Main factors explaining the differences in results between Chile and OECD & Latin American countries in the PISA 2006 – Reading test

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Motivation & Research Objectives

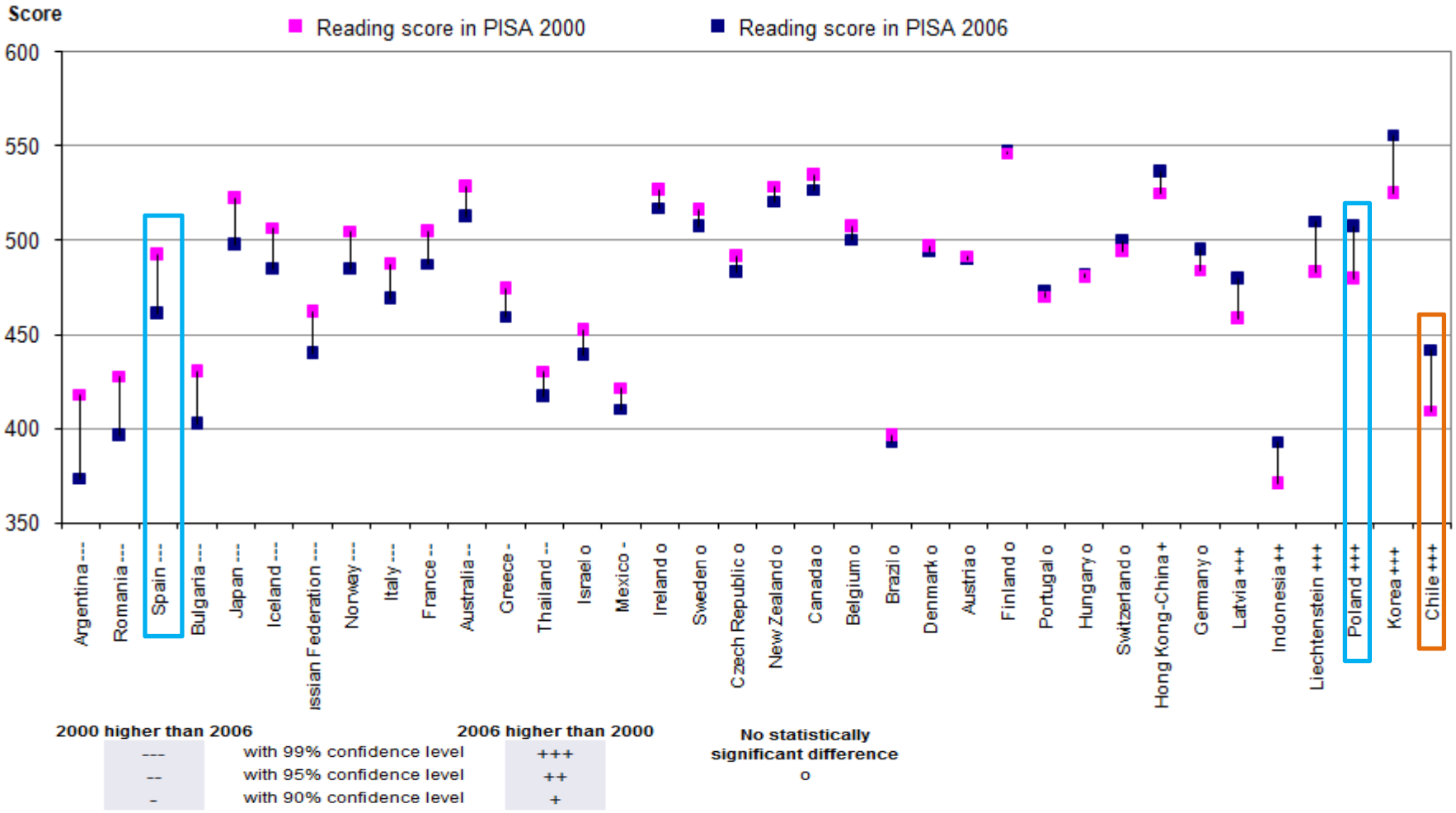
- **Motivation**
  - Chilean scores in PISA (reading test) improved considerably between 2000-2006 (0.33 sd).
  - …but we are still well below OECD average score (0.56 sd).
  - We could learn from other countries about factors related to our results.
  - Spain, Poland and Uruguay are very interesting comparison countries.

- **Objectives**

  Identify and describe factors (related to students/families, schools and institutional issues) which could explain differences – mean and distribution- in PISA reading scores (2006), between Chile and other countries.

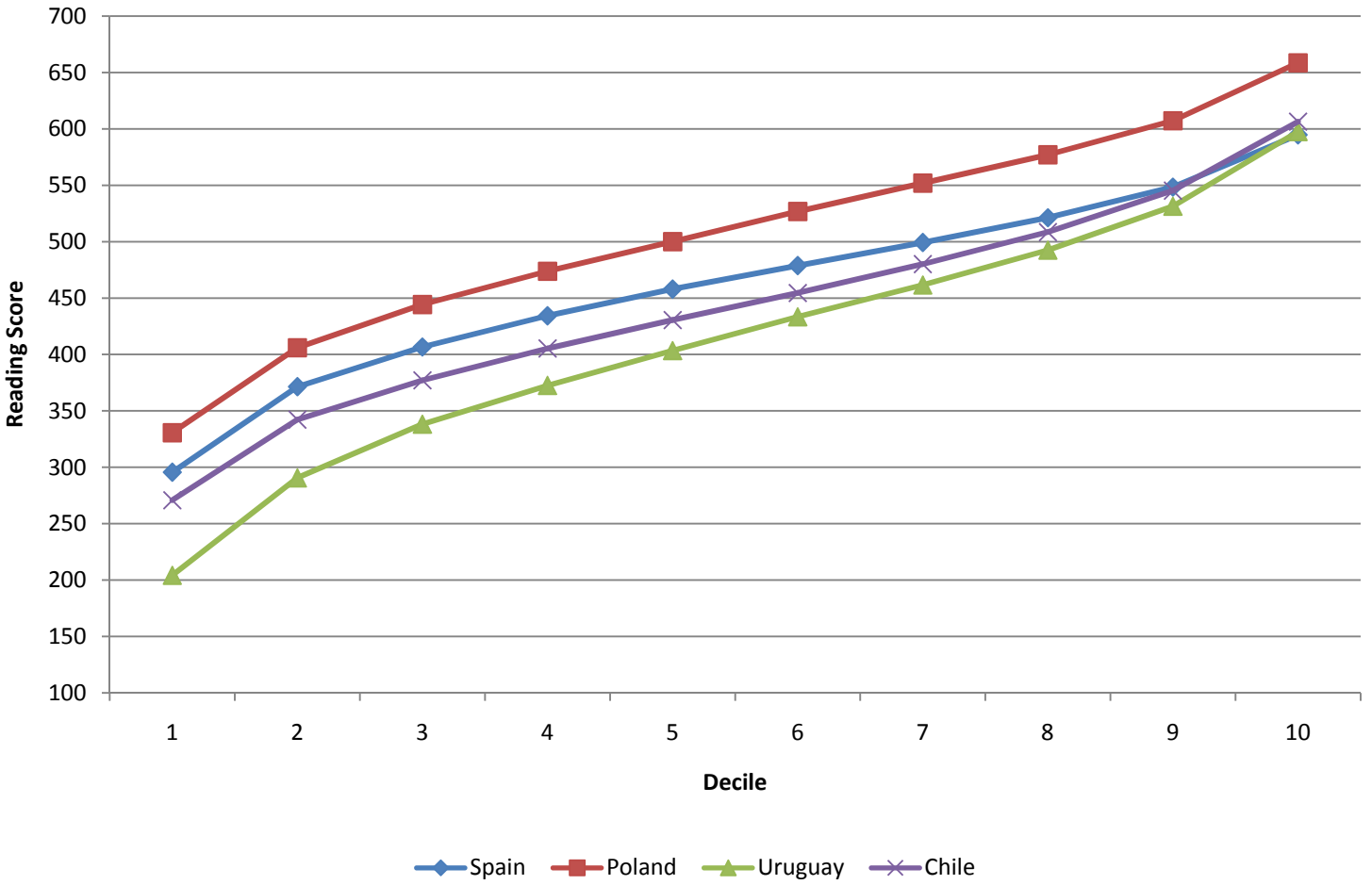
  Estimate whether the differences in PISA results between countries are related to differences in the magnitude of those factors or/and differences in the efficiency in the use of them.

Change 2000 - 2006 in PISA Reading scores



Countries are ranked in ascending order of score difference between PISA 2006 and PISA 2000.
Source: OECD PISA database 2006, Table 6.3a.

Reading Average Score in PISA 2006 by decile: Chile, Uruguay, Spain and Poland



Descriptive Statistics for selected variables PISA 2006 by Country

	Chile	Spain	Uruguay	Poland
PISA-2006 Reading Score	442.5	460.8	412.5	507.5
Variables at student level				
Female student (%)	46.10	49.44*	51.17***	50.33**
Years of schooling	9.78	9.53***	9.473***	8.954***
7th Grade (%)	0.90	0.1**	7.47***	0.57
8th Grade (%)	3.10	7.04***	9.79***	3.84
9th Grade (%)	18.90	33.0***	17.31	95.19***
10th Grade (%)	71.00	59.8***	58.88***	0.40***
11th Grade (%)	6.10	0.03***	6.56	n/a
ISEC (socioeconomic and cultural level of the family)	-0.70	-0.31***	-0.51***	-0.30***
Variables at school level				
Classmates' ISEC (Peer effect)	-0.70	-0.29***	-0.51***	-0.30***
Complex school (%)	47.6	18.12***	21.62***	1.40***
Size of the class	38.11	27.72***	33.11***	25.63***
Size of the school	1048.52	693.56***	435.16***	407.30***
Students per teacher	25.04	12.34***	15.87***	11.29***
Educational resources	-0.62	-0.02***	-0.71***	-0.09***
Institutional Variables (school level)				
Autonomy in the use of resources	-0.25	0.02***	-0.89***	-0.25
Autonomy in curricular and assessment decisions	-0.24	0.24***	-1.10***	0.31***
Academic selection (%)	36.0	4.64***	9.19***	15.18***
Public school (%)	43.80	64.61***	85.13***	98.41***
Number of observations	5,224	19,604	4,839	5,528

Values of P: *** < 1%; ** < 5%; * < 10%

Omitted variables: Schooling delay, High job expectations, Medium job expectations, Low job expectations, Appraisal of Reading performance: Very important, Appraisal of Reading performance: Important, Appraisal of Reading performance: Somewhat or not important, Hours of Language instruction, A majority of parents expecting high standards, A minority of parents expecting high standards, No parents expecting high standards.

Methodology

Production Function:

$$Y_{is,d}^{p} = \beta_{0,d}^{p} + \beta_{1,d}^{p} E_{is,d}^{p} + \beta_{2,d}^{p} S_{s,d}^{p} + \beta_{3,d}^{p} I_{s,d}^{p} + \upsilon_{s,d}^{p} + \varepsilon_{i,d}^{p}$$

where E at individual level, S at school level, I at institutional level, υ and ε are the residuals from the school and he student.

1. Oaxaca-Blinder Decomposition (1973)

- The Oaxaca-Blinder technique allow us to split the score difference between countries into three parts: the first is the difference in the main factors asociated to the student PISA performance (characteristics or endowments effect), the second is the difference in efficiency in these factors compared at country level (efficiency or return effect), and the third is the interaction between differences in characteristics and differences in the return of those characteristics (interaction effect).

Chile-Uruguay differences:

[1] $$\Delta \overline{Y}_l = \overline{Y}_l^{U} - \overline{Y}_l^{Ch}$$

[2] $$\Delta \overline{Y}_l = [E(X_l^{U}) - E(X_{l)}^{Ch})]' \beta_l^{Ch} + E(X_l^{Ch})' (\beta_l^{U} - \beta_l^{Ch}) + [E(X_l^{U}) - E(X_{l)}^{Ch})]' (\beta_l^{U} - \beta_l^{Ch})$$

- Unfortunately we are unable to see the difference along the entire score gap distribution and the effect of the unobserved factors associated to one specific country.

2. Junh-Murphy-Pierce Decomposition (1993)

This methodology has the advantage of considering the whole distribution, not only the mean. And allow us to deal with the distribution of the residuals, which are zero at the mean but not at specific quantiles. The score gap decomposition follows: characteristics, return and residual effect.

Given the models: $y_1 = x_1\beta_1 + \varepsilon_1$

$y_2 = x_2\beta_2 + \varepsilon_2$

The quantile in the residual distribution of model 1 as: $q_{t1} = F_1(\varepsilon_{t1}|x_{t1})$

- Varying quantities, but fixed coefficients and a fixed residual distribution as:

$$y_{1t_1} = x_{t1}\beta + F^{-1}(q_{t1}|x_{t1})$$
$$y_{1t_2} = x_{t2}\beta + F^{-1}(q_{t2}|x_{t2})$$

- Varying quantities and coefficients, and a fixed residual distribution as:

$$y_{2t_1} = x_{t1}\beta_1 + F^{-1}(q_{t1}|x_{t1})$$
$$y_{2t_2} = x_{t2}\beta_2 + F^{-1}(q_{t2}|x_{t2})$$

- Varying each component simultaneously as:

$$y_{3t_1} = x_{t1}\beta_1 + F_1^{-1}(q_{t1}|x_{t1})$$
$$y_{3t_2} = x_{t2}\beta_2 + F_2^{-1}(q_{t2}|x_{t2})$$

- Finally the total score gap can be decomposed as:

$$Y_1 - Y_2 = [Y_{1_1} - Y_{1_2}] + [(Y_{2_1} - Y_{2_2}) - (Y_{1_1} - Y_{1_2})] + [(Y_{3_1} - Y_{3_2}) - (Y_{2_1} - Y_{2_2})]$$

$$T = Q + P + U$$

3. Microsimulation Analysis (Bourguignon, Fournier y Gurgand, 2000)

- A distribution of PISA results can be modeled as a production function (F) associated to a vector of characteristics (X), the return of those characteristics (β), school choice parameters (λ) and unobserved characteristics (ε).

$$Y_{ip} = F(X_{ip}, \varepsilon_{ip}, \beta_p, \lambda_p) \text{ i=1,.....,N}$$

- Therefore, it is possible to simulate score results from a given country using the characteristics of another country. An example, using Uruguay's coefficients on Chile production function, implies:

$$Y_{iCH}(\beta_{UR}) = F(X_{iCH}, \varepsilon_{iCH}, \beta_{UR}, \lambda_{CH})] \; Y_{iCH}(\beta_{UR}) = F(X_{iCH}, \varepsilon_{iCH}, \beta_{UR}, \lambda_{CH}) \text{ i=1,.....,}$$

- Thus, changes in Chile's score distribution are the result of changes in any of the k components of Uruguay's score distribution. Those changes can be measured as a difference at quantile level.

$$I[D_{CH}] - I[D_{CH}(k_{UR})]$$

Results from Oaxaca-Blinder Decomposition

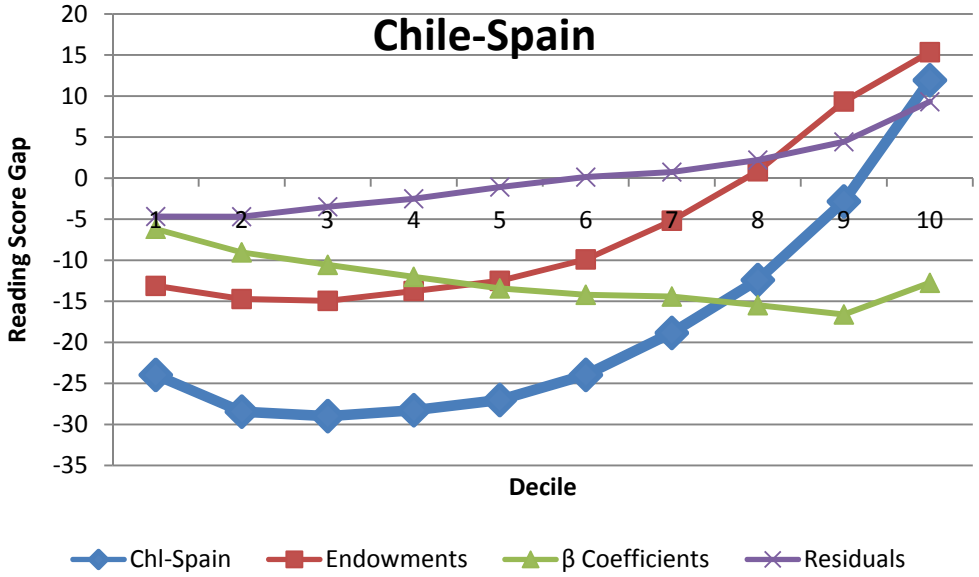
- Differences are concentrated in a Chilean lower efficiency (“returns”) to average years of schooling compared to Spain and Poland. On the other hand, some “factors”, like the individual ISEC and average ISEC at school (peer component) are smaller in Chile than in Uruguay, Spain and Poland, while others, as average years of schooling, are larger in Chile.

General decomposition of the difference between Chile and the three reference countries, PISA-Reading

	Spain	Uruguay	Poland
Total difference PISA-Reading: Chile	*-18.3*	*30.0*	*-65.0*
Explained by differences in characteristics("factors")	-5.9	10.0	9.1
Explained by differences in effects ("returns")	-12.5	20.0	-74.1
Proportion of explained difference (“factors”)	31.9 %	33.2 %	-14.1 %
Proportion of unexplained difference (“returns”)	68.1 %	66.8 %	114.1 %

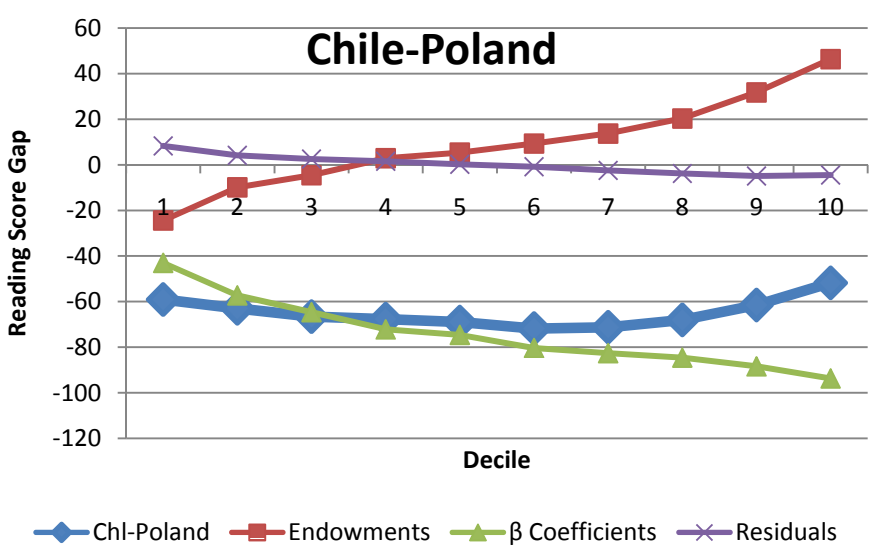
Results from Junh-Murphy-Pierce Decomposition

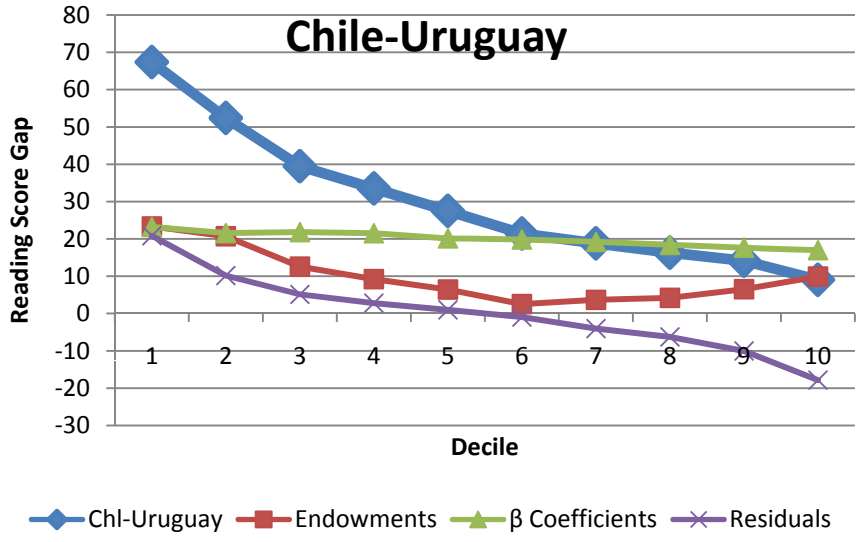
- Spain's advantage in PISA scores is decreasing for higher deciles (in decil 10th Chilean students get 12 points more than Spanish students).
- Larger endowments favor Spain for the fist 7 deciles (particularly better ISEC and peer effect), but for 9 and 10 deciles observable factors are larger among Chilean students. (Graphic shows the larger endowment segregation in the Chilean system)
- Efficiency is larger for all deciles of Spanish students, compared to Chilean students, but this gap is larger for top deciles. This effect is canceled out by better residuals across Chilean top deciles.



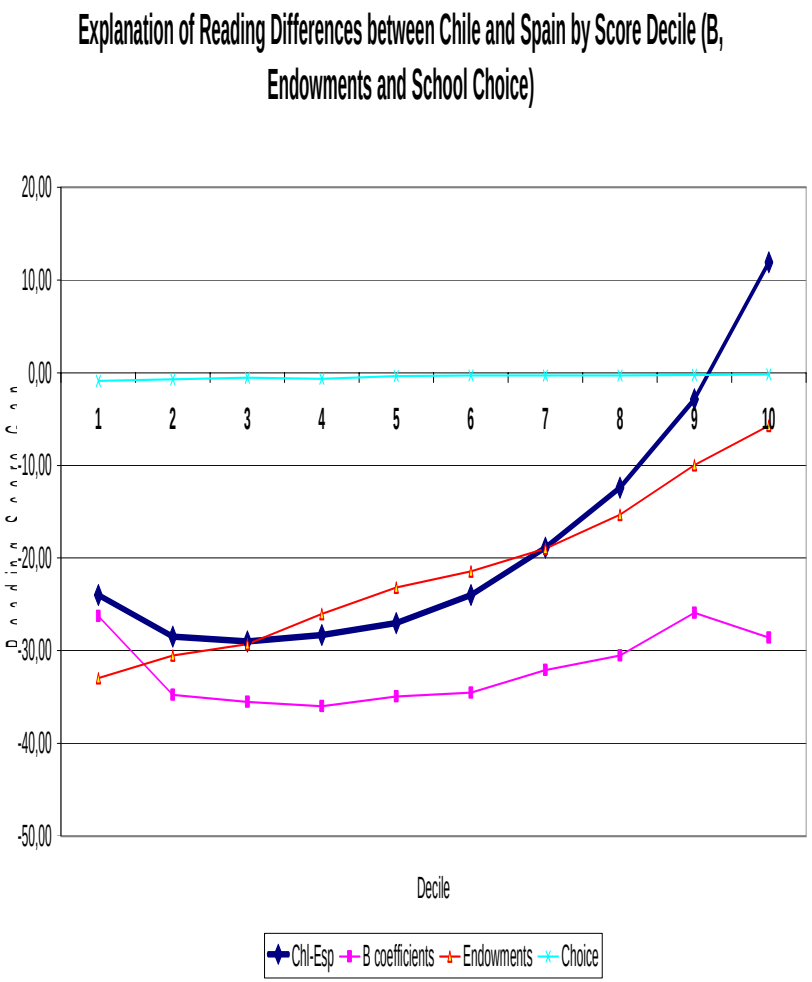
Results from Junh-Murphy-Pierce Decomposition

- Poland advantage in PISA scores is larger for each decile. Its large efficiency could explain more than the total difference with Chile, and the gap is increasing for top deciles (40 points in decil 1, 80 in decile 7 and 100 for decile 10). But the extreme inequality in the endowment distribution (peer effect) in Chile reduces score differences across deciles.
- Chile shows a positive difference with Uruguay for the whole distribution, but larger differences at bottom deciles (explained by efficiency, endowments and positive residuals –which are decreasing for higher deciles-).





Microsimulation results (Chile - Spain)



- Difference in efficiency is larger enough to explain most of the observable positive gap for Spanish students. **Both public and private Spanish schools are more efficient – particularly public-** than Chilean ones, but private Chilean schools get a larger positive effect on higher average years of schooling.
- Endowments are better in Spain than in Chile (for both types of schools); a key factor is peer effect.
- Simulation of composition change between public-private schools does not affect average score: similar average efficiency in Chilean schools!.

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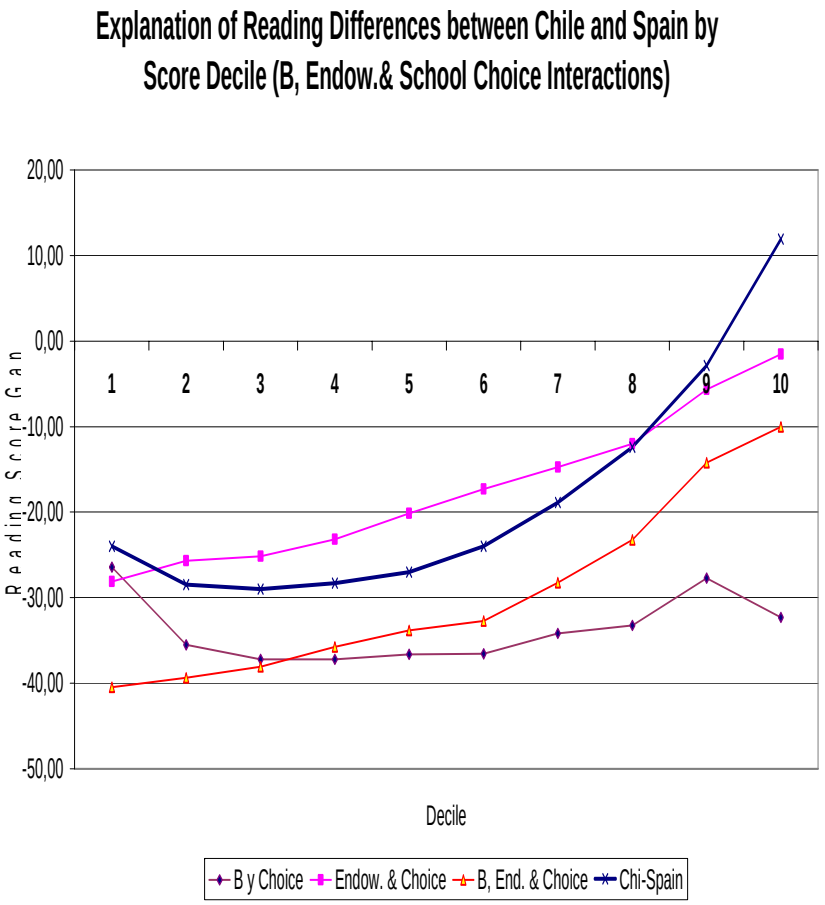
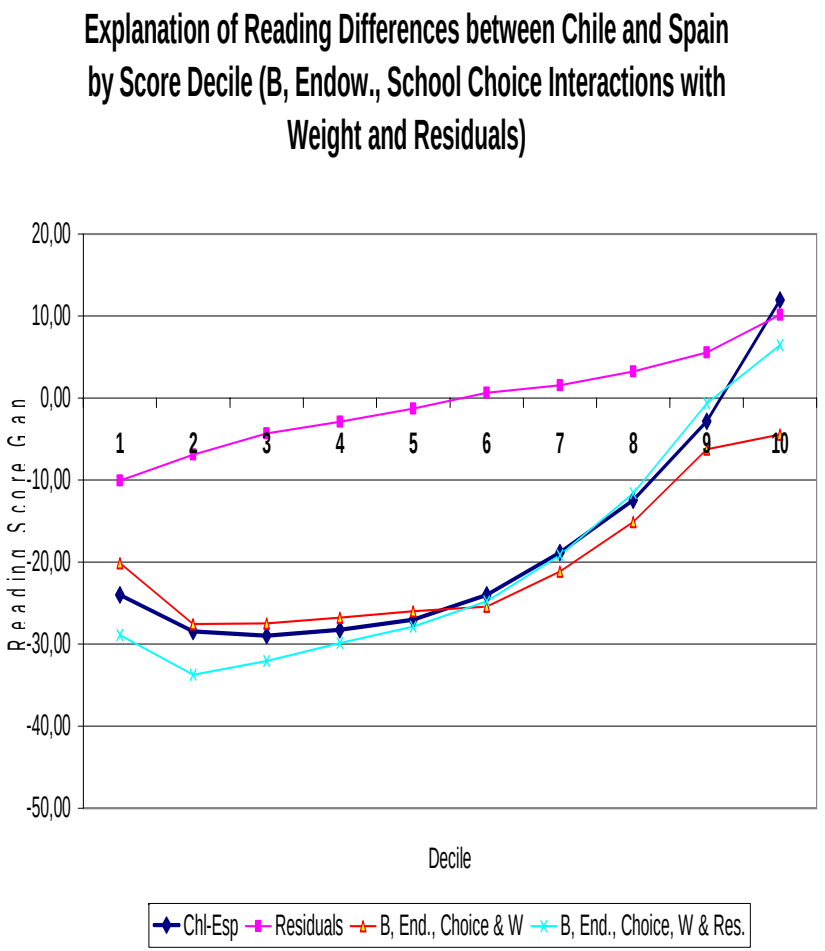
Microsimulation results (Chile - Spain)



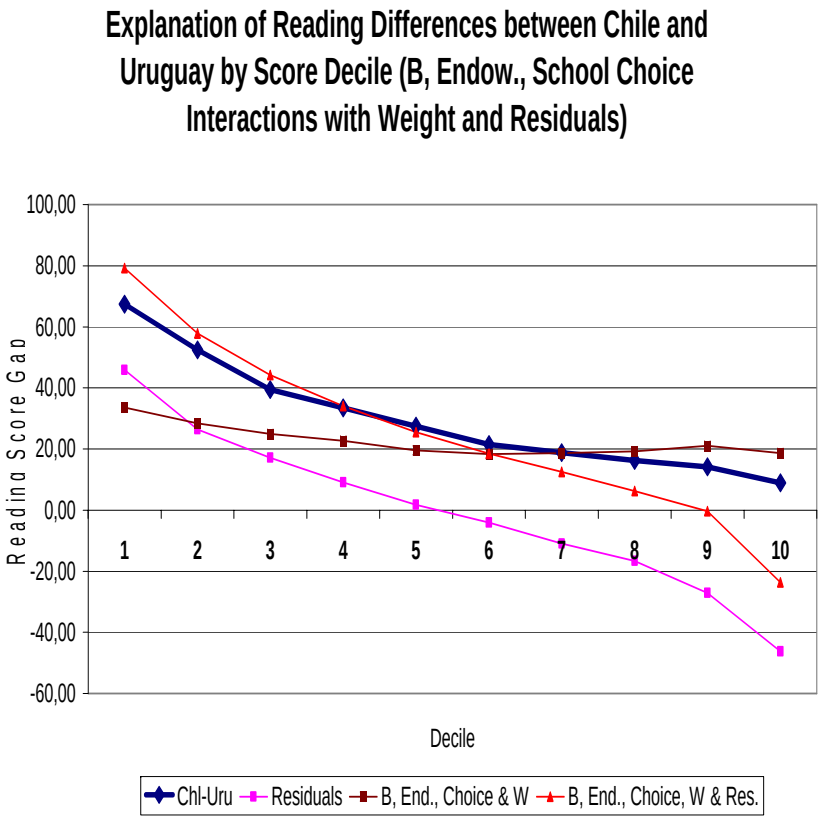
- Interaction between choice and endowment and efficiency differences overexplained differences in average score gaps across deciles.

Microsimulation results (Chile - Spain)



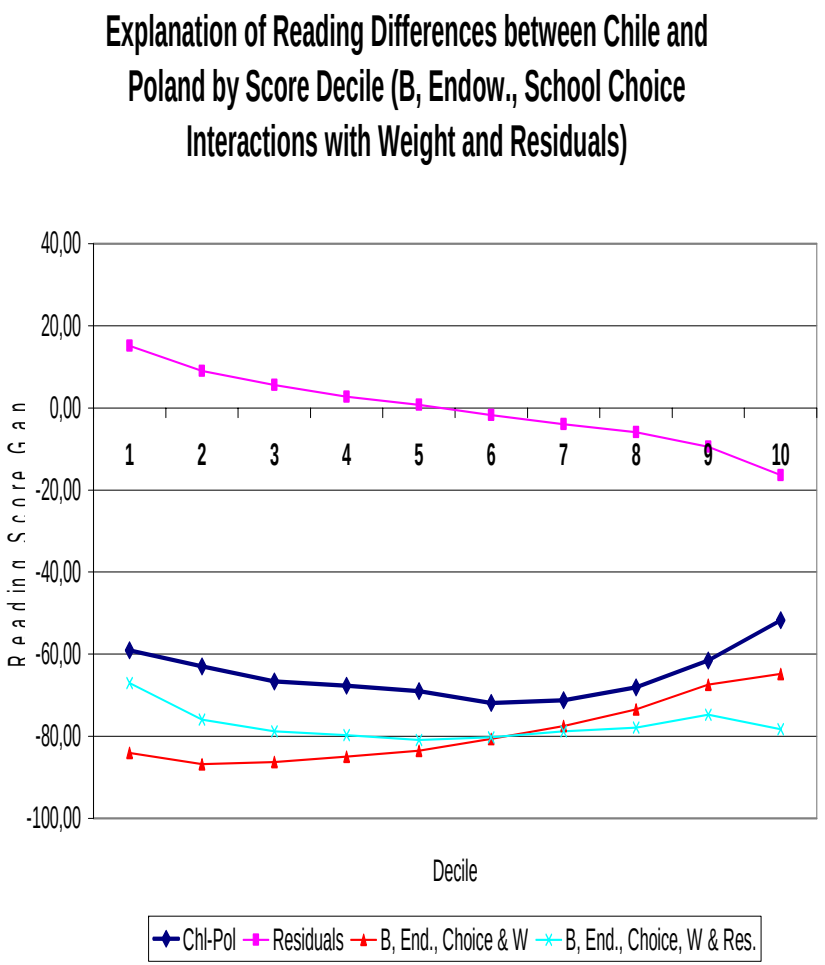
- Finally, adjustment by differences in the residuals between both countries are relevant to explain Chilean positive gap for decil 10.
- **Summing up**: Main factors to explain differences between both countries are: i) the larger segregation of endowment across Chilean schools, (public and private); ii) better peer effect in Spanish schools, particularly among students with lower scores; iii) larger efficiency in Spanish public schools (returns to average year of schooling and peer effect) and iv) apparently, Spanish private schools are not as efficient as public schools.

Microsimulation results (Chile - Uruguay)



- **Summing up**: Model explains better differences for 1-8 deciles.
- Main factors to explain differences between both countries are: i) efficiency is larger in Uruguayans public schools and Chilean private schools; the inverse conclusion is related to comparison of endowments, which explains a part of differences by decile; ii) larger endowments at low-scores Chilean public schools (for most educational inputs), better efficiency among private schools (with lower level of endowments –peer effect-) and return to non observables.

Microsimulation results (Chile - Poland)



- **Summing up**: Main factors to explain differences between both countries are: i) Chilean students and schools have larger endowments than polish ones (eg. average grades, failure rate, institutional variables) and these better conditions are larger for higher deciles (unequally distributed); ii) but positive, and unequal, effect of endowments is more than offset by a big gap in the returns for years of schooling (**the efficiency gap is increasing for higher deciles**), which is compensated by a large inequality in the distribution of inputs across Chilean schools (particularly ISEC and average ISEC at school).

Conclusions

- Different decomposition methodologies are useful to understand a complex story. All of them are relevant.
- Results from different methodologies are robust: Chilean efforts must be focused on increasing efficiency (instead of simply adding resources): we obtain a lower returns by additional years of schooling, peer effect and institutional features.
- Nevertheless, the stated objective could raise inequality, because the current gap is larger among better students and schools –which obtain a smaller return by higher years of students´ education-. These schools offset their inefficiency by segregating educational inputs (segregation is larger in Chile than in the comparative countries).
- …therefore, we need to reduce the levels of segregation in inputs (eg. peer effects). It's possible that extreme input segregation generates part of the larger inefficiency across top deciles
- Chilean public education has the same level of efficiency than Chilean private education, but…
- Chilean public schools are less efficient than public schools in every comparison country (but larger differences are in comparison to Poland and Spain), while Chilean private schools seem to be more efficient than private schools from other countries.