Towards explaining variations in achievement between seemingly similar countries: Findings from a comparative achievement study, PISA 2012 in Latin America*

Fichetti Peralta Ignacio, Héctor Gertel

Instituto de Economía y Finanzas, FCE, UNC

Av.Valparaíso s/n, Ciudad Universitaria, X5000HRV Córdoba, Argentina.

ifichetti@gmail.com

Abstract

The focus of most comparative institutional analysis in the education literature is focused on studies of accountability, autonomy, privatization, levels organization, access and filtering devices which are institutions of education. In contrast, in an increasingly interrelated world, more complex issues of institutions and education should be examined (i.e. those associated with levels of autarky or openness of the national economy). In this research we use a three level HLM design with aggregate data of the eight Latin American countries that participated in PISA 2012. The dependent variable is the individual score in the PISA 2012 mathematical test with explanatory variables at the individual level, such as gender and parents' socioeconomic conditions, at the school level, such as school type or school climate, and at the country level, with selected explanatory variables of institutions signaling at differences between countries' institutional effects. We used lagged values of the institutional variables to test whether the much broader concept of institutional development, that facilitates circulation of ideas and stimulates the demand for innovative citizens and workers to use them, contributes to explaining differences in performance between countries in Latin America. Two main results were obtained. First, examination of the variability between countries has helped remove about 8-10 of the total variability in individual PISA scores of students across Latin America showing the importance of the "country effect". Second, both the broadband indicator of connectivity and the index of innovative environment had the expected sign and were statistically significant at the 90% confidence. The joint effect of the two covariables has explained about 60% of the "country effect". These results tend to confirm that an institutional environment that favors interdependence of nations with the global knowledge society also promote better results in PISA.

Keywords: institutions of education, PISA 2012, hierarchical linear model.

JEL classification: I21, I28, E11.

1. Introduction

Many observers have emphasized the crucial importance of human capital, particularly when it is acquired through quality education, to achieve economic and institutional progress. School enrollment ratios and literacy rates were used in earlier empirical studies to assess how much of the variation in economic well-being across countries does education explain (Mankiw, Romer and Weil, 1992, Barro and Lee, 2011). Furthermore, adding results from international comparative achievement, classical growth equations produce more refined estimates of a significantly positive effect of quality education on economic progress (Hanushek and Woessmann, 2007). But explaining interrelated connections is much more difficult due to

* The authors are grateful to SECYT-UNC for financial assistance to the project 202-2016. This communication has been prepared for presentation at the XIV Arnoldshain Seminar "Institutions, Trade, and Economic Policy". Córdoba, October 3-6, 2016.

identification and endogeneity problems. According to Cipolla(1969), Blaug (1970), Acemoglu, Johnson and Robinson (2005) an inverse relationship can be established. After all, countries with a strong record of institutional development tend to be better and more adequately informed when making the right choice as regards the benefits of quality education. Finally, Hanushek and Woessmann (2012) observed in Latin America that low achievement in international comparative tests may result from historical and institutional determinants although they do not explore further this idea.

In many studies, including PISA, institutions are recognized as a basic ingredient of individual choice. According to Checchi (2008), students and parents, teachers, administrators and policy makers derive incentives to perform in school from inherited institutional arrangements. Yet, the focus of most comparative institutional analysis in the education literature is focused on studies of accountability, autonomy, privatization, levels organization, access and filtering devices which are institutions of education (Hanushek and Woessmann 2011, Behrman, Parker and Todd, 2014, Glewwe, 2014). In contrast, in an increasingly interrelated world, more complex issues of institutions and education should be examined (i.e. those associated with levels of autarky or openness of the national economy). Due to this fact, especially when researching comparative international achievement studies conducted in non-OECD countries, the impact of institutions on national results should be taken into account.

In this paper we take a closer look at PISA 2012's assessment data on mathematics in all Latin American countries. All of them are ranked in the lower quartile of PISA, and are considered to be seemingly similar countries from PISA's perspective. But they differ in the degree of autarky or openness to the world circulation of ideas (Romer, 1992) as well as in their institutional evolution to promote incentives for innovate (Aghion, David and Forey, 2009). These ideas help to explore whether a proper type of institutions provide incentives to improve performance in PISA. This type of questions, that we found of interest in Latin America, might also be illuminating within the EU, where a number of countries has performed below the EU average in international comparative achievement studies and have weaker indicators of institutional development. Assembling information from the International Telecommunication Union, the Global Competitiveness Report and using standard PISA data we introduce instrumental variables to identify in a HLM framework, correlations between openness and country results in PISA, and elaborate further about plausible explanatory channels.

2. Methods, Research Instruments or Sources Used

In this research we use a three level HLM design (Goldstein, 2011) with aggregate data of the eight Latin American countries that participated in PISA 2012. The objective is to discover whether institutions are relevant to explaining differences between countries in PISA results. The dependent variable is the individual score in the PISA 2012 mathematical test with explanatory variables at the individual level, such as gender and parents' socioeconomic conditions, at the school level, such as school type or school climate and at the country level, with institutions signaling at differences between countries' institutional effects. We expand the concept of institutions beyond the usual approach of "institutions of education" and used lagged values of the institutional variables selected to test whether the much broader concept of institutional development, that facilitates circulation of ideas and stimulates the demand for innovative citizens and workers to use them (openness), contributes to explaining differences in performance between countries in Latin America, despite the fact that they are taken as seemingly similar countries through the lens of PISA.

3. Preliminary Results

By using a hierarchical linear model with three levels, two main results are expected. The first one is the resulted value of the Rho coefficient for the third level (the intra-level 3 unit correlation). The second one is the contribution of the covariables introduced to measure the effects of institutions on PISA results.

Table 1 indicates the value of the Rho coefficients in the three level model. In a model with three levels, say with countries, schools and students, we will have two such correlations; the intra-country correlation measuring the proportion of variance that is between-countries (8.6%) and the intra-school correlation measuring that between schools (41.6%). The remaining 49.8% correspond to variability across students. These results justify the use of nesting procedures for estimating the model.

Table 1. Variance decomposition in the three level mod el.

Hierarchical level	Variance of scores by hierarchical level	Rho Coefficient	Standard Deviation of the observations
Country	514.2	8.6%	22.6
School	2495.7	41.6%	49.9
Student	2982.2	49.8%	54.6
Total	5992.1	100%	127.1

Source: Author's calculation based on PISA 2012 data.

In short, examination of the variability between countries has helped remove about 8-10 of the total variability in individual PISA scores of students across Latin America showing the importance of the "country effect".

Table 2 summarizes the results of the estimated three level model showing the specific contribution of the covariables that channel the effect of institutions on PISA results.

Table 2. Summary of multilevel regression results for PISA 2012

VARIABLES	Coefficients	Standard error
Country level variables		
BROADBAND	1.350*	0.819
INNOVATIVE ENVIRONMENT	2.308*	1.217

*** p<0.01, ** p<0.05, * p<0.1
Source: See Annex 1.

Both the broadband indicator of connectivity and the index of innovative environment had the expected sign and were statistically significant at the 90% confidence. These results tend to confirm that an institutional environment that favors interdependence of nations with the global

knowledge society also promote better results in PISA. The joint effect of the two covariables has explained about 60% of the "country effect".

4. Conclusions

Openness, in Latin America, pulls upwards PISA results. In other less developed regions, such as the Mediterranean Region in Europe, reforming institutions at large to catch-up with the global information society may create the right incentives on education to improve individual achievement in international comparative studies.

References

Acemoglu, D., Robinson, J., & Johnson, S. (2005). Institutions as a fundamental cause of long-run growth. In P. A. Durlauf, Handbook ofEconomic Gmwth, Volume IA. (pp. 386-415), London: Elsevier B.V.

Aghion, P., David, P. A., & Foray, D. (2009). Science, technology and innovation for Economic Growth: Linking policy research and practice in 'STIG Systems' , Research Policy , pp. Vol 38: 681-693.

Barro, R. J., & Lee, J.-W. (2011). A New Data Set of Educational Attainment in the World, 1950-2010, Journal of Development Economics , Vol 104: 184-198.

Behrman, J. R., Parker, S. W., & Todd, P. E. (2014). Incentives for Students and Parents . Paul Glewwe (Ed.) Education Policy in Developing Countries, Chicago:The University of Chicago Press .

Blaug, M. (1970). An introduction to the economics of education, London: Penguin Books.

Checchi, D. (2008). The Economics of Education: Human capital, Family background and Inequality, London: Cambridge University Press.

Cipolla, C. M. (1969). Literacy and Development in the West, London: Penguin Books.

Glewwe, P. (2014). Overview of Education Issues in Developing Countries. Paul Glewwe (Ed.) Education Policy in Developing Countries, Chicago: The University of Chicago Press.
Goldstein, H. (2011). Multilevel Statistical Models, West Sussex: John Willey and Sons, Ltd.

Hanushek, E. A., & Woessmann, L. (2007). The role of education quality for economic growth, Policy Research Working Paper Series 4122, The World Bank.

Hanushek, E. A., & Woessmann, L. (2012). Schooling, Educational Achievement, and the Latin American Growth Puzzle. ournal of Development Economics, Vol J99: 497-512.

Hanushek, E. A., & Woessmann, L. (2011). The Economics of International Differences in Educational Achievement. In S. M. Eric A. Hanushek, Handbook of the Economics of Education, Vol. 3, chapter 2 (pp. 89-200). North Holland.

Mankiw, G. N., Romer, D., & Weil, D. N. (1992). A Contribution to The Empirics of Economic Growth, The Quarterly Journal of Economics, 407-437.

Romer, P. (1992). Two Strategies for Economic Development: Using Ideas and Producing Ideas, Washington: Proceedings of The World Bank Annual Conference on Development.

Annex 1

Table A.1. Multilevel regression results for PISA 2012.

VARIABLES	MCO	Empty Model	Level 1 Model	Level 1 and 2 Model	Complete Model
Intercept	244.049***	396.292***	390.945***	336.372***	234.898***
	(4.515)	(8.093)	(6.984)	(7.152)	(42.571)
Variables of student level					
Gender [Female=1]	-21.859***		-22.324***	-22.356***	-23.199***
	(0.677)		(0.376)	(0.375)	(0.375)
Repeat [Repeat=1]	-55.617***		-41.298***	-41.019***	-39.344***
	(0.761)		(0.504)	(0.503)	(0.979)
HISEI	0.347***		0.212***	0.203***	0.196***
	(0.015)		(0.008)	(0.008)	(0.021)
PARED	0.160***		0.091***	0.086***	0.057***
	(0.015)		(0.009)	(0.009)	(0.010)
HOMEPOS	0.980***		0.340*	0.306*	0.210**
	(0.040)		(0.023)	(0.023)	(0.092)
Variables of school level					
SCHTYPE [Private=1]	16.701***			15.431	16.228
	(1.316)			(2.520)	(2.521)
SCHAUTON	0.123***			0.322***	0.327***
	(0.021)			(0.040)	(0.049)
SCMATBUI	0.146***			0.248***	0.269***
	(0.013)			(0.025)	(0.022)
STUDCLIM	0.365***			0.373***	0.341***
	(0.024)			(0.042)	(0.083)
Variables country level					
Broadband	0.675***				1.350*
	(0.097)				(0.819)
Innovation Environment	1.638***				2.308*
	(0.094)				(1.217)

*** p<0.01, ** p<0.05, * p<0.1

Number of observations: students (81.825); schools (3.636); countries (8).

Pseudo R2: covariables of student level (20%); covariables of school level (40%); covariables of country level (64%).