Understanding the Divergent Trends in PISA Test Results for Poland and the Czech Republic

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Figure 1: PISA Test Scores by Country and Year

- Poland Math
- Poland Reading
- Czech Republic Math
- Czech Republic Reading
MATHEMATICS

Year 2000

Year 2009

Density vs. Math Score for Poland and Czech Republic in 2000 and 2009.

Poland
Czech Republic

kernel = epanechnikov, bandwidth = 18.3847

kernel = epanechnikov, bandwidth = 13.7883
READING

Year 2000

Year 2009

Poland

Czech Republic

kernel = epanechnikov, bandwidth = 16.9406

kernel = epanechnikov, bandwidth = 14.1817
Possible sources of test score trends

• Quality or quantity of instruction
  – Focus of national education debates
• Family background
• Grade composition-higher share in 9th grade in Czech Republic
• Sampling frame-PISA national projections of maternal education distribution diverge sharply from national census data
• Weighting algorithm-changing adjustment for nonresponse
Objectives

• Learn more about the contributions of these factors to test score trends in the Czech Republic and Poland
• Gain a better understanding of the deficiencies of PISA and potential implications for research
• Focus this talk on contribution of school quality changes
Maternal Education as Key Family Background Characteristic

• Students report maternal education level
• Non-trivial divergence between student responses and parent responses in Poland
  – Students tend to overstate parental response
• Substantial changes in question structure raise concerns about comparability over time
Primary and Upper Secondary question

• In all years students are asked to consider 5 choices for primary-secondary schooling
  – No school; primary school; lower secondary; upper secondary without exams; upper secondary with exams

• Response instructions change over time
  – 2000: tick highest type completed
  – 2003: tick each type completed
  – 2006 and 2009: tick highest type completed; ask survey administrator for help if unsure
Post-Secondary question

- 2000-Did your mother complete any substantial post-secondary school?
- 2003-Does your have any of the following post-secondary degrees?
  - University degree
  - Other substantial post-secondary (technical college)
  - Insubstantial post-secondary
- 2006, 2009-same as 2003 with the exception that students are encouraged to ask for help if they are uncertain
Table 1: Distributions of Mother's Education in Poland and the Czech Republic by Year

<table>
<thead>
<tr>
<th></th>
<th>Poland (9th grade)</th>
<th>Czech Republic (9th and 10th)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;= Lower Secondary</td>
<td>Upper-secondary no exams</td>
</tr>
<tr>
<td>2000</td>
<td>8.1</td>
<td>26.3</td>
</tr>
<tr>
<td>2003</td>
<td>6.5</td>
<td>25.0</td>
</tr>
<tr>
<td>2006</td>
<td>8.0</td>
<td>30.6</td>
</tr>
<tr>
<td>2009</td>
<td>7.3</td>
<td>29.5</td>
</tr>
<tr>
<td></td>
<td>5.1</td>
<td>35.7</td>
</tr>
<tr>
<td></td>
<td>5.3</td>
<td>33.1</td>
</tr>
<tr>
<td></td>
<td>4.3</td>
<td>30.3</td>
</tr>
<tr>
<td></td>
<td>3.1</td>
<td>30.1</td>
</tr>
</tbody>
</table>
Contribution of Maternal Education

• Actual changes likely contribute to test score trends, though problems with student responses and question comparability over time hinders our understanding of the importance of changes in maternal education

• Within maternal education category changes in achievement are pronounced, indicating that other factors explain much of the achievement trends over time
Key School Characteristics

• Mathematics and language arts class time and pupil-teacher ratio
  – Substantial changes over time in each of these school factors
• Tracking delayed until 10th grade in Poland
• As of 2000 Polish Students take national tests
• School Decentralization in Czech Republic
• Teacher Salary Decline in Czech Republic
• Reallocation of students among school types in Czech Republic (demographic decline a cause)
### 2000 to 2009 Change in School Characteristics, by Maternal Education

<table>
<thead>
<tr>
<th></th>
<th>&lt;= Lower Secondary</th>
<th>Upper-secondary no exams</th>
<th>Upper-secondary with exams</th>
<th>University</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Poland</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>math class time</td>
<td>80</td>
<td>74</td>
<td>69</td>
<td>65</td>
</tr>
<tr>
<td>(minutes/week)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lang arts class time</td>
<td>69</td>
<td>64</td>
<td>58</td>
<td>53</td>
</tr>
<tr>
<td>pupil-teacher ratio</td>
<td>-0.8</td>
<td>-1.2</td>
<td>-1.8</td>
<td>-4</td>
</tr>
<tr>
<td><strong>CZ 9th</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>math class time</td>
<td>21</td>
<td>14</td>
<td>13</td>
<td>10</td>
</tr>
<tr>
<td>(minutes/week)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lang arts class time</td>
<td>27</td>
<td>18</td>
<td>16</td>
<td>10</td>
</tr>
<tr>
<td>pupil-teacher ratio</td>
<td>-3.3</td>
<td>-2.4</td>
<td>-2.1</td>
<td>-1.7</td>
</tr>
<tr>
<td><strong>CZ 10th</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>math class time</td>
<td>37</td>
<td>22</td>
<td>24</td>
<td>21</td>
</tr>
<tr>
<td>(minutes/week)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lang arts class time</td>
<td>12</td>
<td>18</td>
<td>16</td>
<td>23</td>
</tr>
<tr>
<td>pupil-teacher ratio</td>
<td>-4.3</td>
<td>-3.9</td>
<td>-2.5</td>
<td>-1.9</td>
</tr>
</tbody>
</table>
## 2000 to -2009 Change in 10th Grade Czech School Characteristics, by School Type

<table>
<thead>
<tr>
<th></th>
<th>extended gymnasiu</th>
<th>gymnasiu</th>
<th>Vocational school with exams</th>
<th>least selective</th>
</tr>
</thead>
<tbody>
<tr>
<td>math class time</td>
<td>32</td>
<td>23</td>
<td>22</td>
<td>30</td>
</tr>
<tr>
<td>lang arts class time</td>
<td>23</td>
<td>15</td>
<td>16</td>
<td>30</td>
</tr>
<tr>
<td>pupil-teacher ratio</td>
<td>-0.3</td>
<td>-1.2</td>
<td>-1.3</td>
<td>-7.5</td>
</tr>
</tbody>
</table>
Analysis of School Characteristic Effects

• Difficult to identify effects of most variables using PISA data

• Rely on other evidence
  – Limited evidence on effects of pupil-teacher ratio in 9th and 10th grades
  – Likely positive but small

• Use within student across subject variation in instructional time to identify effects
Analysis of Instructional Time Effects

• Build on Lavy (2010)
  – 2006 data are problematic as illustrated in the paper
  – Therefore we focus on 2000 and 2009

• Examine both time in school devoted to a subject and instructional time out of school
Student Fixed Effect Specification

• Comparing relationship between differences in math and language arts scores and differences in minutes per week devoted to math and language arts for each student eliminates the need to account for aspects of students AND schools that have a general effect on the rate of learning.

• Identifying assumption
  – subject specific influences on achievement are not systematically related to school differences in class time devoted to each subject.
Table 8: Student Fixed Effect Estimated Effects of Instructional Time on Achievement

<table>
<thead>
<tr>
<th>Classroom Minutes</th>
<th>0.079 (0.028)</th>
<th>0.084 (0.040)</th>
<th>0.090 (0.039)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Out-of-school Lessons (rel. to 2 to &lt; 4 Hours)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Time</td>
<td>-1.43 (15.07)</td>
<td>1.18 (2.35)</td>
<td></td>
</tr>
<tr>
<td>&lt; 2 Hours</td>
<td>-6.42 (14.28)</td>
<td>0.43 (2.07)</td>
<td></td>
</tr>
<tr>
<td>4 to &lt; 6 Hours</td>
<td>17.33 (34.59)</td>
<td>-8.38 (3.94)</td>
<td></td>
</tr>
<tr>
<td>&gt; 6 Hours</td>
<td>91.63 (51.10)</td>
<td>-12.57 (6.38)</td>
<td></td>
</tr>
</tbody>
</table>

out of school lesson variable based on individual responses no yes
out of school lesson variable based on school distribution of responses yes no
Contribution of class time to test score gains

• In Poland 80 minute increase in class time accounted for at least 6 points (20 percent) of the increase in math score

• In Poland 60 minute increase in class time accounted for almost 5 point (15 percent) of the increase in language arts score

• Error in class size variable means that true effects are likely to be larger

• Much smaller impacts of class size in Czech Rep
Decline in Relative Teacher Salaries in Czech Republic Following 2004

Figure 4a. Share of tertiary educated workers with wages below average wage of upper-secondary school teachers in given group (%)
School Decentralization in the Czech Republic

- Reform law implemented in 2001
  - Transition of authority and institutions during period 2002 to 2005
  - Transfer much of authority over school operations from National Education Ministry to local authorities
    - Regional governmental institutions created to manage upper secondary schools
    - Existing municipal bodies general granted authority over primary and lower secondary schools
  - Abolition of district schooling offices (DSOs)
• Schooling committees as advisory bodies for local municipal councils were established

• No direct measure of decentralization effects, but anecdotal evidence of
  – Loss of expertise
  – Weakened monitoring
  – Growing administrative emphasis on money, employment, and fulfillment of legal regulations
    • Effect likely to depend upon local capacity, parental involvement, teacher experience, etc
Summary

• Class time changes had a substantial effect on achievement

• Large and widespread achievement decline in the Czech Republic suggests that a national policy change was a major contributor
  – Declining teacher salaries
  – School decentralization
  – Changes in pupil-teacher ratio and class time should have lead to test score improvements
• Additional work needed to gain a better understanding of the contributions of teacher salary and school decentralization

• Changes in sampling, weighting, grade composition, and the maternal education distribution may have contributed to observed changes in average achievement, but within category test score declines suggest that school factors explain much of the test score divergence