223	0.737	-0.638	0.081	1.000	0.243

PC: Principal Component. PSE: Primary School Enrolment. SSE: Secondary School Enrolment. TSE: Tertiary School Enrolment.

We devote space to briefly discussing the statistical relevance of the PC-derived lifelong learning indicator. Consistent with Asongu and Nwachukwu (2015, 2016), we engage this at two levels: general and specific points. At the general level, Pagan (1984, p. 242) documented an interesting analysis on issues arising from regressors that are derived from initial estimations. The concerns raised are allied to the consistency, efficiency and validity of corresponding estimated parameters. According to the narrative, while two-step estimators are reliable for the most part, they provide few valid inferences. This concern has been confirmed in more contemporary studies, namely: Oxley and McAleer (1993), Ba and Ng (2006), McKenzie and McAleer (1997), and Westerlund and Urbain (2013a).

With regard to the specific point, we are employing a PC indicator. Concerns about PC variables have been substantially documented by Westerlund and Urbain (2012, 2013b) who have built on previous studies (cited in the preceding paragraph) and other related literature (Stock and Watson, 2002; Pesaran, 2006; Bai, 2009; Bai, 2003; Greenaway-McGrevy et al., 2012). The authors advised that normal corollaries can be made with PC-factor augmented estimations if corresponding estimated coefficients converge towards their true values at the rate of $\sqrt{NT}$ (where N represents cross-section observations and T denotes the number of time series). Moreover, Westerlund and Urbain (2012, 2013b) have argued that conditions for convergence (needed for good inferences of estimated parameters from PC-derived factors) are more appropriate for a relatively large sample. But there is no mention of how large should be large. With regards to our sample, we can neither increase T nor N for two main reasons. *First*, we are unable to increase N, because 53 of the 54 African countries have been engaged, with the exception of South Sudan for which data is not available before 2011. *Second*, we cannot stretch the starting year (of 1996) further back because corruption indicators of the World Bank are only available from 1996.

2.2.2 Estimation technique

An endogeneity-consistent system Generalized Methods of Methods (GMM) is adopted as our empirical strategy for four main reasons. *First,* the methodology is appropriate when the dependent variables are persistent. The correlation between the CPI and its lagged values is 0.945 while that between CC and its lagged values is 0.930. For the system GMM technique, as far as we know, a rule of thumb threshold for evidence of persistence in the dependent variable is 0.800. Second it controls for endogeneity in all the regressors. Third, cross-country regressions are not eliminated with the procedure. Fourth it reduces biases of the difference estimators resulting from small samples. It is substantially for the third reason that we have been consistent with Bond *et al*. (2001, pp. 3-4) in choosing the system GMM estimation (Arellano and Bover, 1995; Blundell & Bond, 1998) instead of the difference approach (Arellano and Bond, 1991). In the specification, the *two-step* procedure is adopted because it is heteroscedasiticty consistent. In order to investigate the validity of the estimations, two tests are preformed, notably: the Sargan overidentifying restrictions (OIR) test for instrument validity and the Arellano and Bond autocorrelation (AR[2]) test for the absence of autocorrelation in the residuals. We control for time-fixed effects to further control for the unobserved heterogeneity. Short-run or business cycle disturbances are mitigated with the use of three-year non-overlapping intervals (NOI). Moreover, by employing data averages, we consolidate the primary condition for the use of the GMM technique: N>T (53>5). Moreover, we have consistently ensured that the instruments are less than the number of cross-sections to mitigate instrument proliferation concerns.

In light of the above, the GMM equations in level and first difference are as follows:

$$C_{i,t} = \sigma_0 + \sigma_1 C_{i,t-1} + \sigma_2 PSE_{i,t} + \sigma_3 SSE_{i,t} + \sigma_4 TSE_{i,t} + \sigma_5 Educatex_{i,t} + \sum_{j=1}^{3} \partial_j X_{i,t} + \eta_i + \xi_t + \varepsilon_{i,t} \quad (1)$$

$$C_{i,t} - C_{i,t-1} = \sigma_1 (C_{i,t-1} - C_{i,t-2}) + \sigma_2 (PSE_{i,t} - PSE_{i,t-1}) + \sigma_3 (SSE_{i,t} - SSE_{i,t-1}) + \sigma_4 (TSE_{i,t} - TSE_{i,t-1})$$
$$+ \sigma_5 (Educatex_{i,t} - Educatex_{i,t-1}) + \sum_{j=1}^{3} \partial_j \left(X_{i,t} - X_{i,t-1}\right) + (\xi_t - \xi_{t-1}) + (\varepsilon_{i,t} - \varepsilon_{i,t-1}) \quad (2)$$

Where: 't' represents the period and 'i' stands for a country. C is either the CPI or CC; PSE, Primary School Enrolment; SSE, Secondary School Enrolment; TSE, Tertiary School Enrolment; *Educatex*, lifelong learning; X is the set of control variables (*GDP growth, trade openness* and *inflation*); η_i is a country-specific effect; ξ_t is a time-specific constant and $\varepsilon_{i,t}$ is an error term. The estimation procedure consists of simultaneously estimating the regression in

levels (Eq. [1]) with that in first-difference (Eq. [2]), thereby exploiting all the orthogonality or parallel conditions between the error term and lagged endogenous variable.

3. Empirical results

The results presented in this section address four main concerns: the incidence of education on corruption; the incremental role of educational levels on the corruption; the role of lifelong learning and a synergy effect. The findings are presented in Tables 2-3 below. Based on the information criteria for the validity of models highlighted above, the models are overwhelmingly valid. In essence, the null hypotheses of the AR(2) and Sargan OIR tests for the absence of autocorrelation and the validity of the instruments respectively are not overwhelmingly rejected.

Table 2: The effect of education on corruption and corruption-control

	Corruption				**Corruption-Control**			
Corruption (-1)	**0.930*** (0.000)**	**0.776*** (0.000)**	**0.692*** (0.000)**	**0.665*** (0.000)**	---	---	---	---
Corruption Control (-1)	---	---	---	---	**1.078*** (0.000)**	**1.160*** (0.000)**	0.990 (0.000)	**0.947*** (0.000)**
Constant	-0.167 (0.693)	0.230 (0.491)	0.698 (0.248)	0.484 (0.215)	0.079 (0.768)	0.192 (0.528)	0.063 (0.643)	0.086 (0.525)
PSE	0.002 (0.597)	---	---	---	0.0006 (0.695)	---	---	---
SSE	---	**0.005* (0.067)**	---	---	---	-0.0006 (0.865)	---	---
TSE	---	---	0.011 (0.103)	---	---	---	-0.001 (0.461)	---
Educatex	---	---	---	**0.158*** (0.002)**	---	---	---	0.029 (0.450)
GDP growth	0.031 (0.127)	0.023 (0.116)	**0.020 (0.316)**	**0.067*** (0.003)**	-0.0003 (0.945)	-0.0009 (0.887)	0.001 (0.869)	0.001 (0.911)
Trade	0.001 (0.577)	0.001 (0.138)	0.001 (0.746)	0.004 (0.311)	-0.001 (0.167)	-0.001 (0.107)	-0.001 (0.124)	-0.001 (0.259)
Inflation	-0.0001 (0.988)	0.001 (0.700)	-0.002 (0.719)	-0.003 (0.799)	**0.001** (0.015)**	0.001 (0.446)	0.0009 (0.186)	**0.001** (0.036)**
Year 1998	---	---	---	---	---	---	---	---
Year 2001	---	---	---	---	---	---	---	---
Year 2004	−0.178 (0.281)	−0.184 (0.216)	−0.165 (0.512)	−0.178 (0.381)	−0.007 (0.914)	−0.002 (0.977)	0.054 (0.410)	−0.042 (0.523)
Year 2007	−0.100 (0.573)	−0.105 (0.546)	−0.106 (0.709)	−0.105 (0.657)	−0.021 (0.750)	0.011 (0.889)	0.038 (0.564)	−0.045 (0.564)
Year 2010	−0.077 (0.734)	−0.172 (0.389)	−0.204 (0.449)	−0.193 (0.449)	0.007 (0.928)	0.027 (0.810)	0.067 (0.333)	−0.042 (0.710)

Time effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AR(2)	**-1.353**	**-1.081**	-1.796	**-0.982**	**-0.147**	**-0.812**	**-1.284**	**-0.270**
	(0.176)	**(0.279)**	(0.072)	**(0.325)**	**(0.882)**	**(0.416)**	**(0.198)**	**(0.786)**
Sargan OIR	**10.787**	**9.571**	**12.616**	**8.525**	**10.855**	**11.809**	**10.447**	**11.609**
	(0.214)	**(0.296)**	**(0.125)**	**(0.383)**	**(0.210)**	**(0.159)**	**(0.235)**	**(0.169)**
Wald (joint)	**131.51*** **	**732.15*** **	**145.54*** **	**154.87*** **	**226.47*** **	**545.01*** **	**446.12*** **	**666.98*** **
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Instruments	17	17	17	17	17	17	17	17
Countries	29	25	22	20	45	42	38	33
Observations	92	77	69	59	165	141	128	104

***, **, and * indicate significance at 1%, 5% and 10% levels respectively. AR(2): Second Order Autocorrelation test. OIR: Overidentifying Restrictions test. The significance of bold values is twofold. 1) The significance of estimated coefficients and the Wald statistics. 2) The failure to reject the null hypotheses of: a) no autocorrelation in the AR(2) tests and b) the validity of the instruments in the Sargan OIR test. P-values are in brackets.

In light of the investigated concerns, the following findings are established. *First*, education is a powerful tool in the fight against corruption. *Second*, there is no evidence of an incremental positive effect in the transition from secondary to tertiary education. *Third*, lifelong learning negatively affects corruption. *Fourth*, there is evidence of a synergy effect because the impact of lifelong learning is higher than the combined effects of various educational levels[4]. The absence of any significant effect of primary school enrolment on corruption is in line with intuition because pupils at this level of education are generally too young to engage in economic activities warranting corruption. The fact that the four concerns are not verified for corruption-control is consistent with intuition. In essence, those attending primary, secondary and tertiary education are more disposed to corruption than to corruption-control. Essentially, the latter is an embodiment of professionals or anti-corruption officials.

Given that time-specific effects are not significant, we replicate the specifications in Table 2 without time-effects. The corresponding results presented in Table 3 are broadly consistent with those in Table 2, with two main additions. *First*, the estimated coefficient of tertiary school enrolment is now significant. Hence, there is evidence of an incremental positive effect in the transition from secondary to tertiary education. In other words, the likelihood of not engaging in corrupt activities decreases as one transits from a secondary school to a university. *Second*, trade is now positively significant for the most part. While we expected economic prosperity to positively affect the scourge (as discussed in the data section), differences in results could be based on methodological variations. In essence, while Asongu and Jellal (2013) have instrumented GDP growth with foreign aid dynamics, the instruments in the GMM approach are lagged levels and differences of the regressors for the first difference and level equations

[4] As highlighted in the data section, when interpreting the effect on corruption, it is important to note that the CPI is measured such that decreasing values denote higher levels of corruption.

respectively. This explanation is broadly in line with Asongu (2012b, p. 191) who has established that economic prosperity is a tool in fighting corruption using Ordinary Least Squares (OLS).

Table 2: The effect of education on corruption and corruption-control (without time effects)

	Corruption				Corruption-Control			
Corruption (-1)	**0.765*** (0.000)**	**0.773*** (0.000)**	**0.761*** (0.000)**	**0.685*** (0.000)**	---	---	---	---
Corruption Control (-1)	---	---	---	---	**1.258*** (0.000)**	**1.254*** (0.000)**	**1.015*** (0.000)**	**0.990*** (0.000)**
Constant	0.136 (0.775)	0.112 (0.724)	0.290 (0.243)	0.389 (0.184)	0.310 (0.473)	0.298 (0.356)	0.114 (0.395)	0.095 (0.535)
PSE	0.002 (0.308)	---	---	---	−0.0001 (0.927)	---	---	---
SSE	---	**0.005** (0.021)**	---	---	---	−0.001 (0.619)	---	---
TSE	---	---	**0.012* (0.098)**	---	---	---	−0.001 (0.500)	---
Educatex	---	---	---	**0.144** (0.015)**	---	---	---	0.014 (0.689)
GDP growth	0.007 (0.765)	0.020 (0.202)	**0.036** (0.031)**	**0.069** (0.012)**	0.001 (0.842)	0.0001 (0.982)	0.001 (0.810)	−0.0001 (0.988)
Trade	**0.003* (0.077)**	**0.002* (0.059)**	0.001 (0.689)	0.003 (0.411)	−0.002 (0.123)	**−0.001* (0.071)**	−0.001 (0.111)	−0.001 (0.232)
Inflation	0.006 (0.569)	0.001 (0.572)	-0.001 (0.650)	−0.008 (0.587)	**0.001** (0.022)**	0.001 (0.251)	0.001 (0.187)	**0.001*** (0.007)**
Time effects	No	No	No	No	No	No	No	No
AR(2)	**-1.354 (0.175)**	**-1.308 (0.190)**	**-1.569 (0.116)**	**-0.806 (0.419)**	**0.007 (0.994)**	**-0.795 (0.426)**	**-0.706 (0.480)**	**-0.609 (0.542)**
Sargan OIR	**11.653 (0.167)**	**7.750 (0.458)**	**12.346 (0.136)**	**9.021 (0.340)**	**8.353 (0.399)**	**10.303 (0.244)**	**9.972 (0.267)**	**9.917 (0.270)**
Wald (joint)	**158.51*** (0.000)**	**655.31*** (0.000)**	**316.32*** (0.000)**	**282.53*** (0.000)**	**313.37*** (0.000)**	**415.16*** (0.000)**	**407.63*** (0.000)**	**1282.4*** (0.000)**
Instruments	14	14	14	14	14	14	14	14
Countries	29	25	22	20	45	42	38	33
Observations	92	77	69	59	165	141	128	104

***, **, and * indicate significance at 1%, 5% and 10% levels respectively. AR(2): Second Order Autocorrelation test. OIR: Overidentifying Restrictions test. The significance of bold values is twofold. 1) The significance of estimated coefficients and the Wald statistics. 2) The failure to reject the null hypotheses of: a) no autocorrelation in the AR(2) tests and b) the validity of the instruments in the Sargan OIR test. P-values are in brackets.

4. Concluding remarks and future directions

The negative effect of education on corruption is traceable to the cognitive and non-cognitive benefits of the former. Such benefits, *inter alia* have been documented in the first paragraph of the introduction (Oreopoulos and Salvanes, 2009; Heyneman, 2002). According to the narrative, education induces patience and the ability to sacrifice the present for better gains in the future, essentially because students have to work hard to obtain pass grades (Kaffenberger,

2012). While the results are not consistent with the strand of the literature suggesting that education increases participation in corrupt activities (Kaffenberger, 2012; Mocan, 2008; Truex, 2011), this stream of the literature nonetheless indirectly recognizes the role of education in fighting corruption if proper policies are put in place (Truex, 2011). The Incremental effect evidence is consistent with Lederman et al. (2005) and Cheung and Chan (2008) who have concluded that lower levels of corruption are linked to higher levels in education. But most importantly, the effect of synergy and the incremental impact have two interesting policy implications. First, encouraging education through the tertiary level enhances the fight against corruption. Second, there is a 'corruption mitigating' benefit in the drive towards knowledge economy by means of lifelong learning.

It is important to note that the measurement of lifelong learning used in this study does not capture moral and ethical conscientious learning which are very likely to be associated with corruption. Moreover, lifelong learning does not stop with schooling. The first few years of work provide an individual with practical realities of life which are equally educative. Hence, the working environment also has some influence in the perception of corruption. Accordingly, while countries with large government sectors could be associated with higher degrees of corruption, those characterized with a substantial private sector and competitive market economy may be associated with less corruption. Future research could account for these factors in order to advance scholarship on the established linkages. Along the same direction of thought, it would be interesting for future lines of inquiry to consider other schooling indicators like dropout rates, standardized tests and repetition rates.

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Appendices

Appendix 1: Definitions of variables

Variable(s)	Definition(s)	Source(s)
Corruption	"Corruption Perception Index represents an aggregation of perceived levels of corruption as determined by expert assessments and opinion surveys".	World Bank (WDI)
Corruption-Control	"Control of corruption (estimate): captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as 'capture' of the state by elites and private interests".	World Bank (WDI)
Primary Schooling (PS)	Primary School Enrolment (% of Gross)	World Bank (WDI)
Secondary Schooling (SS)	Secondary School Enrolment (% of Gross)	World Bank (WDI)
Tertiary Schooling (TS)	Tertiary School Enrolment (% of Gross)	World Bank (WDI)
Educational index	First principal component of PS, SS & TS	PCA
GDP growth	Gross Domestic Product growth rate (annual %)	World Bank (WDI)
Trade Openness	Exports plus Imports of Commodities (% of GDP)	World Bank (WDI)
Inflation	Consumer Price Index (annual %)	World Bank (WDI)

WDI: World Bank Development Indicators. GDP: Gross Domestic Product. PCA: Principal Component Analysis.

Appendix 2: Summary statistics

	Mean	S.D	Min	Max	Obs.
Corruption	3.005	1.064	1.066	6.100	181
Corruption Control	-0.598	0.622	-2.344	0.971	265
Primary School Enrolment	94.414	25.647	28.298	149.70	237
Secondary School Enrolment	38.683	26.489	5.372	115.03	199
Tertiary School Enrolment	6.228	8.489	0.241	53.867	183
Educational index	-0.070	1.327	-2.103	5.527	152
GDP growth	4.755	5.587	-11.272	49.367	254
Trade Openness	78.340	39.979	20.980	250.95	247
Inflation	56.191	575.70	-45.335	8603.3	230

S.D: Standard Deviation. Min: Minimum. Max: Maximum. Obs: Observations.

Appendix 3: Correlation Analysis

PSE	SSE	TSE	Educatex	GDPg	Trade	Inflation	Corruption	C. Control	
1.000	0.452	0.257	0.635	0.095	0.261	-0.064	0.239	0.190	PSE
	1.000	0.725	0.919	-0.078	0.389	-0.100	-0.641	0.548	SSE
		1.000	0.843	-0.036	0.057	-0.081	0.289	0.176	TSE
			1.000	-0.006	0.283	-0.106	0.485	0.374	Educatex
				1.000	0.179	-0.132	-0.056	-0.115	GDPg
					1.000	0.024	0.209	0.194	Trade
						1.000	-0.054	-0.121	Inflation
							1.000	0.896	Corruption
								1.000	C. Control

PSE: Primary School Enrolment. SSE: Secondary School Enrolment. TSE: Tertiary School Enrolment. Educatex: Educational index. GDPg: GDP growth rate. C. Control: Corruption Control.

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