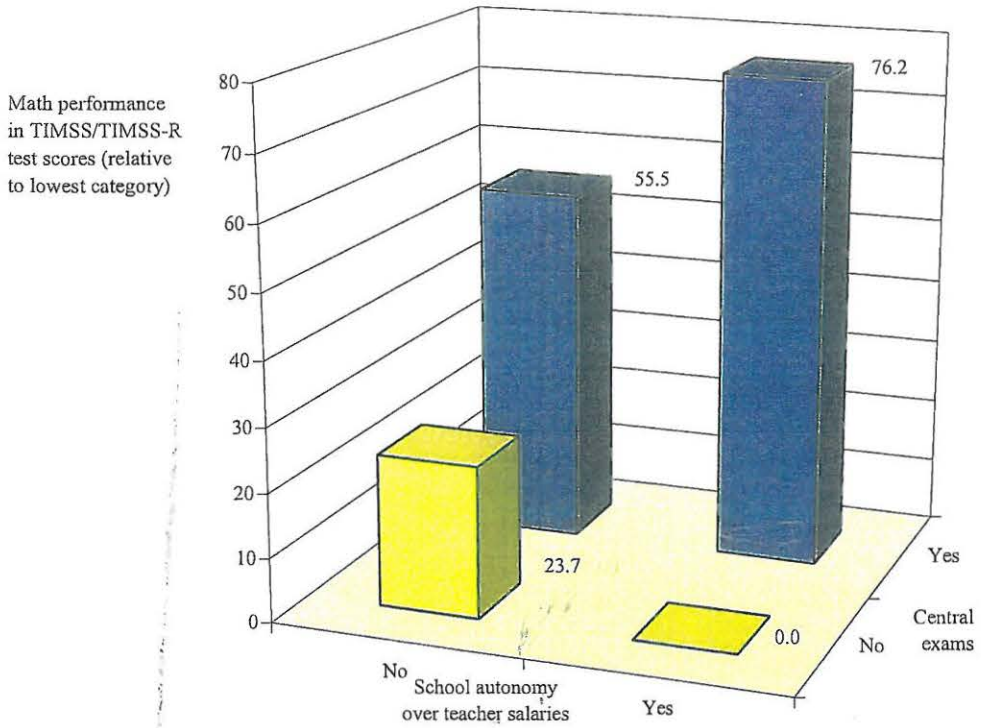
Tabled 10.53am Hubbards School

Figure 6: External exams, school autonomy, and student achievement across countries



Notes: Performance difference between the four categories relative to the lowest category which is set equal to zero. Based on a cross-country student-level multiple regression using the combined TIMSS and TIMSS-Repeat micro databases that extensively controls for family background, school inputs, and other institutional features.

Source: Woessmann (2005c).

4.4.2 Autonomy

Another institutional feature that is sometimes argued to exert positive effects on student outcomes is school autonomy, because local decision-makers tend to have superior information. On the other hand, in decision-making areas where their interests are not strictly aligned with improving student achievement, local decision-makers may act opportunistically unless they are held accountable for the achievement of their students (see Woessmann (2005c) for a discussion in a principal-agent framework).

The school background questionnaires of the international tests allow deriving measures of school autonomy in several different decision-making areas. The general pattern of results (cf. Table 9) is that students perform significantly better in schools that have autonomy in process and personnel decisions (Woessmann (2003b); Fuchs and Woessmann (2007); Woessmann, Luedemann, Schuetz, and West (2009)). These decisions include such areas as deciding on the purchase of supplies and on budget allocations within schools, hiring and rewarding teachers (within a given budget), and choosing textbooks, instructional methods, and the like. Similarly, students perform better if their teachers have both incentives and the possibility to select appropriate teaching methods. By contrast, school autonomy in budget formation and teacher autonomy over the subject matter to be covered in class – two decision-making areas that are likely subject to substantial opportunism but little superior local knowledge – are negatively associated with student achievement.

The international evidence also points to a significant interaction of the effect of school autonomy with the extent of accountability in the school system (as previously found in Table 4).

In some areas, autonomy is negatively associated with student achievement in systems that do not have external exit exams, but the association turns positive when combined with external-exam systems. Reflecting coefficient estimates from a student-level international education production function using the combined TIMSS and TIMSS-Repeat data, Figure 6 depicts school autonomy over teacher salaries as one such example. School autonomy over teacher salaries is *negatively* associated with student achievement in systems without external exams. However, in line with the arguments above, the average level of student achievement is higher in systems with external exams. But what is more, the association between school autonomy and student achievement turns completely around in systems with external exams: Salary autonomy of schools is *positively* associated with student achievement in external-exam systems. The estimates in Figure 6 are expressed in percentages of a standard deviation on the international

Table 3: Performance on selected international student achievement tests

Code	Country	FIMS 1964	SIMS 1980-82	TIMSS 1995	TIMSS-Repeat 99	PISA 2000/02	TIMSS 2003	PISA 2003	PISA 2006	TIMSS 2007	cognitive[a]
ALB	Albania					381					378.5
DZA	Algeria									387	
ARG	Argentina					388			381		392.0
ARM	Armenia						478			499	442.9
AUS	Australia	27.0		530	525	533	505	524	520	496	509.4
AUT	Austria			539		515		506	505		508.9
AZE	Azerbaijan								476		
BHR	Bahrain						401			398	411.4
BEL	Belgium	43.4	52.8	546	558	520	537	529	520		504.1
BIH	Bosnia and Herzegovina									456	
BWA	Botswana						366			364	357.5
BRA	Brazil					334		356	370		363.8
BGR	Bulgaria			540	511	430	476		413	464	478.9
CAN	Canada		50.9	527	531	533	532	532	527		503.8
CHL	Chile				392	384	387		411		404.9
CHN	China										493.9
COL	Colombia			385					370	380	415.2
HRV	Croatia								467		
CYP	Cyprus			474	476		459			465	454.2
CZE	Czech Rep.			564	520	498		516	510	504	510.8
DNK	Denmark			502		514		514	513		496.2
EGY	Egypt						406			391	403.0
SLV	El Salvador									340	
EST	Estonia						531		515		519.2
FIN	Finland	37.7	48.2		520	536		544	548		512.6
FRA	France	30.0	53.5	538		517		511	496		504.0
GEO	Georgia									410	
DEU	Germany	36.3		509		490		503	504		495.6
GHA	Ghana						276			309	360.3
GRC	Greece			484		447		445	459		460.8
HKG	Hong Kong-China		49.9	588	582	560	586	550	547	572	519.5

(continued on next page)

Table 3 (continued)

Code	Country	FIMS 1964	SIMS 1980-82	TIMSS 1995	TIMSS-Repeat 99	PISA 2000/02	TIMSS 2003	PISA 2003	PISA 2006	TIMSS 2007	cognitive[a]
HUN	Hungary		54.6	537	532	488	529	490	491	517	504.5
ISL	Iceland			487		514		515	506		493.6
IND	India										428.1
IDN	Indonesia				403	367	411	360	391	397	388.0
IRN	Iran, Islamic Rep.			428	422		411			403	421.9
IRL	Ireland			527		503		503	501		499.5
ISR	Israel	46.1	45.6	522	466	433	496		442	463	468.6
ITA	Italy				479	457	484	466	462	480	475.8
JPN	Japan	46.0	63.5	605	579	557	570	534	523	570	531.0
JOR	Jordan				428		424		384	427	426.4
KAZ	Kazakhstan										
KOR	Korea, Rep.			607	587	547	589	542	547	597	533.8
KWT	Kuwait			392						354	404.6
KGZ	Kyrgyzstan								311		
LVA	Latvia			493	505	463	508	483	486		480.3
LBN	Lebanon						433			449	395.0
LIE	Liechtenstein					514		536	525		512.8
LTU	Lithuania			477	482		502		486	506	477.9
LUX	Luxembourg		37.9			446		493	490		464.1
MAC	Macao-China							527	525		526.0
MKD	Macedonia				447	381	435				415.1
MYS	Malaysia				519		508			474	483.8
MLT	Malta									488	
MEX	Mexico					387		385	406		399.8
MDA	Moldova, Rep.				469		460				453.0
MNE	Montenegro								399		
MAR	Morocco				337		387			381	332.7
NLD	Netherlands	30.6	58.1	541	540		536	538	531		511.5
NZL	New Zealand		46.4	508	491	537	494	523	522		497.8
NGA	Nigeria		33.4								415.4
NOR	Norway			503		499	461	495	490	469	483.0

(continued on next page)

Table 3 (continued)

Code	Country	FIMS 1964	SIMS 1980-82	TIMSS 1995	TIMSS-Repeat 99	PISA 2000/02	TIMSS 2003	PISA 2003	PISA 2006	TIMSS 2007	cognitive[a]
OMN	Oman									372	
PSE	Palestinian Nat. Auth.						390			367	406.2
PER	Peru					292					312.5
PHL	Philippines				345		378				364.7
POL	Poland					470		490	495		484.6
PRT	Portugal			454		454		466	466		456.4
QAT	Qatar								318	307	
ROU	Romania			482	472		475		415	461	456.2
RUS	Russian Fed.			535	526	478	508	468	476	512	492.2
SAU	Saudi Arabia						332			329	366.3
SRB	Serbia						477	437	435	486	444.7
SGP	Singapore			643	604		605			593	533.0
SVK	Slovak Rep.			547	534		508	498	492		505.2
SVN	Slovenia			541	530		493		504	501	499.3
ZAF	South Africa			354	275		264				308.9
ESP	Spain			487		476		485	480		482.9
SWZ	Swaziland		33.9								439.8
SWE	Sweden	21.9	43.5	519		510	499	509	502	491	501.3
CHE	Switzerland			545		529		527	530		514.2
SYR	Syrian Arab Rep.									395	
TWN	Taiwan (Chinese Taipei)				585		585		549	598	545.2
THA	Thailand		42.7	522	467	432		417	417	441	456.5
TUN	Tunisia				448		410	359	365	420	379.5
TUR	Turkey				429			423	424	432	412.8
UKR	Ukraine									462	
GBR	United Kingdom	32.9	48.8	502	496	529	498		495	500	495.0
USA	United States	25.4	46.0	500	502	493	504	483	474	508	490.3
URY	Uruguay							422	427		430.0
ZWE	Zimbabwe										410.7

Notes: All scores refer to the mathematics test in lower secondary school. (FIMS, SIMS: age 13; TIMSS: grade 8; PISA: age 15).

a. Average score on all international tests 1964-2003 in math and science, primary through end of secondary school (Hanushek and Woessmann (2009a)).

Table 4: An example of an international education production function: PISA 2003

	Coef.	Std. err.
STUDENT CHARACTERISTICS		
Age (years)	17.593***	*(1.101)*
Female	-17.360***	*(0.639)*
Preprimary education (more than 1 year)	5.606***	*(0.703)*
School starting age	-3.863***	*(0.505)*
Grade repetition in primary school	-35.794***	*(1.410)*
Grade repetition in secondary school	-34.730***	*(1.646)*
Grade		
7th grade	-47.184***	*(4.068)*
8th grade	-28.009***	*(2.239)*
9th grade	-12.486***	*(1.337)*
11th grade	-6.949***	*(2.062)*
12th grade	7.030	*(4.826)*
Immigration background		
First generation student	-9.047***	*(1.544)*
Non-native student	-9.040***	*(1.644)*
Language spoken at home		
Other national dialect or language	-23.736***	*(2.849)*
Foreign language	-8.381***	*(1.665)*
FAMILY BACKGROUND		
Living with		
Single mother or father	19.349***	*(1.842)*
Patchwork family	21.272***	*(2.032)*
Both parents	27.432***	*(1.829)*
Parents' working status		
Both full-time	-2.479*	*(1.325)*
One full-time, one half-time	6.744***	*(1.063)*
At least one full time	13.753***	*(1.173)*
At least one half time	8.416***	*(1.133)*
Parents' job		
Blue collar high skilled	0.431	*(0.970)*
White collar low skilled	2.864***	*(0.933)*
White collar high skilled	8.638***	*(0.988)*
Books at home		
11-25 books	5.554***	*(0.978)*
26-100 books	22.943***	*(1.009)*
101-200 books	32.779***	*(1.117)*
201-500 books	49.834***	*(1.219)*
More than 500 books	51.181***	*(1.399)*
Index of Economic, Social and Cultural Status (ESCS)	18.114***	*(0.524)*
GDP per capita (1,000 $)	-1.890*	*(1.060)*

(continued on next page)

IDEAL
- Higher co-efficients
- Positive

*** Means 1% significance i.e. very little variation high degree of accuracy

Table 4 (continued)

	Coef.	Std. err.
SCHOOL INPUTS		
School's community location		
Town (3,000-100,000)	3.226*	*(1.531)*
City (100,000-1,000,000)	10.782***	*(1.890)*
Large city with > 1 million people	7.895***	*(2.378)*
Educational expenditure per student (1,000 $)	1.174***	*(0.405)*
Class size (mathematics)	1.474***	*(0.067)*
Shortage of instructional materials		
Not at all	-10.180***	*(2.576)*
Strongly	6.720***	*(1.300)*
Instruction time (minutes per week)	0.035***	*(0.005)*
Teacher education (share at school)		
Fully certified teachers	9.715***	*(3.422)*
Tertiary degree in pedagogy	6.573***	*(2.010)*
INSTITUTIONS		
Choice		
Private operation	57.585***	*(8.355)*
Government funding	81.839***	*(22.327)*
Accountability		
External exit exams	25.338*	*(10.054)*
Assessments used to decide about students' retention/promotion	12.185***	*(1.631)*
Monitoring of teacher lessons by principal	4.557***	*(1.343)*
Monitoring of teacher lessons by external inspectors	3.796***	*(1.415)*
Assessments used to compare school to district/national performance	2.134*	*(1.259)*
Assessments used to group students	-6.065***	*(1.301)*
Autonomy and its interaction with accountability		
Autonomy in formulating budget	-9.609***	*(2.178)*
External exit exams x Autonomy in formulating budget	9.143***	*(3.119)*
Autonomy in establishing starting salaries	-8.632***	*(3.251)*
External exit exams x Autonomy in establishing starting salaries	5.868	*(3.980)*
Autonomy in determining course content	0.175	*(1.907)*
External exit exams x Autonomy in determining course content	3.224	*(2.858)*
Autonomy in hiring teachers	20.659***	*(2.249)*
External exit exams x Autonomy in hiring teachers	-28.935***	*(3.365)*
Students	219,794	
Schools	8,245	
Countries	29	
R^2 (at student level)	0.390	
R^2 (at country level)	0.872	

Notes: Dependent variable: PISA 2003 international mathematics test score. Least-squares regressions weighted by students' sampling probability. The models additionally control for imputation dummies and interaction terms between imputation dummies and the variables. Robust standard errors adjusted for clustering at the school level in parentheses (clustering at country level for all country-level variables, which are private operation, government funding, external exit exams, GDP per capita, and expenditure per student). Significance level (based on clustering-robust standard errors): *** 1 percent, ** 5 percent, * 10 percent.

Source: Own calculations based on Woessmann, Luedemann, Schuetz, and West (2009), who provide additional background details.

Table 5: Within-country studies on student background and educational achievement

Study	Dataset	Countries	Topic of investigation	Measure(s) of student background	Measure of achievement	Estimation method	Results
Zimmer and Toma (2000)	SIMS	Belgium, France, New Zealand, Canada, U.S.	Peer effects in private and public schools	Peers' mean test score, share of high-/ low-ability students in classroom	Math, age 13-14	Value-added, country and school-type fixed effects	Positive peer effect; gains from high-quality peers stronger for low-ability students; mixed results on school types
Ammermueller, Heijke, and Woessmann (2005)	TIMSS	Czech Rep., Hungary, Latvia, Lithuania, Slovak Rep., Slovenia, Romania	Educational production in transition countries	Immigration, family status, parental education, books at home, community location	Math + science, grade 7+8	Cross-section WCRLR	Substantial effects of family background; larger in more (Czech Rep., Slovak Rep., Hungary, Slovenia) than in less advanced group (Lithuania, Latvia, Romania)
Woessmann (2005a)	TIMSS	Hong Kong, Japan, Singapore, South Korea, Thailand; France, Spain, U.S.	Educational production in East Asian countries	Immigration, family status, parental education, books at home, community location	Math (+ science), grade 7+8	Cross-section WCRLR	Strong family-background effects in Korea and Singapore; more equitable outcomes in Hong Kong and Thailand
Woessmann (2008)	TIMSS	17 West European countries + U.S.	Educational production in West Europe	Books at home, parental education, immigration, family status, community location	Math (+ science), grade 7+8	Cross-section WCRLR, quantile regression	Strong associations; aggregate size similar in Europe and U.S.; France, Flem. Belgium most equitable; Britain, Germany least; equity unrelated to mean performance
Bedard and Dhuey (2006)	TIMSS, TIMSS-R	10 for grade 3+4, 18 for grade 7+8	Effects of relative school starting age	Relative age	Math + science, grade 3+4 + 7+8	IV (instrument: age assigned by cutoff date)	Significant and sizeable effects of relative school starting age on performance at ages 9 and 13
Wolter and Coradi Vellacott (2003)	PISA	Belgium, Canada, Finland, France, Germany, Switzerland	Sibling rivalry	No. of siblings, ISEI, parental education + employment, immigration + family status	Reading, age 15	Cross-section WCRLR	Effects of number of siblings relevant in all six countries, but to a different extent; effects concentrated in sub-group low-SES families
Schuetz, Ursprung, and Woessmann (2008)	TIMSS, TIMSS-R	54 countries	Equality of opportunity	Books at home	Mean math + science, grade 8	Cross-section WCRLR	Significant family-background effect in all countries; considerable variation; large effects in Britain, Hungary, Germany; relatively small effects in France, Canada
Peterson and Woessmann (2007)	PISA	France, Germany, Great Britain, U.S.	Equality of opportunity	Books at home, parental job + employment, immigration status, family status	Math, age 15	Cross-section WCRLR	Family background strongly linked to educational performance; largest in Germany and U.S., slightly smaller in Great Britain, even smaller in France

(continued on next page)

Table 5 (continued)

Study	Dataset	Countries	Topic of investigation	Measure(s) of student background	Measure of achievement	Estimation method	Results
Entorf and Minoiu (2005)	PISA	Australia, Canada, Finland, France, Germany, New Zealand, Sweden, U.K., U.S.	Immigration policy	Immigration status, ISEI index	Reading, age 15	Cross-section OLS	Socio-economic effect highest in Germany, U.K., U.S.; lowest in Scandinavia, Canada; migrant disadvantage larger in Continental Europe than in traditional immigration countries; language spoken at home a key factor
Schnepf (2007)	PISA, TIMSS, TIMSS-R, PIRLS	10 OECD countries with share of foreign born > 10%	Immigrants' disadvantage in high immigration countries	Immigration status, language spoken at home, measures of socio-economic background	math, age 15; math, grade 8; reading, grade 4	Cross-section OLS	Immigrants fare best compared to natives in English-speaking countries and worst in Continental Europe; language skills, socio-economic background, and school segregation as determinants of immigrant gap
Jenkins, Micklewright, and Schnepf (2008)	PISA + PISA 2003	27 countries	Social segregation in schools	ISEI index	–	Calculation of summary indices of segregation	Between-school segregation high in Austria, Belgium, Germany; low in Nordic countries, Scotland; middle in England, U.S.; higher where student selection by schools, but not with more private schools or parental choice
Woessmann (2010a)	PIRLS	Argentina, Colombia, Turkey, Macedonia; Germany, Greece, Italy, England	Educational production in Latin America	Immigration, books at home, parental education, job, employment, + income, community location	Reading, grade 4	Value-added WCRLR model (controlling for pre-school performance)	Family background strongly related to student performance; relatively large in Argentina and small in Colombia
Ammermueller and Pischke (2009)	PIRLS	France, Germany, Iceland, Netherlands, Norway, Sweden	Peer effects	Peers' index of books at home	Reading, grade 4	Cross-section WCRLR, school fixed effects, IV (instrument: students' for parents' report)	Modestly large peer effects; measurement error important; selection introduces little bias
Sprietsma (2010)	PISA 2003	16 countries	Effects of relative school starting age	Relative age	Math + reading, age 15	Cross-section, school random effects	Significant effect of relative school starting age in 10 out of 16 countries; relevant channels are probabilities of starting school too late, grade retention, and grade skipping

Notes: Student is the level of analysis in all studies. SES = socio-economic status. WCRLR = weighted clustering-robust linear regression. OLS = ordinary least squares. IV = instrumental variable. ISEI = international socio-economic index of occupational status. See Tables 1 and 2 for acronyms of datasets.

Table 6: Cross-country studies on student background, school inputs, and educational achievement

Study	Dataset	No. of countries	Level of analysis	Topic of investigation	Measure of inputs	Measure of achievement	Estimation method	Results
Hanushek and Kimko (2000)	FIMS, FISS, SIMS, SISS, IAEP-I,+II	70 country-cohorts	Country	Production of student achievement	Student-teacher ratios, expenditure, adult schooling	Math + science	Cross-section OLS	Positive effect of education of parents on student performance; no effects of school resources
Lee and Barro (2001)	FIMS, FISS, FIRS, SIMS, SISS, SIRS, IAEP-I,+II	58	Country	Determinants of schooling quality	Student-teacher ratios, spending per student, teacher salaries, length of school year	Math, science + reading, repetition + dropout rates	Panel SUR regression, fixed effects	Strong relation between family background and school outcomes; positive and significant impact of school resources
Woessmann (2003b)	TIMSS	39	Student	Effects on student performance	18 background measures, 12 resources + teachers, 26 institutional	Math + science	Cross-section WCRLR	Strong effects of family background and institutional arrangements; far more important than resources
Jürges and Schneider (2004)	TIMSS	23	Student, country	Sources of student achievement	14 groups of student, teacher, class, school measures, 2 national	Math	Cross-section OLS, IV, kernel density	Positive effects of family background, teacher characteristics, and school resources
McEwan and Marshall (2004)	LLECE	2 (Cuba, Mexico)	Student	Explaining Cuban-Mexican gap	Parental education, books at home, school, teacher + peer characteristics	Math + Spanish	Blinder-Oaxaca decomposition	30% of achievement gap explained; family and peer characteristics play a role, school characteristics not
Fertig and Wright (2005)	PISA	30	Student	Class-size effects	Class size	Reading	Cross-section OLS	Class-size estimates get negative and significant only at high aggregation levels, indicating aggregation bias
Gunnarsson, Orazem, and Sánchez (2006)	LLECE	10	Student	Effects of child labor	Intensity of working outside the home	Math + language, grade 3+4	Cross-section, IV	Significant negative effect of child labor on student achievement
Afonso and St. Aubyn (2006)	PISA 2003	25	Country	Efficiency of expenditure	Teachers per students, time spent in school	Avg. of math, reading, science, problem solving	DEA, Tobit, bootstrap	Substantial inefficiencies in most countries; non-discretionary inputs (GDP and parental education) account for large part
Fuchs and Woessmann (2007)	PISA	31	Student	Effects on student performance	13 groups of student measures, 5 resources + teachers, 10 institutional, interactions	Math, science, + reading	Cross-section WCRLR, IV	Background, resources, teachers, and esp. institutions all significantly associated with achievement; models account for >85% of between-country variation
Ammermueller (2007)	PISA 2000	2 (Finland, Germany)	Student	Explaining Finish-German gap	Parents' education, books at home, teacher characteristics	Reading	Oaxaca-Blinder, Juhn-Murphy-Pierce decomposition	Finish-German gap not explained by different backgrounds; Finland uses resources more efficiently
Dolton and Marcenaro-Gutierrez (2010)	TIMSS+R +03, PISA +03 +06	39	Country	Effects of teacher pay	Teacher salaries (absolute, relative), other teacher variables	Math, science + reading	Panel with country fixed effects	Absolute and relative teacher salary positively related to achievement

Notes: SUR = seemingly unrelated regression. WCRLR = weighted clustering-robust linear regression. OLS = ordinary least squares. IV = instrumental variable. DEA = data envelopment analysis. See Tables 1 and 2 for acronyms of datasets.

Table 7: Within-country studies on school inputs and educational achievement

Study	Dataset	Countries	Level of analysis	Topic of investigation	Measure of school inputs	Measure of achievement	Estimation method	Results
Heyneman and Loxley (1983)	FISS, ECIEL, national datasets	29 countries	Student	Educational production in low-income countries	Up to 20 measures, differing by dataset	Science (math in few countries), primary school	Cross-section analysis of variance explained by sets of measures	School and teacher quality predominant influence on student learning; resources more closely related to student performance in developing countries
Michaelowa (2001)	PASEC	Burkina Faso, Cameroon, Cote d'Ivoire, Madagascar, Senegal	Student	Educational production in Francophone Sub-Saharan Africa	Teacher, classroom, and school characteristics, national expenditure per student	Mean of math + French, grade 5	HLM, pooled across countries	Many measures, such as textbooks and teacher education, significantly associated with student performance; no positive association with smaller classes
Gundlach, Woessmann, and Gmelin (2001)	FIMS, FISS, SIMS, SISS, TIMSS	11-17 OECD countries	Country	Change in schooling productivity in OECD countries	Expenditure per student	Math + science, different grades	Longitudinal measurement of skills and expenditures	Real expenditure per student increased substantially in most countries in 1970-1994; student performance remained constant at best; productivity decline larger in many countries than in U.S.
Gundlach and Woessmann (2001)	SIMS, SISS, TIMSS	Hong Kong, Japan, Singapore, South Korea, Philippines, Thailand	Country	Change in schooling productivity in East Asia	Expenditure per student	Math + science, different grades	Longitudinal measurement of skills and expenditures	Real expenditure per student increased substantially in most countries in 1980-1994, mostly due to decrease in student-teacher ratios; student performance did not change substantially
Hanushek and Luque (2003)	TIMSS	37 countries	Classroom	Effects of class size and teacher characteristics	Class size, teacher experience and education	Math, ages 9+13	Cross-section OLS	Limited evidence of effects of school inputs; cross-country differences hard to explain systematically; no evidence of stronger effects in developing countries
Woessmann and West (2006)	TIMSS	11 countries	Student	Class-size effects	Class size	Math + science, grades 7+8	Cross-section WCRLR, school fixed effects (using between-grade variation), IV	Sizable beneficial effects of smaller classes rejected in 8 countries; only in Greece, Iceland; noteworthy effects only in countries with low teacher salaries; conventional estimates severely biased

(continued on next page)

Table 7 (continued)

Study	Dataset	Countries	Level of analysis	Topic of investigation	Measure of school inputs	Measure of achievement	Estimation method	Results
Woessmann (2005b)	TIMSS	17 West European + U.S.	Student	Class-size effects	Class size (shortage of materials, instruction time)	Math, grades 7+8	Cross-section WCRLR, school fixed effects, IV, RD	No statistically and economically significant class-size effect in any country; small statistically significant effects only in Iceland, Norway, Spain
Ammermueller, Heijke, and Woessmann (2005)	TIMSS	7 East European (see Table 5)	Student	Educational production in transition countries	Class size, shortage of materials	Math + science, grades 7+8	Cross-section WCRLR, school fixed effects, IV	No causal class-size effects; in some countries, positive association with teacher experience and education and with sufficient reported materials
Woessmann (2005a)	TIMSS	5 East Asian + 3 (see Table 5)	Student	Class-size effects in East Asia	Class size, shortage of materials, teacher background	Math (+ science), grades 7+8	Cross-section WCRLR, school fixed effects, IV	No causal class-size effects; not much evidence of positive association with other school inputs
Ammermueller and Dolton (2006)	TIMSS/ R/2003, PIRLS	England, U.S.	Student	Student-teacher gender interaction	Teacher gender	Math + science, grades 4+8; reading, grade 4	Cross-section WCRLR, student fixed effects (across subjects)	Some evidence of positive interaction effects of student and teacher gender in 8th-grade math in England in 2003, but not U.S. and most other specifications
Woessmann (2010a)	PIRLS	2 Latin American + 6 (see Table 5)	Student	Educational production in Latin America	Class size, instructional time, shortage of materials or staff	Reading, grade 4	Value-added WCRLR model (controlling for pre-school performance)	No consistent evidence of association between student performance and schools' resource endowments
Bratti, Checchi, and Filippin (2008)	PISA 2003	24 countries	Student	Cooperative vs. competitive learning approach	OECD index of students' reports of cooperative and competitive attitudes towards learning	Math, age 15	Pooled cross-section CRLR with country fixed effects, quantile regressions	Positive association with individual competitive learning attitude (higher in comprehensive systems) and with school-average cooperative learning attitude (higher in tracked systems)
Altinok and Kingdon (2009)	TIMSS 2003	33-45 countries	Student	Class-size effects	Differences in class size across subjects	Math + science, grade 8	Cross-section WCRLR, school and student fixed effects (across subjects), IV	Few class-size effects; small significant negative effects only in 10 countries, positive in 6; larger in developing countries and with low teacher quality

Notes: WCRLR = weighted clustering-robust linear regression. HLM = hierarchical linear model. OLS = ordinary least squares. IV = instrumental variable. RD = regression discontinuity. See Tables 1 and 2 for acronyms of datasets.

35 million people 315 million people

Table 8: Within-country studies on institutions and educational achievement

Study	Dataset	Countries	Level of analysis	Topic of investigation	Measure of institutions	Measure of achievement	Estimation method	Results
Bishop (1995), ch. 6	IAEP-II	Canada, U.S.	Student	Effect of curriculum-based external exams	Central exams, type of school	Math + science	Cross-Section	External exams positively associated with student achievement; also with student, parental, and teacher behavior
Toma (1996)	SIMS	Belgium, France, New Zealand, Ontario (Can.), U.S.	Student	Effects of public funding and private schools	Type of school (public/private)	Math, beginning and end of school year	Value-added achievement model	Positive effect of private schools; funding not significantly associated with performance; governmental control over private schools negative factor
Vandenberghe and Robin (2004)	PISA	9 countries	Student	Private vs. public education	Type of school (public/private)	Math, science, + reading	Cross-section IV, Heckman two stages, PSM	Significant positive association of private schools with achievement in some but not all countries
Corten and Dronkers (2006)	PISA 2000	19 countries	Student	Low-SES students and private schools	Governance and funding of school.	Math + reading	MLM	Slight advantage of private government-dependent schools, no significant differences between public and private-independent schools
Dronkers and Robert (2008)	PISA 2000	22 countries	Student	Public and private schools	Governance and funding of school.	Reading	MLM	Better performance of government-dependent private schools explained by better school climate
Cascio, Clark, and Gordon (2008)	IALS	13 countries	Country	Age profile of literacy and university education	Average years of university education	Share of population with high-level literacy	Cross-section	High correlation between literacy gains into adulthood and university graduation rate

Notes: SES = socio-economic status. IV = instrumental variable. PSM = propensity score matching. MLM = multilevel modeling. See Tables 1 and 2 for acronyms of datasets.

Table 9: Cross-country studies on institutions and levels of educational achievement

Study	Dataset	No. of countries	Level of analysis	Topic of investigation	Measure of institutions	Measure of achievement	Estimation method	Results
Bishop (1995), ch 4	IAEP-II	15-21	Country	Effects of CBEEE	CBEEE	Math, science, + geography	Cross-section OLS	Student achievement and teacher salaries higher in CBEEE countries; differences in qualifications and spending not significant
Bishop (1997)	TIMSS, IAEP-II	39, Canada	Country, School	Effects of CBEEE	CBEEE	Math + science	Cross-section OLS	Large effect of CBEEE on student achievement; effects on parent, teacher, administrator behavior
Woessmann (2003b)	TIMSS	39	Student	Effects on student performance	Seven different categories	Math + science	Cross-section WCRLR	Large effects of institutional arrangements such as external exit exams, school autonomy, and private competition; far more important than resources
Woessmann (2003a)	TIMSS+ TIMSS-R	39, 38 (54)	Student	Effects of central exit exams	Central exit exams	Math + science	Cross-section WCRLR	Performance of students higher in systems with central exams; positive interaction with autonomy
Woessmann (2005c)	TIMSS+ TIMSS-R + PISA	39, 38 (54), 32	Student	Heterogeneity of central exam effect	Central exit exams, school autonomy	Math + science	Cross-section WCRLR, quantile regr.	Substantial heterogeneity of central exam effects along student, school, and time dimension
Bishop (2006), ch. 3	PISA	41	Country	Effects of MCE and CBEEE	CBEEE	Math, science + reading	Cross-section OLS	Positive effects of CBEEE on student achievement; do not affect school attendance
Fuchs and Woessmann (2007)	PISA	31	Student	Effects on student performance	CBEEE, autonomy, private schools	Math, science, + reading	Cross-section WCRLR, IV	Institutional variation accounts for a quarter of between-country achievement variation; external exams interact positively with autonomy; positive effect of private operation
Sprietsma (2008)	PISA 2003	8	Student	School choice, school selectivity, and student performance	School choice, schools' student selection	Math, reading + science	Cross-section, MLM, quantile regression	Regional intensity of school choice and school selectivity positively related to student achievement; similar effect for low and high performing students
Woessmann (2009b)	PISA	29	Student	Public vs. private school funding and operation	Private operation and funding	Math + reading	Cross-section WCRLR	Negative effects of public operation on student achievement; positive effect of public funding
Woessmann, Luedemann, Schuetz, and West (2009), ch. 2-6	PISA 2003	29, 37	Student	Accountability, autonomy, and choice	Several measures of accountability, autonomy, choice	Math +science	Cross-section WCRLR	Positive effects of several accountability measures on student performance and on role of autonomy; positive effects of share of privately operated schools and of government funding

(continued on next page)

Table 9 (continued)

Study	Dataset	No. of countries	Level of analysis	Topic of investigation	Measure of institutions	Measure of achievement	Estimation method	Results
West and Woessmann (forthcoming)	PISA 2003	29	Student	Effect of competition from private schools on student achievement	Share of privately operated schools	Math, science, + reading	Cross-section WCRLR, IV (instrumenting private school share by historical Catholic share)	Positive causal effect of share of privately operated schools on student achievements, negative effect on costs
Schuetz (2009)	PISA 2003	38	Student	Effect of pre-primary education on later educational achievement	Characteristics of pre-primary education system	Math	Cross-section WCRLR, country fixed effects, (DiD)	Positive association of pre-primary attendance with test scores; systematically stronger in countries with higher spending, larger shares of privately managed institutions, and higher training and relative pay of educators in pre-primary system

Notes: CBEEE = curriculum based external exit exams. MCE = minimum competency exams. WCRLR = weighted clustering-robust linear regression. OLS = ordinary least squares. IV = instrumental variable. MLM = multilevel modeling. DiD = differences in differences. See Tables 1 and 2 for acronyms of datasets.

RIGOROUS INTERNATIONAL INTER- AND INTRA-COUNTRY META-STUDIES ON SCHOOL MATHS & SCIENCE COGNITIVE SKILLS SHOW CLEAR LINKS TO THE PRODUCTIVITY OF COUNTRIES

HANUSHEK E.A. and WOESSMANN L. (2010) THE ECONOMICS OF INTERNATIONAL DIFFERENCES IN EDUCATIONAL ACHIEVEMENT
(IZA DP.No 4925 Institute for the study of labour productivity).
P.O. Box 7240 53072 Bonn Germany

Can be found at:
http://ftp.iza.org/dp4925.pdf