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Do cognitive able societies nurture entrepreneurs?

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Abstract

The aim of this paper is to examine the impact of cognitive skills on the cost of start-up business procedures. Recent empirical studies have identified intelligence to be instrumental to institutional arrangements. Our empirical findings suggest that higher cognitive skills lead to lower costs of start-up business procedures.

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1. Introduction

Entrepreneurs can contribute to economic growth and development. New businesses may directly influence economic performance through creation of new jobs and new products. Empirical analyses of the determinants of entrepreneurship have largely focused on the impact of governance indicators (see, for instance, Aghion et al., 2007, Klapper et al., 2006, Klapper et al., 2010, and Klapper and Love, 2011b). Overall, these studies conclude that entry is hampered by bureaucratic barriers (costs, and procedures).

In addition to this, it is important to note that the issue of intelligence only drew the attention of economists recently. Previous empirical studies have documented a positive effect of intelligence on economic growth (for instance, Jones & Schneider, 2006; Weede & Kämpf, 2002; and Jones, 2011). Potrafke (2012) found a negative effect of intelligence on corruption. A number of other studies have studied the topic within a game theoretic framework (Jones, 2008; Jones and Podemska, 2010). It is obvious that much is still left to be explored on the topic of entrepreneurship and intelligence. Only recently, Masa and Simonov (2014) have empirically documented using individual level data for Sweden over the period 1966-2006 that cognitive abilities might influence the ability to pursue an entrepreneurial activity. However, there are several reasons to anticipate the importance of cognitive abilities in entrepreneurship. For example, intelligence is a strong predictor of social capital and enables economic agents to recognize opportunities, mobilize resources, and build legality for their business ventures (see e.g. Batjargal, 2003). Consequently, we may conjecture that high-IQ societies that are endowed with social capital stock "provide external sources of information, support, finance and expertise allowing mutual learning and boundary crossing." (Cope et al., 2007 p.214). Indeed, cross-national empirical studies document that intelligence is correlated with the supply of credit/finance (Salahodjaev, 2015a), interpersonal trust (Sturgis et al., 2010; Carl & Billari, 2014), and cooperation (Proto et al., 2014). In addition, in a meta-analysis of 61 studies, Stam et al. (2014) document that social capital is positively linked with firm performance.

On the other hand, intelligence is instrumental to institutional arrangements (Lynn & Vanhanen, 2012a) - a robust explanatory factor of business environment (La Porta et al., 1997). For example, intelligence predicts governance indicators, anti-corruption policies and the size of informal economy (Potrafke, 2012; Salahodjaev, 2015b; Kanyama, 2014). Therefore, we may hypothesize that cognitive able societies consist of more individuals with "entrepreneurship values" and institute productive institutions, and thus more economic agents will become entrepreneurs.

While this study is the first attempt to investigate the connection between intelligence and the costs of business start-up procedures in what seems like a growing literature on the determinants of entrepreneurship, it has a certain number of innovative elements in the following directions: first, it makes use of a newly constructed cross country data for as large sample as possible, and as long time span as possible at the time of writing. Lastly, our econometric model deals with the potential endogeneity and measurement error of the intelligence. Thus, not accounting for this problem can lead to misleading inference, and thus cast doubt on the empirical results.

We also think that our empirical findings have important policy implications. The main message is that the cost of business start procedures is negatively associated with our measure of intelligence, national IQs. The results displays that a national IQ scores increase by 10 points (approximately one standard deviation), the logged cost of business start-up procedures decrease by 0.995 (slightly more than half standard deviation). This finding is novel and suggests that being an entrepreneur is related to cognitive skills.

The remaining of the paper is organized as follows. Section 2describes the empirical model and the data. Section 3 presents the main empirical results, and some sensitivity analysis. Section 4 concludes.

2. Data and methodology

In this study we used three main proxies for all procedures officially required, or commonly done in practice, for an entrepreneur to start up and formally operate an industrial or commercial business, as well as the time and cost to complete these procedures. These are cost of business start-up procedures (% of GNI per capita), time required to start a business (*days*) and start-up procedures to register a business (*number*). The data is for 2015 (the most recent statistics) and comes from the World's Bank Doing Business project.

Intelligence is variable of interest in our analysis. As a measure for intelligence, we use national IQ scores from Lynn & Vanhanen (2012b). This dataset has been widely used in empirical studies (for instance, Potrafke, 2012; Kanyama, 2014; Salahodjaev, 2015b; Salahodjaev, 2016; Nikolaev & Salahodjaev, 2016; Burhan et al., 2015). In this (their most recent) study the authors provide estimates for national IQ scores for 192 countries, containing all the countries in the world with populations over 40,000. These scores have been estimated in relation to a British mean of 100 and standard deviation of 15. Fig. 1, 2 and 3 present preliminary evidence that intelligence is negatively correlated with institutional barriers to start a business.

Considering that, intelligence is not only one and only determinant of entrepreneurship we use a set of control variables in our analysis. We incorporate control variables that capture direct effect of institutions, culture, geography, and successfulness of economic policies on entrepreneurship. We use logged real GDP per capita to control for the effect of economic development. The data is from the World Bank. With respect to impact of institutions on entrepreneurship, we add democracy index and corruption perceptions index. Democracy index is measured as simple average of political rights and civil liberties. The data are drawn from Fraiser House. The Corruption Perceptions Index (*CPI*) ranks countries and territories based on how corrupt their public sector is perceived to be. A country or territory's score indicates the perceived level of public sector corruption on a scale of 0 - 100, where 0 means that a country is perceived as highly corrupt and 100 means it is perceived as very clean. The data is extracted from Transparency International[1]. To test the robustness of our findings, we also control for geographic endowments measured by the share of population living in the tropics. The data is from Ashraf & Galor (2013). Finally, as proxy for culture, we use ethnic fractionalization (*EF*) index taken from Alesina et al. (2003). A country's degree of ethnic fractionalization is the probability that two randomly drawn individuals are from different ethnic groups. The larger the number of and the more equal in size, the larger is EF. Table 1 reports descriptive statistics for all variables used in the empirical analysis. Pearson's correlation coefficients for all variables are displayed in Table 2. These coefficients indicate that multicollinearity does not appear to be at hand here. The correlation signs are as expected.

In line with related literature, we formulate Eq. (1) to explore the link between intelligence and entrepreneurship across countries.

$$ENT_i = \beta_0 + \beta_1 IQ_i + \beta_2 X_i + \varepsilon_i \qquad i = 1, \ldots N. \qquad (1)$$

The subscript *i* refers to country. *ENT* is an indicator of entrepreneurship in nation *i*, *IQ* is national IQ score; X_i denotes the vector of other determinants of entrepreneurship as proposed by the discussions above; and e_i is the random error term. In this paper, we are

[1] http://www.transparency.org/cpi2012/results

primarily concerned whether the estimate of IQ, i.e., β_1 is negative and statistically significant. Eq (1) will be estimated using OLS and 2SLS. Empirical analysis was carried out using Stata version 13. To test whether intelligence is non-linearly related to entrepreneurship, we conducted Ramsey RESET test. The F-statistics from the RESET test (F=0.90; p = .44) suggests that econometric model does not require any higher order polynomial terms.

Table 1: Descriptive statistics

Variable	**Mean**	**Std. dev.**	**Min**	**Max**
Cost of business start-up procedures (log)	2.1380	1.7254	-2.3025	5.7994
Time required to start business (log)	2.5710	0.9626	-0.6931	4.9698
Number of start-up procedures to register a business (log)	1.8194	0.5112	0	2.8904
IQ	84.1026	10.8475	60.1	107.1
GDP per capita (log)	9.1519	1.2243	6.3705	11.8352
Democracy index	4.6641	1.9803	1	7
CPI	43.1657	19.6846	8	90
Share population living in the tropics	42.9243	46.3190	0	100
Ethnic index	0.4384	0.2583	0	0.9302

Table 2: Correlation matrix

	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**
Cost of business start-up procedures (log)	1.00								
Time required to start business (log)	0.52	1.00							
Number of start-up procedures to register a business (log)	0.52	0.81	1.00						
IQ	-0.66	-0.37	-0.32	1.00					
GDP per capita (log)	-0.66	-0.26	-0.20	0.75	1.00				
Democracy index	-0.37	-0.29	-0.27	0.45	0.44	1.00			
CPI	-0.55	-0.44	-0.34	0.55	0.67	0.68	1.00		
Share population living in the tropics	0.47	0.31	0.29	-0.47	-0.38	-0.11	-0.30	1.00	
Ethnic index	0.34	0.21	0.16	-0.53	-0.46	-0.38	-0.42	0.28	1.00

3. Empirical Results

Table A1 shows the results of estimating Eq. (1) for cost of business start-up procedures, after controlling for various variables that are shown to be linked with institutional regulations. Column 1 provides simple bivariate association between intelligence and entrepreneurship. As one anticipated, IQ is inversely related to the cost of business start-up

procedures. The estimate for IQ is statistically significant at the 1% level suggesting that when national IQ scores increase by 10 points (approximately one standard deviation), the logged cost of business start-up procedures decrease by 0.995 (slightly more than half standard deviation). This result is in line with recent experimental economics literature. Dohmen et al. (2010) show that individuals with higher cognitive ability are significantly more willing to take risks in the lottery experiments, and are significantly more patient over the year-long time horizon studied in the inter-temporal choice experiment. One can also argue that societies with cognitive skills can develop more efficient bureaucratic paperwork that reduces the time to start up a new business. Another potential explanation for our finding is that in societies with high cognitive skills, people are under pressure to be successful, so they might also be willing to take risks to start a new business.

Along with this, intelligence exclusively explains 40% of cross-national differences in cost to complete the procedures to start limited liability company (LLC). In column 2, we add logged GDP per person to control for the effect of economic development on the costs to get a local LLC up and running. In poorer countries, there are fewer business opportunities and the demand for goods and services is smaller, unstable and less diverse, so the entry rate is expected to be lower. Both IQ and GDP per capita are negative and statistically significant at the 1% level.

In column 3 and 4, we separately add democracy index and CPI to the regression. The estimates suggest that only control of corruption is related to the costs to start a business. The significance of the *IQ* and logged GDP per person is unaffected. Adding both of these variables simultaneously in column 5 does not alter the results. Column 6 presents the estimates when share of populations living in the tropics is incorporated in the econometric model: a proxy for geographic (and climatic) endowments. The coefficient for geographic endowments is positive and suggests that higher share of population living in the tropical zone is associated with poor private sector institutions. The results are in line with Gallup et al. (1999, p. 29) who argue that "[g]ood policy and good geography may have a tendency to go together...".The result is that natural differences in growth potential tend to be amplified by the choice of economic policies". Lastly in columns 7 and 8, we incorporate ethnic fractionalization index. We find that *EF* is insignificant, while the estimate for intelligence and several of control variables retain their significance levels.

Thus, the findings reported in Table A1 suggest that cognitive abilities are significantly associated with cross-country differences in the costs to start a business.

[INSERT TABLE A1]

We also estimate Eq. (1) for time required to start a business (days) and start-up procedures to register a business (number) in Table 3. In comparison with the estimates reported in Table A1, intelligence is also negative, albeit statistically significant at the 5% level.

Table 3: Intelligence and time (and procedures) to start a business

	(1)	(2)
IQ	-0.0257**	-0.0128**
	(0.0103)	(0.0057)
GDP per capita	0.2420**	0.1123**
	(0.0938)	(0.0520)
Democracy	0.0143	-0.0221
	(0.0506)	(0.0281)

CPI	-0.0242***	-0.0076**
	(0.0059)	(0.0033)
Tropics	0.0036**	0.0023**
	(0.0018)	(0.0010)
Ethnic	-0.1550	-0.1210
	(0.3209)	(0.1780)
Constant	3.4196***	2.2673***
	(0.8306)	(0.4608)
N	161	161
adj. R^2	0.2454	0.1703

Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01

However, for a number of arguments, the coefficients produced in Tables 3 and A1 are incredible to illustrate a causal effect of intelligence on entrepreneurship. A key concern is that our measures of business regulations are correlated with nation-specific aspects that are not adequately captured in or regression, such as religion, and/or history. Ideally, we could have addressed this problem by applying a panel data technique. However, national IQ scores are not available over time. Thus, the only way to explore the causal effect of intelligence on business regulations is to apply an instrumental variable (IV) regression estimator. The instrumental variables approach accounts for the endogeneity of the IQ variable as well as the fact intelligence can be measured with error. We should identify instruments for intelligence (IQ) that are related to intelligence but are uncorrelated with the quality of business regulations. One strategy is to review related studies on the consequences of intelligence and find instruments that were verified in previous studies. Eppig et al. (2010) have proposed that historical prevalence of infectious diseases and regional dummies are valid instruments for cognitive abilities in cross-national regressions

With these warnings in mind, Table 4 displays the IV regression estimates. First, we find very strong link between our proposed instruments and national IQ scores. Especially, the first-stage F-test statistic together with the high partial R^2 observed throughout the empirical analysis indicate that the instruments are strong in the sense discussed in the recent econometrics literature on instrumental variables methods (Stock & Yogo, 2005). An additional check on instrument validity is whether the instruments really belong in the main estimation equation. This is possible to test as the equation is over-identified, and final row reports the Hansen's J statistic and the corresponding probability associated with the null hypothesis of no over-identification. Throughout the null cannot be rejected.

Coefficients for the second-stage regressions strengthen the OLS betas reported in Tables 3 and A1. The estimates for IQ are negative and statistically significant at the 1% level in all cases. Moreover, the coefficient estimates of IQ are larger compared to the ones in OLS regressions, indicating that exogenous IQ scores suffer from measurements error.

In general, the IV regression estimates along with OLS results indicate that intelligence has a statistically significant and sizable impact on entrepreneurship across nations.

Table 4: IV estimates

	Cost of business start-up procedures	Time required to start a business	Start-up procedures to register a business

	(% of GNI per capita)	(days)	(number)
	(1)	(2)	(3)
IQ	-0.062**	-0.051**	-0.033***
	(0.027)	(0.020)	(0.010)
Constant	10.404***	4.488***	3.135***
	(1.368)	(1.117)	(0.588)
N	139	140	140
First stage F-stat	118.86	120.07	120.07
First stage R2	0.80	0.80	0.80

Standard errors in parentheses; Baseline control variables are included but not reported here;
* p<0.1, ** p<0.05, *** p<0.01

Figure 1. Scatter plot of time required to start business and IQ

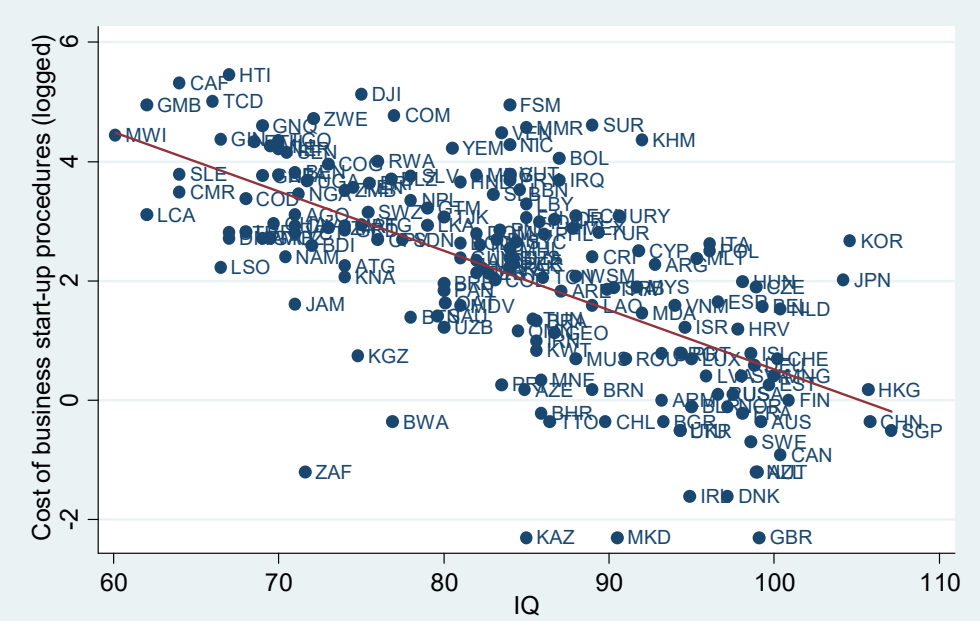

Figure 2. Scatter plot of cost of business start-up procedures and IQ

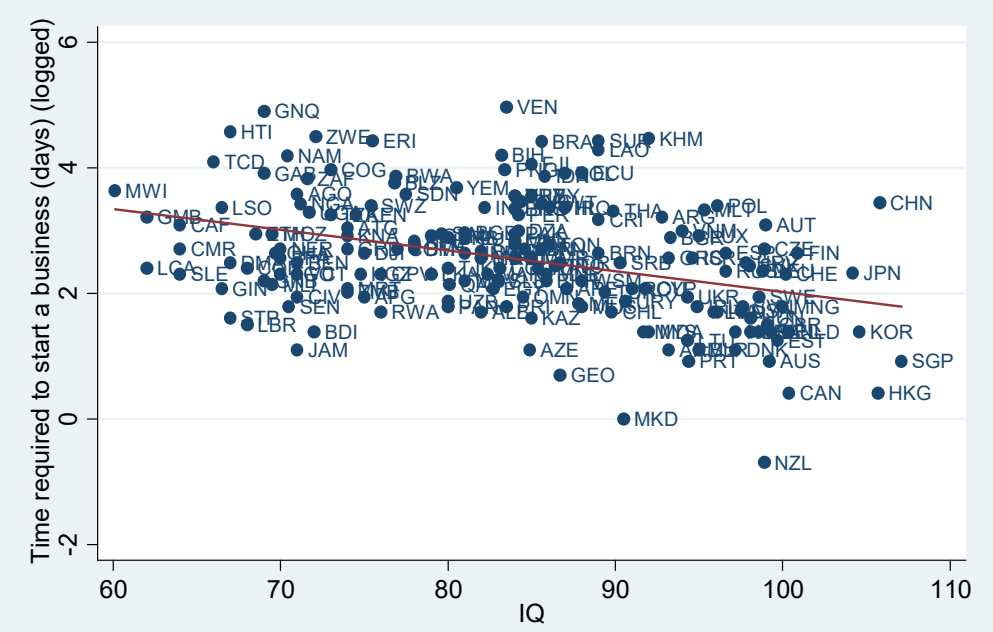

Figure 3. Scatter plot of start-up procedures to register a business and IQ

4. Conclusions

The analysis of this paper should be seen as a preliminary empirical inquiry into the effect of intelligence on the cost of start-up business procedures. Our results are robust to model specifications. In particular, an extension of the sample of countries is warranted. A crucial problem that more data will not solve, however, follows from the nature of the intelligence data; this data is (perhaps very) imprecisely estimated, and, therefore, one should be very

cautious in making results such as these the basis for policy intervention or policy recommendation. Rather, the goal of the present analysis is to emphasize, once again, the importance of cognitive skills on entrepreneurial activity. An interesting empirical extension would be to test the hypothesis on a panel data set or using micro-data that shows that higher sub-national level of intelligence fosters entrepreneurship. Such data are much more precise than cross sectional data, and allow to control for unobserved heterogeneity. Unfortunately, the use of this data is severely restricted due to the IQ variable.

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APPENDIX 1

Table A1: Intelligence and cost of business start-up procedures

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
IQ	-0.099***	-0.052***	-0.052***	-0.051***	-0.053***	-0.040***	-0.045***	-0.057***
	(0.009)	(0.012)	(0.012)	(0.013)	(0.013)	(0.014)	(0.014)	(0.013)
GDP per capita		-0.598***	-0.574***	-0.431***	-0.413***	-0.402***	-0.402***	-0.580***
		(0.108)	(0.111)	(0.131)	(0.133)	(0.130)	(0.130)	(0.111)
Democracy			-0.033		0.023	-0.014	-0.013	
			(0.054)		(0.070)	(0.070)	(0.070)	
CPI				-0.015**	-0.016**	-0.014*	-0.014*	
				(0.007)	(0.008)	(0.008)	(0.008)	
Tropics						0.007***	0.008***	
						(0.002)	(0.002)	
Ethnic							-0.474	-0.221
							(0.445)	(0.418)
Constant	10.464***	11.943***	11.867***	10.936***	10.927***	9.526***	10.168***	12.267***
	(0.764)	(0.752)	(0.772)	(0.855)	(0.869)	(0.970)	(1.153)	(0.989)
N	180	177	175	165	163	162	160	171
adj. R^2	0.401	0.495	0.488	0.507	0.499	0.524	0.526	0.493

Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01