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Patent Protection, Intelligence and Economic Growth: A Cross-Country Empirical Investigation

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Abstract

Extant literature on the link between patent protection and economic growth have yielded inconclusive results. In this study, we aim to engage in this debate by conjecturing that intelligence moderates the effect of patent protection on economic growth. Using annual data of 88 nations from 1970 to 2013 we find that patent protection has positive effect on growth only after accounting for the interaction between IQ and IPR. Indeed, we find that the interaction term is negative and statistically significant suggesting that countries with higher level of intelligence (above 90 points) can offset the negative effect of weak IPR protection. The results remain robust for a battery of robustness tests.

Keywords: IQ; Intelligence; Patent Protection; Economic Growth.

1. Introduction

The role of institutions in the economic growth have received considerable attention in the empirical literature (see e.g. Acemoglu, 2005). As suggested by North (1989 p. 1320) 'institutional requirements that are necessary in order to be able to realize the productivity gains associated with the model of impersonal exchange outlined above entail both the development of efficient products and factor markets and of a medium of exchange with reliable features'. While theoretical arguments favor the positive effect of institutions on economic growth, the empirical evidence has been mixed and even controversial. For example, in a meta-review of 81 papers on democracy and growth (Doucouliagos & Ulubasoglu, 2008) finds that democracy has insignificant effect on economic growth. Similarly, Przewosrki (2004) concludes that direct effect of democracy on per capita income growth is not statistically different from zero. Moreover, the author argues that democracy has indirect effect on growth via demography and investments. In a similar, meta analysis of 41 empirical articles, Campos et al. (2010) concludes that corruption has negative effect on economic growth, although this effect may be subject to publication bias and sample selection. Similarly, another aspect of quality of institutions that has attracted significant attention in the scholarly literature is the consequences of intellectual property protection. By-and-large, theoretical studies suggest that 'patent protection raises the R&D incentives and improves technological progress, which in turn decreases economic growth volatility, proving that a superior patent breadth leads to a higher expected growth rate' (Azevedo et al., 2014). Laik (2005) further elaborates that intellectual property is a robust predictor of economic growth in the era of globalization. Globalization, increasing FDI inflows to developing countries and North-South trade linkages lead to convergence of standards such as institutions and patent protection. On the other hand, empirical evidence comes to puzzling conclusions. One of the early studies by Gould & Gruben (1996) show that IPR index has a positive impact on economic growth in cross-country growth regressions. However, the authors also show that his effect is stronger in open economies. In a follow up study, Park & Ginarte (1997) using data from 60 countries and applying seemingly unrelated regressions show that patent protection has negative and insignificant effect on economic growth. In contrast the study suggests that effect of IPR may run indirectly through other determinants of economic growth. Sattar & Mahmood (2011) revisit the patent-growth nexus considering the heterogeneity of countries in earlier studies. The estimate separate regressions for low-, middle- and high-income countries. The authors come to conclusion that 'the impact is found to be more significant in high income countries as compared to middle and low income countries. Similarly, the effect is stronger in case of upper middle income countries

as compared to lower middle income and low income countries' (p. 163). The results for single countries studies also remain inconclusive. For instance, Fleisher & Zhou (2010) show that stronger patent laws explained more than 60% of TFP dynamics in China over the period 1990 - 2007. Imam (2005) shows that a significant increase in the competitiveness of Japanese manufacturing was driven by IPR.

Over the past decade a separate strand of empirical literature has emerged in the cross-country literature which explores the role of national intelligence in the socio-economic outcomes (Jones & Schneider, 2006; Burhan et al., 2014; Lynn & Vanhanen, 2009; Salahodjaev & Yuldashev, 2016). These studies show that intelligence predicts per capita wealth (Daniele, 2013), economic growth (Weede, 2004) and historical rates of technological development (Lynn, 2012). On the country level intelligence also predicts life satisfaction (Salahodjaev, 2015a) and more equal distribution of happiness (Nikolaev & Salahodjaev, 2016).

More importantly, these studies show that intelligence predicts cross-country differences in the quality of institutions. For example, Potrafke (2012) show countries with higher level of national IQ are associated with lower levels of corruption. Salahodjaev & Azam (2015), using OLS and instrumental variable regressions show that intelligence is important determinant of gender equality. Turning to the role of intelligence in economic growth, Salahodjaev (2015b) shows that intelligence moderates the relationship between political institutions and economic growth.

Focusing on the role of intelligence, the aim of this study is to investigate the relationship between patent protection and economic growth using global data from 88 economies from 1970 to 2013.

Indeed, there are several reasons to anticipate the importance of intelligence in the relationship between patent protection and economic growth. While patent protection is an essential aspect of market policies, there is evidence that 'a measure of national intelligence such as IQ provides a good approximation of the degree of the support to [pro-market] policies' (Kanyama, 2014 p. 52). Moreover, protection of intellectual property requires certain cultural values such as liberalism which is considered to be attributed to individuals with higher levels of intelligence (Carl, 2015).

In addition, IPR stringency is aimed to reduce digital/technological crime rate a behavioral tendency that was significantly associated with cognitive abilities. Templer & Rushton (2011), using data for 50 U.S. states, shows positive correlation between state-level IQ and 11 measures of crime. In an earlier study, Rushton & Templer (2009), using data for the period 1993–1996 from International Crime Statistics published by INTERPOL, document that IQ predicts approximately 51% of cross-country variations in crime rates. Bartels et al. (2010) revisits the IQ crime-crime nexus and finds that intelligence is negatively related with crime statistics even after controlling for large set of socio-economic covariates. In this vein intelligence predicts rent-seeking behavior such as underground economic activities (Salahodjaev, 2015c) and deforestation rates (Salahodjaev, 2016).

Therefore, departing from earlier discussion this study tests the following hypotheses:

- Intelligence moderates the relationship between IPR protection and economic growth.
- IPR has positive effect on economic growth after accounting for the role of national intelligence.

2. Econometric Model and Data

The econometric model in this study to test the role of national IQ and IPR protection in economic growth can be specified as:

$$\mathbf{g_i = \beta_0 + \beta_1 IQ_i + \beta_2 IPR_i + \delta X_i + \varepsilon_i}$$

where is average GDP growth rate between 1970-2103 in country *i*; IQ is the national IQs as a proxy for intelligence; is the IPR protection index from Park (2008). To mitigate the effect of excluded variable bias a vector of control variables (X) is added in the econometric model: investment rate, population growth rate, initial level of GDP per capita, average years of schooling. We also add democracy index measured as the average of civil rights and political liberties as intelligence is correlated with quality of institutions. The descriptive statistics are presented in Table 1.

Table 1: Descriptive Statistics

Variable	Source	Mean	Std. Dev.	Min	Max
GDP growth rate	World Bank	3.811	2.197	-5.411	16.906
Investment as % of GDP	World Bank	22.957	8.343	8.242	95.732
Population growth rates	World Bank	1.755	1.222	-0.344	8.724
GDP per capita in 1990 (log)	World Bank	7.717	1.553	4.974	11.231

Democracy index	Freedom House	4.125	2.092	1	7
Average years of schooling	Barro & Lee (1995)	4.308	2.632	0.048	11.21
IQ	Lynn & Vanhanen (2012)	84.102	10.847	60.1	107.1
IPR index	Park (2008)	3.369	0.854	1.2	4.88

3. Results

The main results are reported in Table 2. Column 1 estimates tradition Barro-type economic growth model where only control variables are added on the right hand side of Eq. 1. In line with the predictions of Mankew et al. (1992), investment has positive effect on economic growth. For example, a 10 percentage points increase in gross fixed capital formation normalized by GDP increases GDP growth rates by 1.5%. The estimate for initial level of GDP per capita is negative and statistically significant indicating the convergence effect within countries. This model explains approximately 37% of cross-country fluctuations in the GDP growth rates.

Column (2) adds intelligence proxied by national IQs. As expected intelligence is positive and statistically significant at the 1% level. A numerical meaning of this relationship is that when national IQ increases by 10 points, GDP growth rates increase by 1%. Moreover, after including IQ the econometric model explains more than 58% of international differences in GDP growth.

Column (3) further adds IPR index in the regression. Although the coefficient is positive it is statistically insignificant, suggesting that patent protection does not have direct effect on economic growth.

Finally, in column (4) we test the hypothesis that intelligence moderates the effect of IPR on economic growth. To do so, we add interaction term between IQ and IPR. Indeed, we find that the interaction term is negative and statistically significant suggesting that countries with higher level of intelligence (above 90 points) can offset the negative effect of weak IPR protection. Moreover, we find that after controlling for the interaction effect between IPR and IQ, the estimate for IPR is now positive and significant. These findings are in line with the study by Salahodjaev (2015b) who shows that intelligence moderates the effect of democracy on economic growth.

Table 2: Main Results

	(1)	(2)	(3)	(4)
Investment	0.1563***	0.1049***	0.1045***	0.1012***
	(0.0276)	(0.0235)	(0.0275)	(0.0270)
Population growth	0.5798***	0.9915***	1.0923***	1.0255***
	(0.2116)	(0.1816)	(0.2036)	(0.2019)
GDP per capita (log)	-0.5133***	-0.7456***	-0.7718***	-0.7618***
	(0.1411)	(0.1192)	(0.1356)	(0.1329)
Schooling years	0.1623*	0.0610	0.0334	0.0486
	(0.0837)	(0.0694)	(0.0743)	(0.0731)
Democracy index	0.0334	0.0256	0.0366	0.0194
	(0.0880)	(0.0713)	(0.0807)	(0.0795)
IQ		0.1075***	0.1122***	0.2175***
		(0.0157)	(0.0185)	(0.0532)
IPR index			0.1459	2.8296**
			(0.2217)	(1.2938)
IQ * IPR				-0.0313**
				(0.0149)
Constant	2.5253*	-3.9928***	-4.8206***	-13.5132***
	(1.2961)	(1.4180)	(1.6048)	(4.4199)
N	93	93	88	88
adj. R^2	0.3657	0.5842	0.5775	0.5949

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

The robustness tests are reported in Table 3. Column 1 re-visits the baseline results but with additional control variables. We further add trade openness and government size to the growth regressions. For example, Rodigues & Rodrik (2001) shows that trade policies are an important source for economic growth in developing countries. Similarly, Bergh & Henrekson (2001) in a survey of related literature shows that government size is an important aspect of economic growth. While government size is insignificantly related to economic growth, we find evidence that trade openness has positive impact on real GDP growth. The estimates for IPR, IQ and their interaction term remain significant and robust. In column 2, we tested whether our results are fragile to the period of analysis. We re-estimate Eq. (1) for the period 1990-2013 (short-run). The results again robust.

Table 3: Robustness Test

	(1)	(2)
Investment	0.0790***	0.0657**
	(0.0275)	(0.0316)
Population growth	0.9466***	0.9471***
	(0.1972)	(0.1876)
GDP per capita (log)	-0.8367***	-0.7465***
	(0.1401)	(0.1784)
Schooling years	0.0196	0.1198
	(0.0714)	(0.0808)
Democracy index	0.0135	-0.0924
	(0.0768)	(0.1041)
Government size	0.0159	-0.0195
	(0.0275)	(0.0314)
Trade openness	0.0065***	0.0030
	(0.0024)	(0.0027)
IQ	0.2315***	0.2585***
	(0.0528)	(0.0648)
IPR	3.3004**	3.4343**
	(1.2822)	(1.5382)
IQ*IPR	-0.0353**	-0.0416**
	(0.0147)	(0.0173)
Constant	-14.5034***	-14.9773***
	(4.3722)	(5.3255)
N	88	103
adj. R^2	0.6219	0.5370

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

4. Conclusion

The determinants of economic growth have received substantial attention in the empirical literature over the past decades. For example, human capital, trade, investment, demographic transitions were robustly linked to economic growth. On the other hand, related literature on the role of institutions in the growth processes remained inconclusive. Plethora studies provide mixed evidence on the impact of democracy, corruption, government efficiency, rule of law and patent protection on economic growth. In this study we contribute to the empirical debate on the IPR protection growth nexus by suggesting that this relationship is rather complex. In particularly, departing from growing body of literature on the role of national intelligence, we assert that intelligence moderates the effect of IPR protection on economic growth.

The estimates based on a sample of more than 80 nations show that countries with higher level of intelligence (above 90 points) can offset the negative effect of weak IPR protection on economic growth. We provide novel empirical support on the ongoing debate on the effect of patent protection on economic growth. Our results again highlight important conclusion asserted by Kanyama (2014 p. 52) 'a measure of national intelligence such as IQ provides a good approximation of the degree of the support to [pro-market] policies'.

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