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ABSTRACT

This paper explore the effect of intelligence on financial development using data from 180 nations, over the period 2000–2012. The results provide strong support for the claim that intelligence is positively associated with the supply of finance to economy. This paper establishes that, moving from country with the mean IQ score (84.1) to the highest national IQ score (107.1) is associated with 3.6 fold increase in the size of banking sector. The positive effect of intelligence remains intact when we control for other antecedents of financial development.

1. Introduction

There are ample cross-country studies on the link between financial development and economic growth (e.g. Roubini & Sala-i-Martin, 1992; Roubini & Sala-i-Martin, 1995; King & Levine, 1993; Levine, 1997; Rajan & Zingales, 1998). By and large, extant literature documents that financial development has a positive effect on economic growth. Access to finance improves productivity (Butler & Cornaggia, 2011), reduces poverty (Jalilian & Kirkpatrick, 2002) and promotes exports (Beck, 2002).

While the literature addressing the link between finance and economic development dates back at least as far as Hicks (1969), 'the frontier of the literature in this field is, therefore, shifting towards providing answers to the question of why some countries are more financially developed than others' (Baltagi, Demetriades, & Law, 2009 p. 1). Indeed, research shows that economic development, trade openness, and institutions are determinants of financial development across the nations (e.g. La Porta, Lopez-de-Silanes, Shleifer, & Vishny, 1999; Rajan & Zingales, 2003; Huang & Temple, 2005; Law, 2009). Another line of studies finds that non-economic antecedents, such as culture, social trust and religion, have significant effect on finance (e.g. Stulz & Williamson, 2003).

The recent advances in the intelligence literature show that intelligence has direct effect on wide range of socio-economic outcomes (Weede & Kämpf, 2002; Lynn & Vanhanen, 2010; Meisenberg, 2012). We depart from a seminal work by Lynn and Vanhanen (2002) (L&V henceforth) who develop a novel model where 'population IQs are the major determinant of the wealth and poverty of nations in the contemporary world' (Lynn & Vanhanen, 2002 p. 1). Departing on the findings posited by L&V we suggest that intelligence may be an important antecedent of financial development through which it influences economic growth. Particularly, we conjecture that there are several channels through which intelligence can be linked to financial development.

First, intelligence, measured by IQ scores, does promote economic growth (e.g. Weede & Kämpf, 2002; Salahodjaev, 2015a). Moreover the effect of cognitive skills on economic growth is relatively stronger compared to other conventional measures of human capital (literacy rates and school enrollment) employed in the related growth literature (Hanusek, 2013).

In particular cross-country variations in intelligence levels are associated with the degree of technological achievement (Lynn, 2012) and ability to produce sophisticated goods (Rindermann, Sailer, & Thompson, 2009), which in turn are instrumental to economic outcomes. As suggested by Rindermann et al. (2009) p. 20 'In societies with a higher cognitive average the smart fraction reaches a higher cognitive level. This smart fraction pushes growth through excellence in areas relevant for economic affluence, like in technology and science'. Subsequently, this will have effect on demand for financial services and, later, on the level of financial development (Ang & McKibbin, 2007). In developing countries, running efficiently functioning financial institutions may require a degree of skills and education, which might indicate intelligence. Combining these links with the findings of previous studies we propose that intelligence will have positive effect on finance.

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Second, the decision of financial institution to supply credit has been conjectured as to be driven by higher level of social capital and trustworthiness of the borrower. In light of the growing complexity and pace of financial operations, the supply of finance to economy is closely interlinked with such characteristics of the social order as trust (Guiso, Sapienza and Zingales (2004)), which is viewed by modern economics as one of the main underpinnings of human society that enables the functioning of markets and institutions (Seabright, 2010).[1] In societies that are more intelligent economic agents trust each other more (Kosugi & Yamagishi, 1998) as intelligence produce social networks that detect and penalize the dishonest behavior (Bacharach & Gambetta, 2001). For example, Sturgis, Read, and Allum (2010), using data from National Child Development Study (NCDS) and British Cohort Study (BCS70), shows that generalized trust of individual is a function of individual's intelligence. Similarly, Carl (2014) documents that intelligence is positively associated with trust in a sample of 15 Spanish regions, 20 Italian regions, 50 US states, and 107 countries.

In addition, intelligent agents have wider time horizons and intelligence can be important in decreasing agency problems and moral hazard. In this context, using experimental data, Skowronski (2002) links cognitive mechanisms to consistent-behavior of individuals. As a result, the supply of the finance to economy will depend not only on the social trust, but also on the intelligence, which may signal willingness of economic agents to cooperate in favor of long-term rewards (Shamosh & Gray, 2008). Based on the findings that social trust is the result of intelligence, we can argue that intelligence may increase financial development and consequent supply of credit to economy.

Combining these streams of literature, we document that intelligence is a robust determinant of financial development. Specifically, moving from country with the mean IQ score (84.1) to the highest national IQ score (107.1) is associated with 3.6 fold increase in the size of banking sector.

The rest of the paper is organized as follows. Section 2 presents data and methodology. Then, in Sections 3 and 4, we discuss empirical results. Finally, Section 5 concludes the paper.

2. Data and methods

2.1. Financial development

Financial development is a complex, multidimensional concept (Rajan & Zingales, 2003). While much of the celebrated literature on this issue measures financial development by the banking sector depth and stock market development, some studies take into account inflow of foreign capital (e.g. Chang, 2015).

In line with conventional literature, the financial data in our study covers two aspects of financial development (e.g. King & Levine, 1993). These are (1) the size of banking sector, and (2) the size of stock market relative to the size of GDP. The proxy for the size of banking sector is domestic credit to private sector relative to GDP (dcred). The size of stock market is measured by stocks traded as % of GDP (stock). Because intelligence is available on a cross-sectional basis, we average the data over the years 2000–2013 (Table A1).

2.2. Intelligence

We measure intelligence using the data by Lynn and Vanhanen (2012a). While a number of studies criticized the use of IQ in empirical literature (Volken, 2003; Barnet & Wiliams, 2004), there is plenty robust evidence showing that national IQ's are highly correlated with other measures of human capital and social development (e.g. Rindermann, 2007; Jones and Schneider, 2010; Lynn & Vanhanen, 2012b; Salahodjaev, 2015b).

2.3. Control variables

Since intelligence is not only determinant of cross-national differences in financial development, we control for the key antecedents of finance. By and large, empirical literature is close to broad consensus that three kinds of macroeconomic variables matter: First, more developed countries enjoy greater demand for financial services and therefore the size of banking sector and stock market is larger compared to less developed nations. We include logged GDP per capita in 2000 to control for this effect. Second, increase in the rates of inflation may distort decision-making and reduce the supply of finance. In particular, severe inflation rates drive down that ability of financial institutions to distribute financial resources efficiently (Boyd, Levine, & Smith, 2001). In our study inflation rate is measured by the average GDP deflator over the years 2000–2013. Third, trade openness may have effect on financial development. Trade openness is represented by the sum of exports and imports as a percentage of GDP.

To test whether types of legal system have impact on financial development (La Porta et al., 1999), we include historical legal systems as the control variables. Similarly, we control for major religious denominations. Since the seminal work by Weber (1905), religion has been shown to affect the creditor rights and economic attitudes among individuals (e.g. Guiso, Sapienza, & Zingales, 2003).

Descriptive statistics of the dependent variables and key explanatory regressors and bivariate correlation matrix are shown in Table 1 and Table 2. The variance inflation factor (VIF) scores computed after regression estimations did not indicate concern with multicollinearity issues.

To illustrate the association between intelligence and financial development, we provide correlations between IQ scores and the measures of financial development. Fig. 1 lends support that overall intelligence is positively associated with finance. For instance, the correlation between national IQ scores and size of banking sector is $r = .70$.

2.4. Methodology

This section presents the econometric specification to explore the effect of intelligence on financial development. The regression model of interest can be expressed as:

$$FD_i = \alpha_0 + \alpha_1 IQ_i + \beta X + \varepsilon_i$$

where FD_i is one of the measures of financial development in country i, IQ is the intelligence which will be proxied by national IQ's, and X is a vector of control variables suggested by the literature.

Table 1
Descriptive statistics.

Variable	Source	Mean	St. dev.	Min	Max
Private credit as a % of GDP (logged)	WDI	3.45	0.95	0.67	5.39
Stocks traded as % of GDP (logged)	WDI	1.67	2.28	−4.36	5.91
IQ	Lynn and Vanhanen (2012a)	84.10	10.85	60.1	107.1
Openness (logged)	WDI	4.39	0.58	−0.40	5.95
Initial GDP per capita (logged)	WDI	8.84	1.26	6.16	11.62
Inflation	WDI	7.63	9.24	−2.51	84.41
English common law	La Porta et al. (1999)	0.34	0.47	0	1
Napoleonic civil law	La Porta et al. (1999)	0.43	0.49	0	1

[1] For example, Oxford Dictionary defines credit as 'the ability of a customer to obtain goods or services before payment, based on the trust that payment will be made in the future'.

Table 2
Correlation matrix.

	I	II	III	IV	V	VI	VII
Private credit as a % of GDP (logged)	1.00						
Stocks traded as % of GDP (logged)	0.64	1.00					
IQ	0.70	0.51	1.00				
Openness (logged)	0.25	−0.09	0.19	1.00			
Initial GDP per capita (logged)	0.69	0.57	0.63	0.23	1.00		
Inflation	−0.63	−0.37	−0.47	−0.18	−0.41	1.00	
English common law	−0.11	−0.00	−0.41	0.03	−0.20	0.05	1.00
Napoleonic civil law	0.00	−0.05	−0.06	−0.15	0.13	−0.00	−0.54

3. Results

The main results are presented in Tables 3 & 4. We start with the banking sector development regressions. Without any additional control variables intelligence has a positive and statistically significant, at the 1% level, effect on domestic credit to private sector (column 1). Moving from country with the mean IQ score (84.1) to the highest national IQ score (107.1) is associated with 3.6 fold increase in the size of banking sector. This specification explains a large percentage of cross-country variation in the banking sector size.

Column 2 presents results of the association between intelligence and domestic credit to private sector controlling for main macroeconomic variables. The control variables are in line with previous literature. Initial GDP per capita is positive and statistically significant. Inflation has a negative effect on supply of credit to economy. The trade openness does not matter however. The effect of intelligence on size of banking sector remains positive and significant related to at the 1% level.

Including the dummy variables for legal systems in column 3 does not change estimates much. The results show that of these variables, only English common law is statistically significant, at the 1% level, indicating a positive link with financial development. The difference is that intelligence now has a greater effect on financial development. It is worth emphasizing that signs and significance levels of IQ and other control variables remain intact when we control for religious denomination (column 4).

We repeat this exercise for the stock market in Table 4. The link between intelligence and the stocks traded relative to GDP remains robust. Unlike in Table 3, intelligence has a stronger effect and is significant at the 1% and 5% levels when we control for the main determinants of finance. One possible channel through which intelligence can promote stock market development is by virtue of financial innovation. Since financial innovation helps ameliorate market inefficiencies (Tufano, 2003), we can argue that national IQ's assess the ability of country to understand the complexity of market imperfections and provide opportunities for risk sharing.

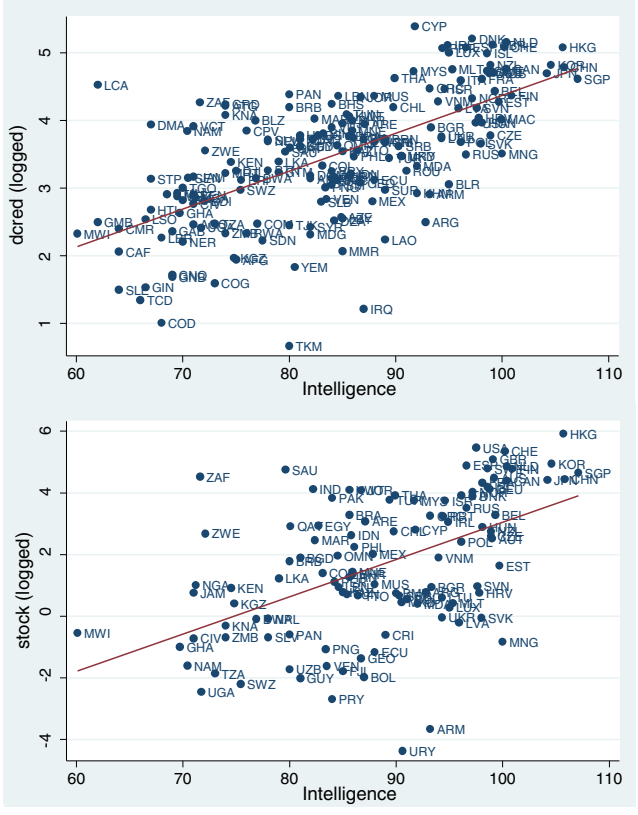

Fig. 1. Financial development and intelligence.
Source: Lynn and Vanhanen (2012a) and WDI.

Table 3
Regression results: size of banking sector.

	(1)	(2)	(3)	(4)
IQ	0.056***	0.028***	0.038***	0.034***
	(0.005)	(0.006)	(0.008)	(0.008)
Trade		0.041	0.031	0.022
		(0.095)	(0.099)	(0.102)
Initial GDP		0.285***	0.238***	0.253***
		(0.051)	(0.052)	(0.052)
Inflation		−0.028***	−0.025***	−0.025***
		(0.007)	(0.007)	(0.006)
English common law			0.481***	0.442***
			(0.138)	(0.133)
Napoleonic civil law			0.160	0.180
			(0.145)	(0.162)
Religion	−	−	−	+
Constant	−1.234***	−1.299***	−1.946***	−1.637***
	(0.424)	(0.458)	(0.593)	(0.593)
N	180	174	173	171
Adj. R^2	0.418	0.612	0.640	0.664

Notes: Heteroskedasticity adjusted robust standard errors in parentheses. Significance at the 1% level is denoted by ***; ** denotes significance at the 5% level; and * significance at the 10% level.

Table 4
Regression results: size of stock market.

	(1)	(2)	(3)	(4)
IQ	0.121***	0.053**	0.082***	0.109***
	(0.018)	(0.023)	(0.029)	(0.028)
Trade		−1.198***	−1.301***	−1.262***
		(0.386)	(0.343)	(0.312)
Initial GDP		0.900***	0.881***	0.664***
		(0.201)	(0.207)	(0.198)
Inflation		−0.065**	−0.046	−0.074**
		(0.032)	(0.034)	(0.031)
English common law			1.096**	1.170***
			(0.458)	(0.442)
Napoleonic civil law			−0.043	0.470
			(0.517)	(0.527)
Religion	−	−	−	+
Constant	−9.029***	−5.681**	−8.075***	−8.720***
	(1.579)	(2.603)	(2.952)	(2.873)
N	112	110	109	108
Adj. R^2	0.254	0.432	0.467	0.538

Notes: Heteroskedasticity adjusted robust standard errors in parentheses. Significance at the 1% level is denoted by ***; ** denotes significance at the 5% level; and * significance at the 10% level.

Table 5
Cluster analysis between intelligence and financial development.

Cluster	N	Example states	Size of banking sector	Size of stock market
Countries with nation IQ above 95	37	Canada, Hong Kong, Japan	98.339	73.462
Countries with nation IQ from global average (84) to 95	54	Greece, Indonesia, Ukraine	48.657	12.573
Countries with nation IQ from 73 to global average (84)	89	Venezuela, Panama, Nepal	26.590	12.247

Turning to control variables, as before, they are in line with predictions: the size of stock market is lower in countries that are more open as well as in countries with higher inflation rates. A higher GDP per capita is positively correlated with the size of stock market. Adding religion dummies in column 4 does not significantly change the results.

In Table 5, we further verify our finding of the positive effect of intelligence on the financial development by showing that high-IQ nations have higher level of financial development. We cluster the countries into three groups: the first includes 89 countries with nation IQ below average level, the second group includes 54 countries with nation IQ between the average level and one standard deviation above the mean level and the third group includes 37 countries with nation IQ one standard deviation above the average level.

The results of cluster analysis suggest that in countries with the high-IQ scores (IQ ≥ 95) the size of banking sector is two times that of countries in the second cluster (84 ≤ IQ < 95). Moreover, the size of stock market in high-IQ is five times that of countries with or below the average IQ score, indicating that intelligence is relatively more important for the stock market development.

4. Robustness results

To investigate the robustness of our findings we conduct a number of tests. Until now, we have generally neglected potential heterogeneity among the countries. However, it may be true that intelligence can have different effect on financial development across the nations. First, we perform regressions for the sub-sample excluding OECD members. The estimates reported in Table 6, columns 1–2, are considerable similar to those derived for full sample of countries. Although the effect of intelligence on stock market size is lower. In Table 6, columns 3–4, the sample excludes African countries that are in general described by two aspects: relatively low IQ scores, and underdeveloped financial system. The results are in line with our earlier estimates suggesting that the link between intelligence and finance is relatively balanced across different groups of countries.

Moreover, we explore whether the effect of intelligence on finance is driven by the choice of financial development measures. Therefore, Table 7 reports separate regressions for alternative proxies of financial development (i.e., liquid liabilities as a % of GDP (liabilities) and stock turnover ratio (turnover)). For the sake of brevity, we present only the coefficients of the intelligence and macroeconomic variables.

Across different regressions with alternative proxies for financial development the sign and significance of the estimated coefficients for intelligence seem to be identical to those reported above.

Finally, we tested whether our estimated coefficients are affected by the presence of influential observations. To address this issue we rely on robust regression which fits the regression, calculates Cook's D and excludes any observation for which D > 1. It performs a regression, calculates case weights from absolute residuals, and regresses again using those weights.[2] The results presented in Table 8 show that IQ is positive and statistically significant throughout the regressions.

[2] See http://www.stata.com/manuals13/rrreg.pdf for detailed description.

5. Conclusion

This paper makes use of cross-country data on the measures of financial development to present a first estimate of the relationship between intelligence, measured by mean IQ scores, and finance. Our finding show that intelligence is significantly related to all financial development outcomes examined. In addition, the results remain robust after we control for conventional drivers of financial development. These findings underline the importance of intelligence in economic development through the effect on financial markets. Indeed, while Guiso et al. (2003) links culture, measured by social trust and religion, to financial development, the authors did not consider for other personality outcomes in their study. Our results show that intelligence can

Table 6
Robustness check: sub-samples.

	(1) dcred	(2) Stock	(3) dcred	(4) Stock
IQ	0.032***	0.076**	0.022***	0.146***
	(0.009)	(0.037)	(0.008)	(0.024)
Trade	0.010	−1.073*	0.070	−1.198***
	(0.138)	(0.634)	(0.102)	(0.306)
Initial GDP	0.232***	0.572**	0.310***	0.573***
	(0.053)	(0.227)	(0.059)	(0.194)
Inflation	−0.024***	−0.052	−0.040***	−0.097***
	(0.006)	(0.036)	(0.011)	(0.037)
English common law	0.574***	1.897***	0.350***	1.094**
	(0.193)	(0.671)	(0.130)	(0.458)
Napoleonic civil law	0.187	1.065	0.125	0.637
	(0.218)	(0.808)	(0.170)	(0.537)
Constant	−1.626**	−8.083**	−1.048	−10.702***
	(0.688)	(3.621)	(0.719)	(3.005)
N	137	74	120	91
Excluding	OECD	OECD	Africa	Africa
Adj. R^2	0.550	0.384	0.634	0.559

Notes: Heteroskedasticity adjusted robust standard errors in parentheses. Significance at the 1% level is denoted by ***; ** denotes significance at the 5% level; and * significance at the 10% level.

Table 7
Robustness check: alternative measures of finance.

	(1) Liabilities	(2) Turnover
IQ	0.012**	0.076***
	(0.006)	(0.016)
Trade	0.168	−1.117***
	(0.102)	(0.277)
Initial GDP	0.214***	0.299*
	(0.047)	(0.158)
Inflation	−0.026***	0.007
	(0.007)	(0.025)
Constant	0.320	−1.660
	(0.460)	(1.806)
N	169	109
Adj. R^2	0.477	0.382

Notes: Heteroskedasticity adjusted robust standard errors in parentheses. Significance at the 1% level is denoted by ***; ** denotes significance at the 5% level; and * significance at the 10% level.

Table 8
Robustness check: robust regression results.

	(1) dcred	(2) Stock	(3) Liabilities	(4) Turnover
IQ	0.031***	0.126***	0.015***	0.104***
	(0.007)	(0.027)	(0.005)	(0.020)
N	171	108	167	107
Adj. R^2	0.654	0.590	0.568	0.528

Notes: Heteroskedasticity adjusted robust standard errors in parentheses. Significance at the 1% level is denoted by ***; ** denotes significance at the 5% level; and * significance at the 10% level. All regressions include constant term and the vector of control variables.

predict financial development across the nations. Specifically, intelligence alone explains 42% of cross-country variation in the size of banking sector. The fact that finance is an important antecedent of economic growth renders this as an important discovery from a policy perspective.

Appendix A. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.paid.2015.06.017.

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