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DETERMINANTS OF EDUCATIONAL ATTAINMENT IN MENA

by

Menshawy Badr, Oliver Morrissey and Simon Appleton

Abstract

This study examines the determinants of educational outcome in eight selected MENA countries. The complicated structure of the TIMSS data has been considered carefully during all the stages of the analysis employing plausible values and jackknife standard error technique to accommodate the measurement error of the dependant variable and the clustering of students in classes and schools. The education production functions provide broad evidence from mean and quantile analysis of very low returns to schooling; few school variables are significant and none have effects across countries and quantiles. In general, student characteristics were far more important than school factors in explaining test scores, but there was considerable variability across countries in which specific factors were significant. Strikingly, computer usage was found to influence students' performance negatively in six MENA countries. Only Turkey and Iran had a significant positive effect of computer usage on maths achievements.

JEL Classification: I21, O15, O53

Keywords: Educational Attainment; Education Production Functions; quantile regression; meta-analysis; MENA

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1. Introduction

Education is central to human capital capacity-building, a major determinant of economic development, but the Middle East and North Africa (MENA) suffers from many problems regarding education (Lietz et al., 2008). This paper investigates and assesses the determinants of educational attainment in MENA countries. The aim is to identify the factors that need to be addressed in designing policies to improve the quality of education in MENA countries. The lack of evidence on determinants of education in MENA is mainly due to lack of data, hence no large-scale testing of micro level data. The Trends in International Mathematics and Science Study (TIMSS) offers comprehensive data on international student achievement test scores which have the advantage of being comparable across countries. In TIMSS, eighth grade students of representative samples have been tested in maths and science; data include test scores, family background, school resources, and teacher characteristics. Comparative data such as TIMSS permit analysis of the factors influencing differences in education achievements across MENA countries, provided the data are of sufficient quality and the research design is appropriate (Glewwe, 2002).

Empirical estimates of the determinants of educational attainment of students are focused on education production function to explore the relationship between students' educational outcomes and their inputs from family background as well as from school resources. Such evidence provides the foundation for many policy discussions and initiatives in developed countries (Woessmann, 2005). However, few developing countries have been fully analysed, especially Middle East and North Africa countries (MENA). Empirical evidence on MENA is even lower than the share of other developing regions such as sub Saharan Africa (SSA), Latin America or southern Asia. For example, Ghana, Kenya, Bangladesh, India, Pakistan, Indonesia, Argentina, Bolivia, and Brazil are covered in the Glewwe et al (2011) review, but only Turkey from MENA region is included.

This study tries to fill this gap by estimating education production functions using data on a representative sample of lower secondary students in eight MENA countries. This allows a comparison of the determinants of student performance between MENA countries and with other developing and developed countries. The main contribution is to identify any differences across MENA countries in the factors determining educational achievements

using comparable data on test scores. The meta-regression analysis allows us to evaluate and synthesise the effects of different variables across countries. Including quantile regression analysis allows for heterogeneity in the effect of school and family variables across the distribution of test scores.

We begin with a brief overview of some relevant characteristics of MENA countries in Section 2, covering Algeria, Egypt, Jordan, Iran, Saudi Arabia, Syria, Turkey and Tunisia. The eight countries share similarities in religion, language (except for Iran and Turkey), culture, history, geography and to some extent political features that promotes some similarity in educational systems (Saber, 1977). There are economic differences in terms of wealth from natural resources, per capita income and population. Although Egypt is the poorest country with GDP per capita below the MENA average, Egyptian students perform better than Algeria and Syria. TIMSS provides comparable data for the eight MENA countries (discussed in the next section).

The econometric methods are outlined in Section 4. Three methods are employed for the cross-country analysis in addition to school fixed effects for the production function model. First, we estimate an educational production function for each country to examine the effect of school resources and of socioeconomic family characteristics (SES) on test score achievements in maths and science. Second, Meta-analysis is employed to identify any factors that are significant across the set of countries. Third, quantile regressions are employed to assess if the influence of factors on attainment varies according to the level of attainment.

The study tackles three research questions: what are the main determinants of student performance in each country? How do the results vary across distributions and across different education systems in MENA? Is MENA educational production different from or similar to other educational systems? The potential determinants groups are family background measures (SES) and school resources measures.

Microeconometric student-level least-squares regressions, weighted by sampling probabilities and adjusted for clustering within schools are adopted in order to address the first question. A meta-analysis method is applied to address the comparability question and

get a synthesis of the results. Quantile regressions are applied to investigate the differences across the distribution taking into consideration the sampling weights and clustering. Also, the study considers school fixed effects estimates to exploit the variation among students based on their family inputs.

2. Background

Growth rates compared to educational achievements globally indicate some positive relationship. Hanushek and Woessmann (2005), using global data on education and GDP per capita, show a positive relation between education output and GDP per capita growth rates (Figure 1). Using the regional average, MENA appears on the regression line; the inclusion of a MENA dummy is not significant in such a regression. However, when individual countries are considered many MENA countries fall below the line for their level of income; this is especially the case for some of the wealthy oil rich countries (Figure 2 show the relation between GDP per capita and test scores across selected countries).

Figure 1: Hanushek and Woessmann estimates of the test scores relation to Growth

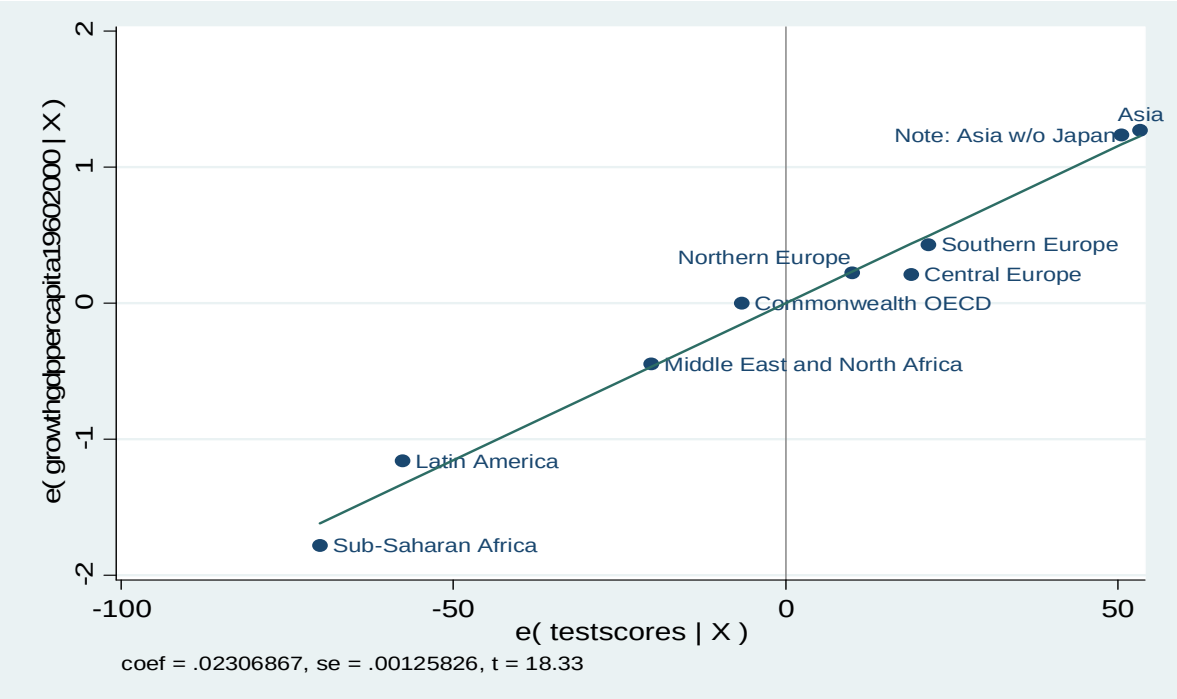


Figure 2: Maths test scores and GDP per capita for TIMSS selected countries

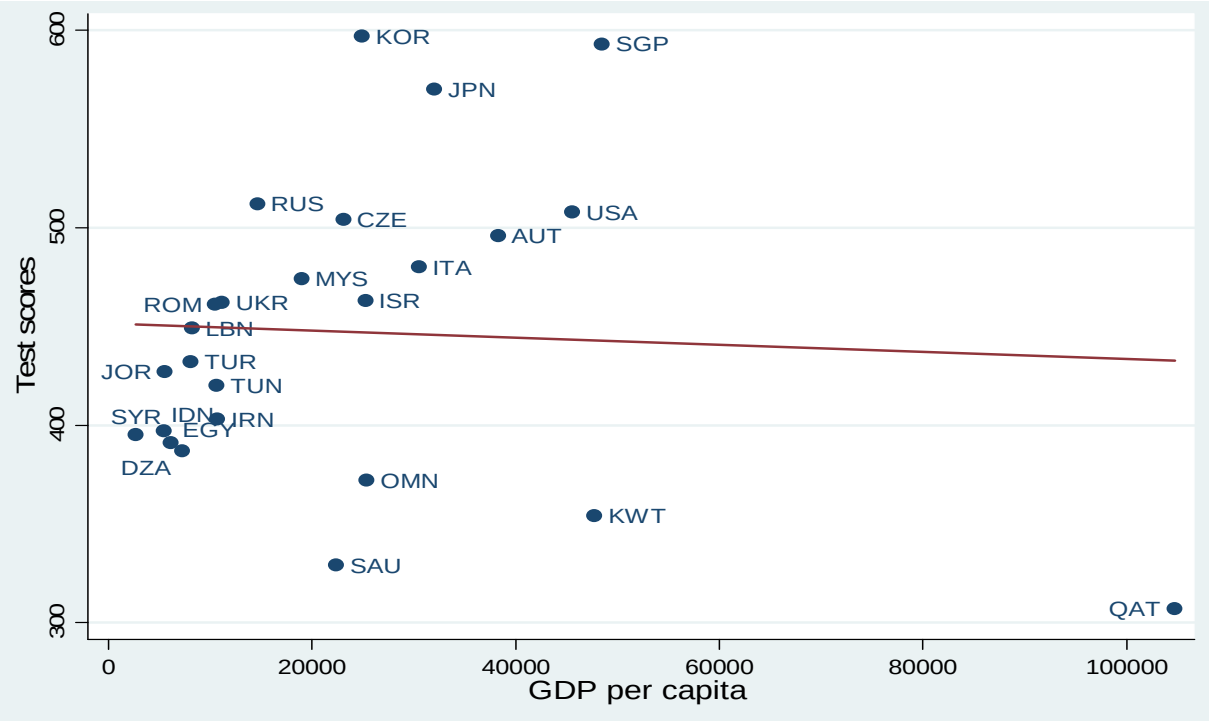
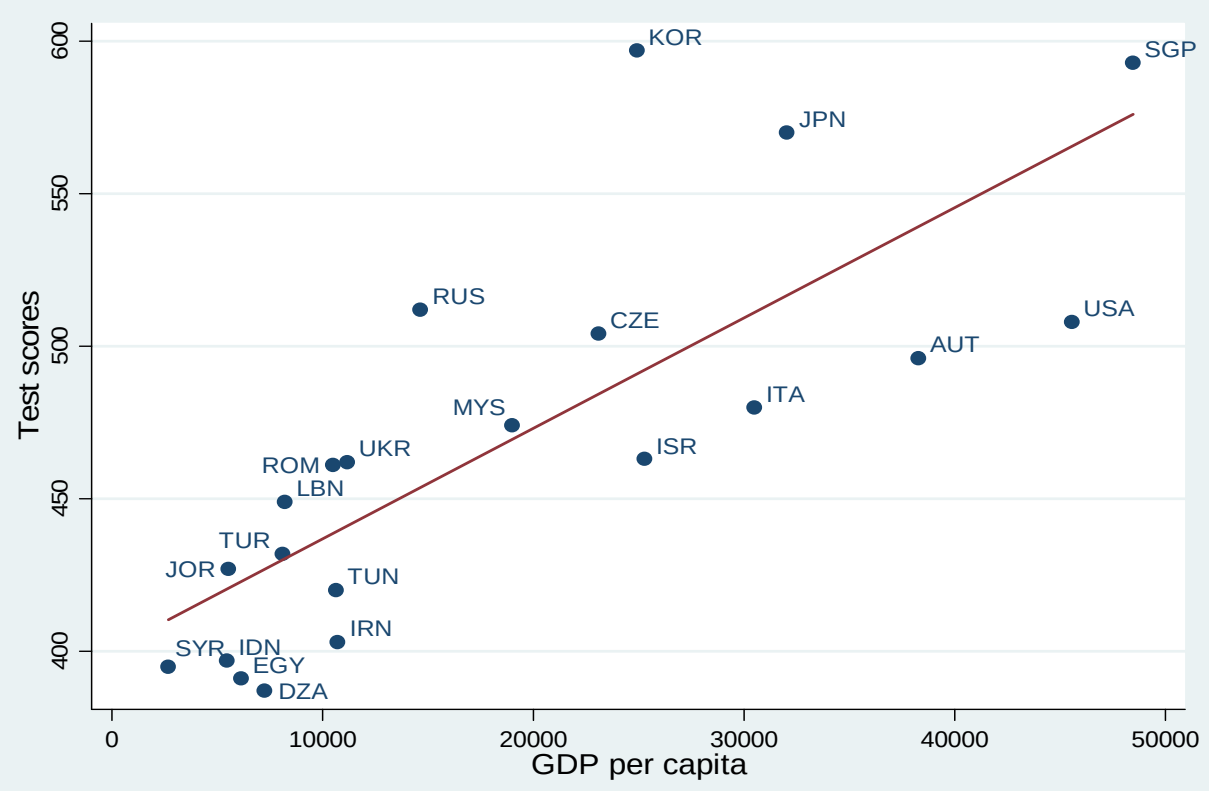


Figure 3: Maths test scores and GDP per capita for TIMSS (without high income Arab oil countries)



The Arab oil countries have high GDP per capita but still underperformed in education outcomes. Although some countries possess natural resources, development performance has been poor; net growth rates in non-oil economies are very low compared to many other developing countries, and even the high growth oil economies have relatively low levels of human development. Unemployment is high and human capital formation is low compared to the rest of the world. Excluding oil countries changes the relationship: the low education outcome is clear from Figure 3 where Algeria, Egypt, Syria, Iran, Turkey, Jordan and Saudi Arabia (excluded from this figure) are below the 450 point level of maths. The findings indicate a motivation to investigate more about this relation in MENA.

The education outcome of developing countries in Sub-Saharan Africa and South Eastern Asia might be more sensible in terms of comparability. The Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ) provides data for the six grade students in the Southern and Eastern African countries for maths and reading. The maths scores are comparable to the TIMSS scores as they based on the same methodology and statistical foundations. The average maths scores for the set of countries (Botswana, Kenya, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Uganda, Zambia, Zanzibar and Zimbabwe) in 2007 is 509.5 points which above the average of MENA (412).

3. Literature Review

The Coleman Report (Equality of Educational Opportunity, 1966) initiated large theoretical debates and enriched the economics of education empirical research using education production functions. United States research on education has focused on resources effects especially class size effects. Hanushek (1995) summarizes studies on developing countries which provide evidence on education production function. Glewwe (2002) criticized many of the developing countries studies for the lack of methodological and data quality. Developing countries including Latin America, South Asia and sub-Saharan Africa have their share of the literature, although in most of the cases a single country study is undertaken. In MENA countries there is nothing to match any of those developed or even developing countries literature.

Heyneman (1997) discussed the educational quality in MENA and argued it is not a financial problem but it might be a culture problem, and the inefficient allocation of educational resources follows the central planning era concept of a school system to provide graduates for the public sector with planned fields of study. At the ninth grade, an exit examination determines student track, whether to go to university or to lower demand technical school, with the intention of restricting the number of university graduates. The lack of empirical evidence on MENA and the lack of available data restricted further research.

The vast majority of research on education quality is on industrialized or developed countries. However, research on developing countries has shifted from education quantity to education quality with increasing availability of measures of student performance in academic tests (Glewwe and Kremer, 2006). As many of these studies suffer from serious methodological shortcomings, we have to be careful reviewing them (Glewwe, 2002).

Examining the quality and efficiency of private and public education in India, Kingdon (1996) used data collected in 1991 from 902 students aged 13-14 in 30 schools in urban Lucknow in Uttar Pradesh, India. Estimating education production function for cognitive achievements (reading and mathematics) Kingdon examined the impact of three school level variables (class size, index of physical facilities and teaching aids, and time of academic instructions per week) and five teacher variables (years of general education, years of general training, years of teaching experience, salaries in rupees per month, and teacher's average division). The most influential variables were the school resources, length of structured teaching time per week, school management type and teacher's cognitive skills. Class size, teacher training and teacher experience have no significant impact on student's achievements and years of teacher education is only just significant (at 10% level).

Glewwe and Jacoby (1994) used data from the 1991 Ghana Living Standards Survey and written tests covering reading (in English), mathematics and abstract thinking given to middle school students. Collective data about schools attended and teachers were used to estimate the impact on students' achievements in the tests. Only teaching experience was found to be significant and its impact was indirect through raising the grade level attained by students. Repairing roof leaks and providing blackboards have an impact on raising cognitive achievement of students on maths and reading. Glewwe (2002) summarizes studies

on Brazil, Ghana, India, and Jamaica. The estimated effects from Harbison and Hanushek (1992) for Brazil were relatively small. Only school facilities, writing materials, textbooks and teacher salary were significant. In Jamaica the largest impact was a change from never using textbooks to regular use in every lesson.

Exploring the effectiveness of In-Service Education and Training (INSET) in Namibia, O'Sullivan (2001) showed how to implement and benefit from putting the training mechanism in the right context. Implementing the INSET model for 99 lower primary teachers and 46 senior primary English teachers in 31 primary schools she collected data by interviews, semi-structured and unstructured observations, lesson observations, assessment of learners' work, and an examination of documents. She described factors of success to be school based and school focused programmes, objective training to teacher's needs, preferring trainers related to classroom realities, cyclical and complementary courses, open training to add new practices and skills, supervision and follow up after training, and training should be planned and formally. School effectiveness studies focus on the educational process itself rather than examining resources per se.

Hanushek (1995) claimed in his review for developing countries that school resources or inputs have no impact on student's achievements. Kremer (1995) argued for an alternative interpretation from the same studies that five of the six variables (teacher's education, experience and tsalary; expenditure per pupil, and physical facilities) raised test scores. However, he noted that some have a small impact and the teacher pupil ratio has no positive effect. Heyneman and Loxley (1983) argue that the impact of school and teacher quality is greater than family socioeconomic status on student performance in developing countries compared to developed countries (Heyneman-Loxley effect).

Although results from the 1970s supported the claim, Baker, Gosling and Letendre (2002) and Hanushek and Luque (2003) do not find support in developing countries. In their study on schools, teachers, and educational income in developing countries Glewwe and Kremer (2006) describe the impact of additional resources inputs on educational achievements as mixed. Retrospective studies show limited impact while experiments and randomized trials, recently conducted in middle-income countries, show more mixed results. Good governance

practices and reforms giving more autonomy to schools are better than giving incentives to teachers for improving student achievement.

The research findings from developed countries do not necessarily work for developing countries. Developing countries are very heterogeneous in nature and are not like industrialized countries. Each country has different socio-economic status, school practices, teachers, students, cultures, geography, and political systems. In-depth research at a country level, in context and with good data, is required to address the methodological and estimation problems.

Studies using TIMSS dataset

Woessmann (2003) studies educational production in East Asia based on international comparable micro level data collected from TIMSS 1995. Investigating the influence of family background and schooling policies on students' achievements, he estimated education production function for each of the five highly performing counties (Japan, Korea, Hong Kong, Thailand, and Singapore). He found that resource allocation especially class size is not strongly related to student's achievements, more institutional schooling policies regarding school autonomy (Japan and Singapore), homework policy (Hong Kong, Japan and Singapore) might increase educational performance, and parents participation in the teaching process in Hong Kong gives superior achievements.

Exploring efficiency and equity in schools around the world, Hanushek and Luque (2003), used data from TIMSS 1995 on 37 countries, investigate the impact of resources policies such as improving teacher education or reducing class size on cognitive achievements both in developing and developed countries. Also, they test for Heyneman-Loxley effect in developing countries. They state that "across the sampled countries, the overall strength of resources in obtaining better student performance appears rather limited, but it is more positive than in the corresponding analyses of the US achievement." (Hanushek and Luque, 2003: p497). Nonetheless, this variation is not specific to poor countries or countries that began with low levels of resources. They found that the Heyneman-Loxley effect, using alternative methods, does not hold.

To sum up, the existing literature on education production functions is ambiguous regarding the relationship between school resources and student achievements; institutional reform, school autonomy and accountability do appear to be important. Glewwe and Kremer (2006) argue that future EPF studies can improve results by increasing the sample size. TIMSS data set offers the opportunity for further research based on its comprehensive nature.

4. Data and empirical model

The Trends in International Mathematics and Science Study (TIMSS) carried out by the International Association for the Evaluation of Educational Achievement (IEA), an independent organization, collects data on students at fourth (9-10 years) and eighth (14-15 years) grade for a large sample of countries to give comparative assessments dedicated to improving teaching and learning in maths and science for students around the world.

This study relies on data from TIMSS on student tests results with extensive information from the student background questionnaire and teachers and school characteristics for both maths and science. Each participant country followed a uniform sampling approach applied by TIMSS team to assure high quality standards. A two stage stratified cluster design was followed: at the first level a random schools sample is selected and within each of these schools one or two classes are selected at the second stage randomly. All students in a selected class were tested for both maths and science. Two main issues need to be addressed in using TIMSS; the complex multi-stage sample design mentioned above and the use of imputed scores or "plausible values" (Foy and Olson, 2009).

To assess the role of school and student background characteristics on performance we use a standard education production function (EPF) for maths test scores. For comparability it is important to consider country differences and avoid aggregation bias from pooling country data, so we estimate education production function for each country separately. The EPF specification and variables is based on the literature and employs a common set of characteristics of student background and school resources to test their impact on cognitive achievements across MENA countries. The dependent variables are math test scores, using plausible values. The literature suggests there are no or minimal effects of school resources on attainment so we explicitly test this; within school variation is examined by applying school fixed effects estimation across countries.

Given the presence of unobserved country-specific factors, a simple comparison of separate estimates for each country is not fully informative for identifying the most important determinants of educational attainment. To address this we use Meta regression analysis to investigate significant effects across countries: 'Meta-analysis is the empirical analysis of all previously reported empirical estimates (or tests) on a given subject. It employs the same statistical tools available to any empirical researchers but has the advantage of a more comprehensive, more integrative perspective' (Stanley and Doucouliagos, 2010, p. 180) .

Meta-analysis is very common in medical research and recently in economic studies (Stanley, 2001, Coric and Pugh, 2008, Doucouliagos and Paldam, 2008). The EPF and meta-regressions identify average effects of a variable for a sample. However, the effect of school or family characteristics may vary depending on (unobserved) student ability. One way of addressing this is quantile regressions, where the coefficient on explanatory variables is allowed to vary across the distribution of test scores. The three techniques employed are explained in more detail below.

4.1 **Education Production Function (EPF)**

We estimate an education production function of the following form:

$$A_{ics} = \beta_0 + \delta_1 F_{ics} + \delta_2 S_{cs} + \alpha D_{ics} + \varepsilon_{ics} \qquad \textbf{(1)}$$

Where A is the test score of student i in class c in school s *(MENA selected samples are different across countries. Some countries select only one class from each school, simplifying notation to students and schools only, and some select two classes.)*, F is a vector of family background variables and S is a vector of school characteristics variables. The coefficient vectors α, δ_1 and δ_2 are to be estimated. We include D, a vector of dummy variables for each variable both in F and S to capture the effect of missing observations; a dummy takes the value 1 for observation with missing data and 0 otherwise (the variables themselves are set to zero if their values are missing). The error term ε has two components as we have a two-stage stratified sample, the imputation error on student's level and the sample error at the school level. Employing EPF on TIMSS data is complicated by the fact that TIMSS uses a two stage stratified sample and IRT (Item Response Theory) for performance measurement. This

requires employing plausible values for the dependant variable and the jackknife technique to calculate the correct (robust) standard errors.

To control for differences across schools and estimate the pure effect of family and home on performance, we incorporate a school fixed effects estimate. The inclusion of dummy variables for school effect on the education production function gives the required fixed effect estimates.

4.2 **Meta Regression Analysis (MRA)**

To find the reliable determinants across countries we conduct a meta regression analysis. In this approach the key concern is whether there is a systematic effect of any given variable on the dependant variable and whether a significant effect remains after controlling for differences across studies. Meta regression analysis (MRA) is a statistical tool to synthesis the output of different studies to determine variables with systematic effects; following Stanley and Jarrell (1989) the specification takes the form:

$$f_j = \beta + \sum_{k=1}^{K} \alpha_k Z_{jk} + e_j \qquad (\mathrm{j} = 1,\ 2\ \ldots\ \mathrm{N}) \qquad \textbf{(2)}$$

Where the dependant variable, f_j is the estimated coefficients on variable j, β is the 'true value' of the coefficient across studies (N=8 MENA countries), Z_{jk} are the independent variables which control for any different characteristics across j, α_k is the meta regression coefficient which measures the biasing effect from variations in k, and e_j is the disturbance term. The heteroskedasticity of estimates requires estimating a weighted least squares version of equation (2) by dividing through by estimated standard errors (SE_j) controlling for sample size differences to yield (3), where the dependant variable becomes the t-statistics of the estimates.

Weighted Least Squares MRA:

$$t_j = \beta_1 \left(\frac{1}{SE_j} \right) + \sum_{k=1}^{K} \alpha_k \frac{Z_{jk}}{SE_j} + \nu_j \qquad \textbf{(03)}$$

We conduct a meta-analysis to summarize and evaluate the findings from our comparative EPF estimates for MENA, based on a uniform analysis of the same specification based on comparable TIMSS 2007 data. The estimates from such analysis should not carry any

systematic variation from outside the specification, such as different authors, publication, or different data so the Z_{jk} variables are dropped. The MRA accounts for differences or sources of bias across studies, making the application relatively simple. This analysis has the advantage of giving the required precision of the investigated effect over the normal vote-counting procedure. In vote-counting the effects are counted based on its direction and significance and do not account for sample differences. However, the estimates from equation (3) give us the average weighted impact of each variable across the sample and show which predictors are the consistent determinants of performance in MENA selected countries.

4.3 **Quantile regression**

Our baseline model will be re-estimated using quantile regression to examine whether student background and school resources have different effects at various points of the achievement distribution. Following Buchinsky (1998), a simple quantile regression model can be written as

$$y_i = x_i \beta_\theta + u_{\theta i}, Quant_\theta(y_i \mid x_i) = x_i \beta_\theta \qquad \textbf{(4)}$$

Where $(y_i \mid x_i)$, *i=1,…., n* is a sample of population, y_i is the dependant variable and $\mathbf{x}_i$ is a *(kx1)* vector of explanatory variables, $Quant_\theta \ (y_i \mid x_i)$ is the conditional quantile of y_i conditional on the vector of explanatory variables $\mathbf{x}_i$ and $\theta \in (0,1)$ assuming that $Quant_\theta (u_\theta \mid \mathbf{x}_i)=0$. The θ^{th} conditional quantile regression estimator for β is obtained by the minimization of the weighted sum of absolute value of errors as in equation (5)

$$\min_{\beta} \left[\sum_{\{i; y_i \geq x_i \beta\}} \theta \mid y_i - x_i \beta \mid + \sum_{\{i; y_i \prec x_i \beta\}} (1-\theta) \mid y_i - x_i \beta \mid \right] \qquad \textbf{(5)}$$

Quantile regression will allow for the impact of explanatory variables on educational attainment to be analysed along the distribution. For example, the impact of parental education at the 25th quantile of the conditional test scores distribution might be compared and examined against the impact at the median and the 75th quantile, holding all other variables constant. Quantile regression will allow us to check the robustness of our OLS estimates based on the errors distributions. QR is based on a weighted sum of absolute

deviations which give a robust measure of location on the distribution scale (Buchinsky, 1998). Since TIMSS uses five plausible values for the test scores, we should repeat QR five times to get the correct estimates. We used the jackknife technique to calculate robust standard errors.

5. Results

Table 1 reports the results of the family background and school resources regression on maths scores for the different MENA countries. It shows measures of educational backgrounds of parents, followed by student characteristics, school-level measure including teacher background and school resources, and finally community location and poverty levels.

5.1 **Family backgrounds and student performance**

The education level attained by the parents is strongly related to student achievements in all MENA countries. The estimations use all the information available for the parents' education including dummy for each category, namely parents whose highest education level is lower secondary, finished upper secondary, some post-secondary education, and finished university, with parents with no secondary education (i.e. no, or no more than, primary) as reference category.

Across MENA countries, the relationship between student's maths performance and parents' level of education is weak in Algeria and Saudi Arabia and non-monotonic in Jordan and Egypt. There are two countries, Algeria and Egypt, where the difference in maths performance between students whose parents finished university and students whose parents did not finish lower secondary education is not statistically significant. However, in Algeria, students whose parents finished lower secondary education have significantly lower performance in math compared to students whose parents had no lower secondary education. In Egypt, students whose parent had finished upper secondary or some post-secondary education perform statistically better than student whose parents had no lower secondary education.

At the other extreme, the difference is the largest in Turkey at 88.34 point of test scores in favour of student whose parents had a university degree compared to student whose parent

had no secondary education. The effect size in both Jordan (35) and Iran (37) is quite close to the observed effect in Western European countries and below the United States observed effect (52 points, as this relates to a higher mean test score proportionally the rates are quite similar) (Woessmann, 2005).

The second indicator of family background measures is number of bookcases in the student's home. That measure will be correlated with parental education and both will be correlated with other unobserved family characteristics such as ability, motivation and capability to help children at home with respect to school matters. Each student was asked in TIMSS questionnaire to report the total number of book cases at their home, excluding newspapers, magazines or school books. These two indicators act as proxies of socio-economic and educational background of student. This measure was included in three categories; has two or more bookcases at home, one bookcase and the reference category of very little or no books at home. Again, Algeria, Egypt and Syria show insignificant effect of homes with more than two bookcases compared to homes with very little or no books. Tunisia has the largest effect with Turkey in second place, with students from home with two bookcases performing better in maths test by 33.64 and 27.25 points respectively. The effect of homes with one bookcase is statistically significant across all countries; the lowest effect is for Syria, Egypt, and Algeria.

Native students outperform non-natives in all countries except in Saudi Arabia where students with Saudi parents do worse by 10 significant points than non-Saudis (Algeria sampled 100% Algerian students in their sample and the effect of native parents was insignificant in Jordan). Home possessions are measured by an index of three categories, namely high, medium and low home possessions. Each student was asked to report if they have certain items at their home, then an index is constructed using this information[1]. Home possessions being high or medium show the expected significant positive effect on maths performance in all countries. The largest effect size is in Egypt and Jordan followed by Saudi Arabia and Syria and the lowest effect size was in Iran where students who have high home possession do better by 13.7 point test score in maths compared to student with low home possessions.

[1] Both average index and factor analysis index were introduced with no differences, so for comparability and simplicity we included the average index.

Student's gender indicated a significant different effect between boys and girls, where boys outperform girls in Algeria, Syria, Tunisia, and Turkey and girls outperform in Egypt, the effect was insignificant in Saudi Arabia, Iran, and Jordan.

Students were asked if they use a computer at home and school, at home but not school, at school but not at home, other places, or no computer at all. Computer usage is re-categorized into three groups; using computer both at home and school, either at home or school, and the reference group is no computer to measure the effect of using computer under supervision compared to no computer or using it without supervision.[2] Students who use a computer perform worse (statistically significant) than students who do not use computer at home or school in all MENA countries except in Iran and Turkey. This surprising result will be discussed later. The largest effect is in Iran where a student who uses computer both at home and school performs better by 73.6 point test score in maths.

With respect to test language and home spoken language, student was asked to report how frequently the test language is spoken at home. Test language always spoken at home affected student performance in math significantly negatively in Egypt, Tunisia, and Jordan; the effect significantly increases test scores in both Iran and Turkey.

5.2 **School resources, teacher characteristics and performance**

This section presents the results for school resources and location represented in equation (1) by the vector $\boldsymbol{S}$ which contains measures of teacher characteristics including: teacher gender, teaching experience, teaching certificate, teacher's level of education; school resources availability, class size, and some other location measures (community type if the population is greater than 50000 person and poverty measure of catchment area of the school by percentage of disadvantage students who attend this school).

Teacher characteristics do not make a difference for student performance in MENA countries except for teaching experience in Egypt and Tunisia. However, the effect is very small, a one year more of teaching experience increases student's maths test scores by 1 point in Egypt and less than half point in Tunisia.

[2] The full classification and comparison of using computer is further explored for Egypt in Badr (2012).

Table 1: Determinants of education in MENA, Education Production Function estimates

DV: Maths test scores	Saudi Arabia		Algeria		Egypt		Syria		Iran		Tunisia		Jordan		Turkey	
	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.
Lower-sec EDC	0.19	-5.41	-6.522**	-2.88	7.33	-5.97	0.52	-6.69	2.38	-4.24	-11.19***	-3.97	-4.10	-9.38	7.72	-4.89
Upper-sec	-0.81	-4.73	2.96	-2.89	22.88***	-6.42	-6.62	-6.48	14.28***	-5.13	-7.802*	-4.16	11.33*	-6.73	31.07***	-6.50
Post-sec not UNI	15.27	-9.88	5.60	-3.74	33.79***	-7.02	15.58**	-6.79	17.84**	-8.17	1.34	-4.74	40.83***	-8.05	45.26***	-10.29
University degree	18.62***	-5.81	0.10	-3.48	3.11	-6.88	20.34**	-7.94	36.62***	-8.39	10.72**	-5.15	34.89***	-7.43	88.34***	-10.73
Natives	-10.13**	-5.05	-	-	48.86***	-5.11	19.47***	-5.65	20.55**	-9.78	24.27***	-5.63	-5.93	-3.69	42.29***	-8.84
One bookcases	14.31***	-5.12	11.44***	-2.72	10.57**	-4.32	6.226*	-3.40	21.36***	-3.95	17.94***	-3.12	14.70***	-4.67	25.29***	-3.71
Two bookcases	9.070*	-4.82	5.61	-4.48	2.14	-6.33	1.57	-4.43	10.86*	-5.77	33.64***	-4.51	20.60***	-5.48	27.25***	-5.74
Home possess H	51.24***	-4.94	16.44***	-4.23	58.99***	-5.30	41.03***	-5.27	13.71*	-7.72	35.38***	-5.04	57.03***	-7.00	28.44***	-8.94
Home possess M	24.93***	-4.56	14.21***	-3.70	41.22***	-4.77	29.22***	-4.90	11.67***	-4.00	15.90***	-3.83	48.53***	-5.88	18.29***	-6.41
Boy Student	-10.90	-12.79	6.845***	-1.79	-10.65*	-5.50	18.66***	-5.56	5.59	-11.38	22.58***	-2.06	-20.74	-22.71	7.852**	-3.55
TL spoken ALs	-4.14	-3.44	0.72	-2.12	-20.12***	-3.76	2.94	-4.98	12.90***	-4.57	-15.46***	-4.32	-11.05**	-4.81	28.68***	-4.61
PC at H&SCL	-15.39**	-6.19	-14.21***	-4.61	-26.32***	-5.17	-13.02**	-5.48	73.64***	-22.14	-31.44***	-6.67	1.59	-7.56	31.77***	-8.44
PC at H/SCL	-13.64***	-3.95	-3.28	-2.99	-23.78***	-4.30	-13.52***	-5.07	14.90**	-6.34	-11.65***	-2.72	-22.42***	-7.22	12.74**	-6.49
Male teacher	-5.20	-12.61	4.65	-4.05	1.42	-7.54	0.30	-7.37	-8.26	-11.99	-5.06	-3.24	4.02	-23.10	9.27	-7.50
T. Experience	0.13	-0.33	-0.32	-0.29	1.008***	-0.36	0.36	-0.47	0.17	-0.37	0.473**	-0.20	0.60	-0.54	0.74	-0.71
T. Certificate	-	-	3.75	-3.87	8.14	-9.66	-7.93	-9.36	-	-	2.44	-5.94	1.79	-9.74	27.27	-27.59
M SCL RCS	-10.81	-10.79	-2.97	-6.54	-5.15	-7.12	10.60	-13.86	-18.06*	-9.82	-1.34	-5.82	-7.97	-10.28	-25.61**	-11.63
L SCL RSC	-17.33	-12.17	0.55	-8.67	-22.65	-14.26	12.83	-20.43	-26.88**	-11.03	-2.01	-6.99	-2.64	-14.99	-34.26**	-13.48
T. UNI Degree	-13.53	-17.51	-2.87	-5.33	0.08	-21.17	10.24	-6.99	3.30	-5.17	-5.33	-7.98	12.30	-17.28	6.93	-15.88
COMMU.>50000	14.55***	-4.63	1.39	-3.36	10.45	-6.55	-6.34	-8.80	16.88**	-6.92	0.16	-3.27	20.96***	-7.63	17.42**	-8.16
Pov 50% Disadv	-3.83	-5.59	1.27	-3.93	-9.18	-5.92	-23.16***	-8.30	-10.59*	-5.82	-8.081**	-3.66	-15.67*	-9.21	-31.69***	-8.97
Class size	-0.59	-0.56	1.702*	-0.93	-0.69	-1.34	-3.41	-3.11	-0.46	-2.01	-4.537***	-1.28	-0.91	-2.18	-0.14	-1.41
Class size Sq	0.01	-0.01	-0.02	-0.02	0.00	-0.02	0.05	-0.05	0.01	-0.04	0.104***	-0.03	-0.01	-0.03	0.00	-0.02
Constant	346.3***	-25.97	336.9***	-16.23	351.3***	-32.21	409.0***	-52.53	365.1***	-25.95	417.8***	-22.25	412.9***	-49.40	304.4***	-44.93

(Jackknife standard errors, p<0.01, p<0.05, p<0.1 & dummy controls for missing values included)

School resources availability is measured by an index of required components for schooling and teaching different subjects classified into high, medium, and low. School principals were asked to report the level of these resources in their schools. The impact of a shortage in school resources is found to be statistically significant in only Iran and Turkey. Students who attend a school where resources availability was medium performed worse than students who attend a high resources availability school by 18 point test scores in Iran and quarter standard deviation of math test scores in Turkey. The effect size increases the gap if the student attends a school with low level of resources.

The results in Table 1 indicate the effect of school on student performance is only significant in two MENA countries, Iran and Turkey. Form a policy perspective this would imply that increasing resources availability in the two countries will increase maths performance substantially, but begs the question of why school resources shortages do not make any difference on student performance in the other MENA countries.

For class size, a measure of number of students in the class and the class size squared are used. Across MENA, one class from each sampled school is chosen in TIMSS except in Tunisia where two classes are chosen to fulfil the sample requirements. The class size effect features in the literature of school resources effect on student performance, with no general agreement on the effect. For MENA countries, class size has a statistically significant effect only for Algeria and Tunisia. The effect is different for the two countries; a larger class increases maths performance in Algeria but reduces scores in Tunisia (class size may increase performance after some point but by a very small amount, implied from the class size squared effect).

School community, the school external environment, might have an effect on students' performance. A school located where the community population is more than 50,000 increases student maths performance in Saudi Arabia, Iran, and Turkey. This measure could be viewed as a proxy for community classification into urban or rural. The results indicate a more positive impact on student performance in urban communities compared to students who attend a school in less populated communities. The other important measure of school environment is whether the school is located in a poor or affluent community. Students who attend school where most of students are disadvantaged or poor perform worse than

students who attend more affluent students' schools. The effect is significant in Syria, Iran, Tunisia, and Turkey.

5.2.1 **School fixed effects**

A specification that includes a whole set of school dummies to control for school fixed effects (SFE) is employed to estimate the education production functions of MENA countries. Any systematic between-school variation stemming from any source is thereby removed when estimating the family background and student characteristics effects. However, controlling for school fixed-effects means that we are unable to explore the effect of school-level determinants of learning such as school resources, teachers' qualifications and class size. It gives finer estimates for the impact of student level variables.

The school fixed effect estimates (Table A-10) do not show major differences from the baseline model. As expected the explanatory power of the SFE model is higher than the full model (Table A-9). The changes mostly relate to estimates for Iran. Controlling for any unobservable from the school side variables by SFE changes the majority of home background and student characteristics indicators effects. Native students, home spoken language, computer usage at home or school, and more books at home turn to be insignificant, whereas the gender indicator shows a significant effect in favour of boys.

5.3 **Meta-Analysis results**

The variations present in the baseline results of the education production functions in MENA with this uniform analysis do not provide a general view of determinants of education; one way to do this is by "vote counting" for each of the variables. Column 2 of Table 2 shows the number of significant effects for each of the variables and determines the effect direction being positive or negative. Then, by the majority in either case, a variable is judged to have positive or negative effect. It is a superficial method since it doesn't account for the difference between the effect sample size and standard error. The alternative is to use meta-analysis. Table 2 also shows the results of the meta-regression analysis. The last column shows un-weighted effect of average coefficient to compare with MRA weighted estimates.

Table 2: Meta-Analysis of the determinants of maths achievements for MENA

DV: t-statistics of the coefficient estimates	Meta-regression analysis (FE)		Vote-counting		Average un-weighted effect
	Coef.	se	Pos. (sig)	Neg. (sig)	average coefficient
Lower-sec EDC	-2.289	(2.429)	5(0)	3(2)	-0.41
Upper-sec	5.110	(4.141)	5(4)	3(1)	8.54
Post-sec not UNI	14.41**	(5.331)	8(5)	-	22.17
University degree	14.54*	(7.245)	8(6)	-	26.87
Native parents[!]	13.88	(8.265)	5(5)	2(1)	17.31
One bookcases	14.90***	(2.206)	8(8)	-	15.28
Two bookcases	13.69**	(4.368)	8(5)	-	13.78
Home possess H	37.80***	(6.073)	8(8)	-	37.73
Home possess M	22.73***	(4.374)	8(8)	-	25.43
Boy Student	11.63**	(3.483)	5(4)	3(1)	2.44
TL spoken ALs	-1.398	(4.703)	4(2)	4(3)	-0.69
PC at H&SCL	-12.78*	(6.653)	3(2)	5(5)	0.87
PC at H/SCL	-9.302**	(3.801)	2(2)	6(5)	-7.62
Male teacher	-0.152	(1.915)	5	3	0.17
T. Experience	0.352**	(0.149)	7(2)	1	0.41
T. Certificate[!]	2.595	(2.044)	5	1	4.12
M SCL RCS	-6.099*	(2.854)	1	7(2)	-7.76
L SCL RSC	-9.786*	(4.830)	2	6(2)	-11.43
T. UNI Degree	1.664	(1.631)	5	3	2.57
COMMU.>50000	6.243*	(2.977)	7(4)	1	9.38
Pov 50% Dis-adv	-8.029**	(3.069)	1	7(5)	-12.70
Class size	-0.586	(0.601)	1(1)	7(1)	-1.14
Class size sq	0.00564	(0.00691)	5(1)	3	0.02

! No. of observation for native parents is 7 [no Algeria] and teaching certificate is 6 [no Saudi Arabia and Iran]

The MRA results indicate dominance of home background and family (SES) effects on students' performance in maths across MENA. The fourteen significant indicators of educational determinants on student performance are presented using forest plots (Lewis and Clarke, 2001) displaying an inverse-variance weighted fixed effect meta-analysis Figures 4 to 7. The symbols in the plots are explained in notes to the figures.

5.3.1 **The home influence on performance**

The influence of home background, socio-economic status and parents' education is very clear across MENA countries from the meta-analysis. Figure 4 and Figure 5 provide the forest plot for these variables and show the heterogeneity among the indicator effects across countries.

Figure 4: Forest plot displaying an inverse-variance weighted fixed effect meta-analysis for the effect of education determinants on student performance

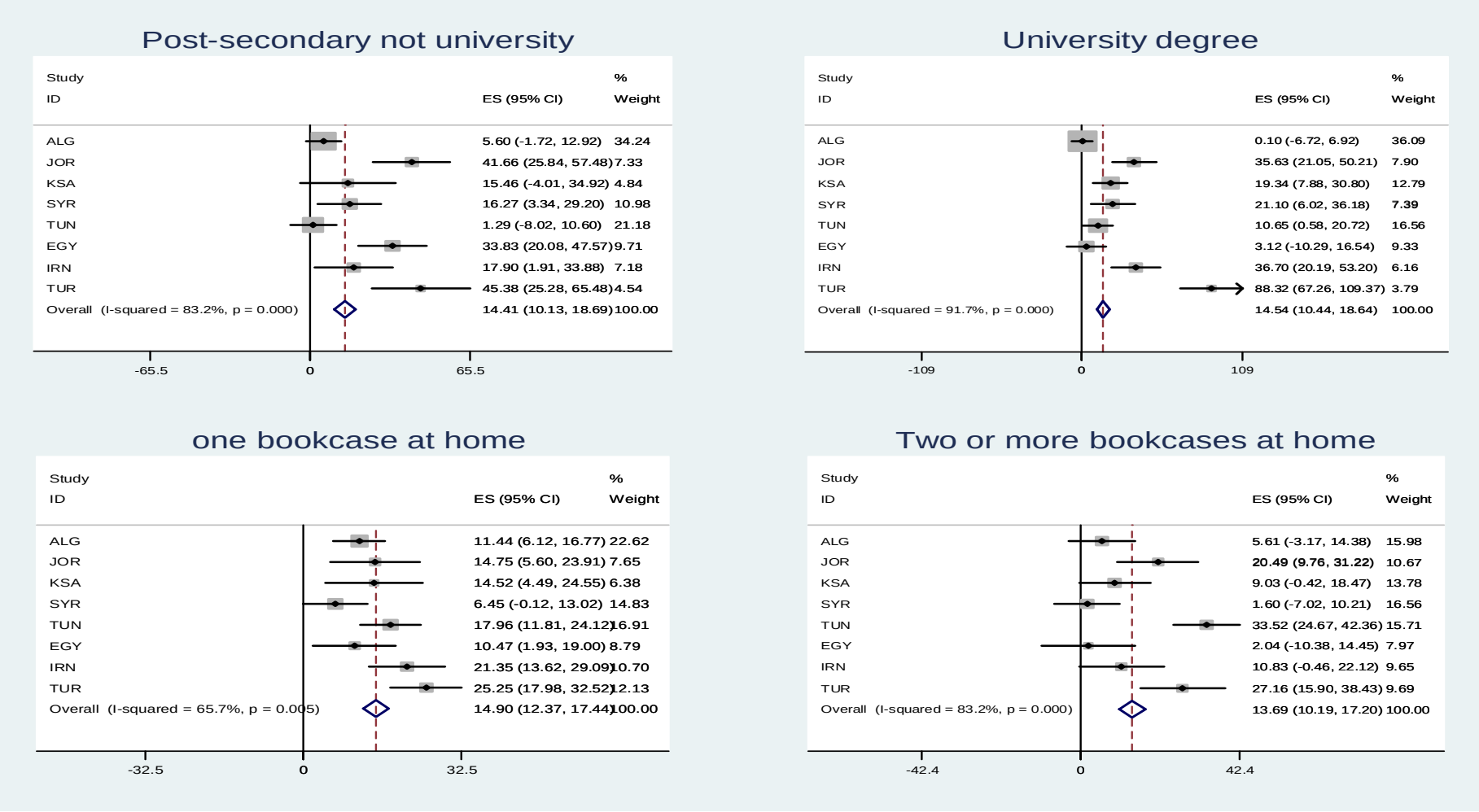


Figure 5: Forest plot displaying an inverse-variance weighted fixed effect meta-analysis for the effect of education determinants on student performance

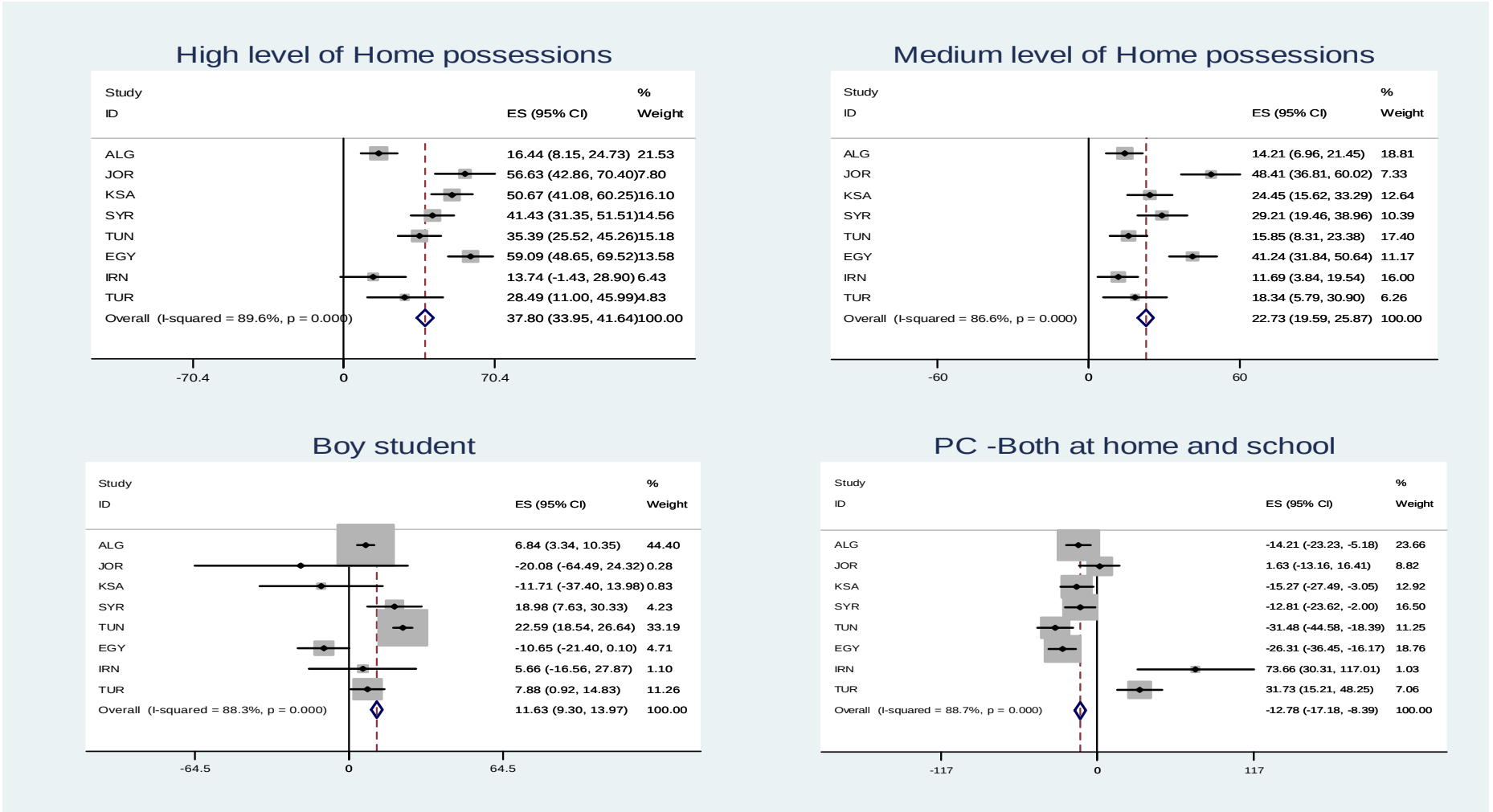


Figure 6: Forest plot displaying an inverse-variance weighted fixed effect meta-analysis for the effect of education determinants on student performance

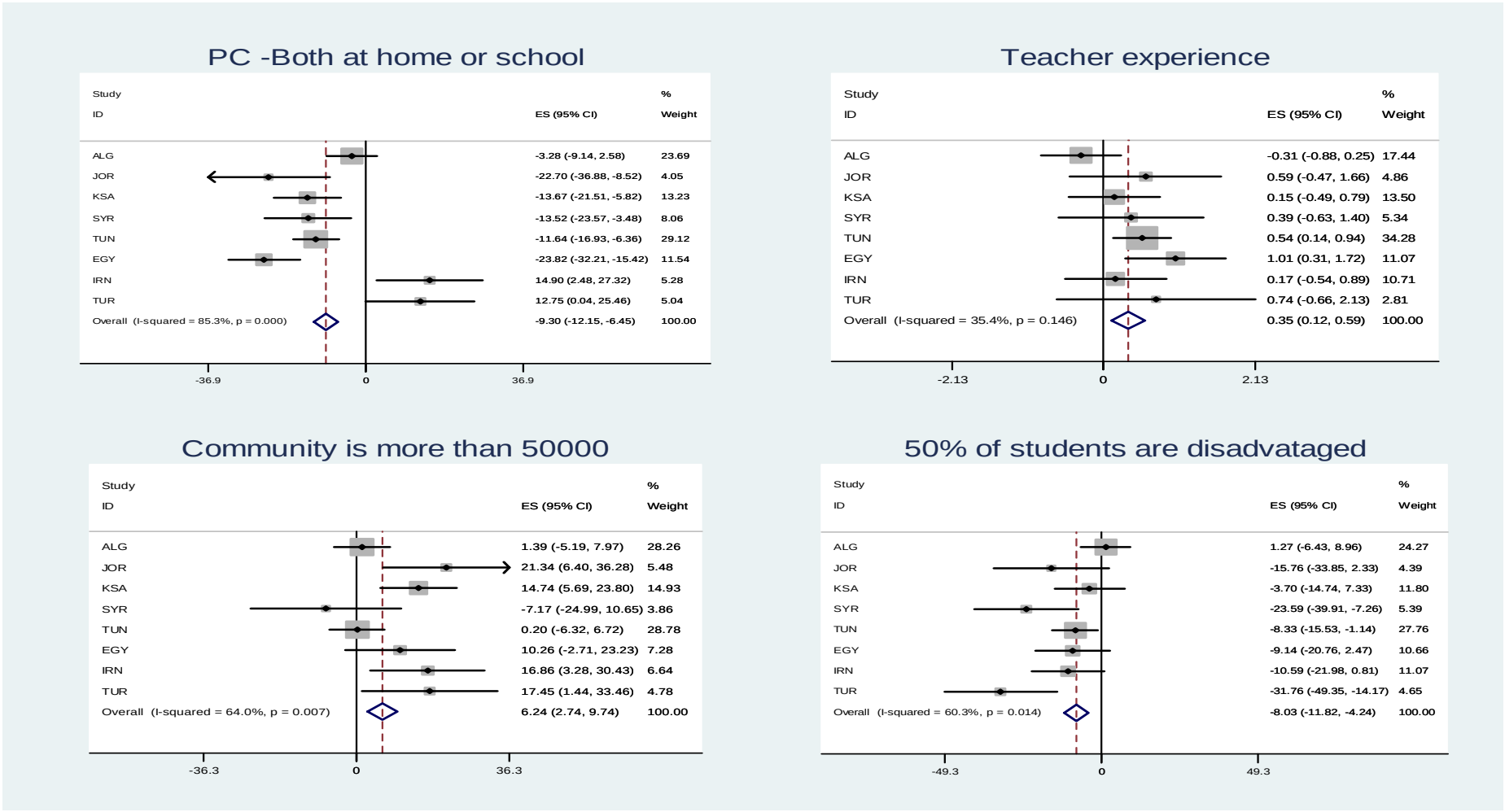
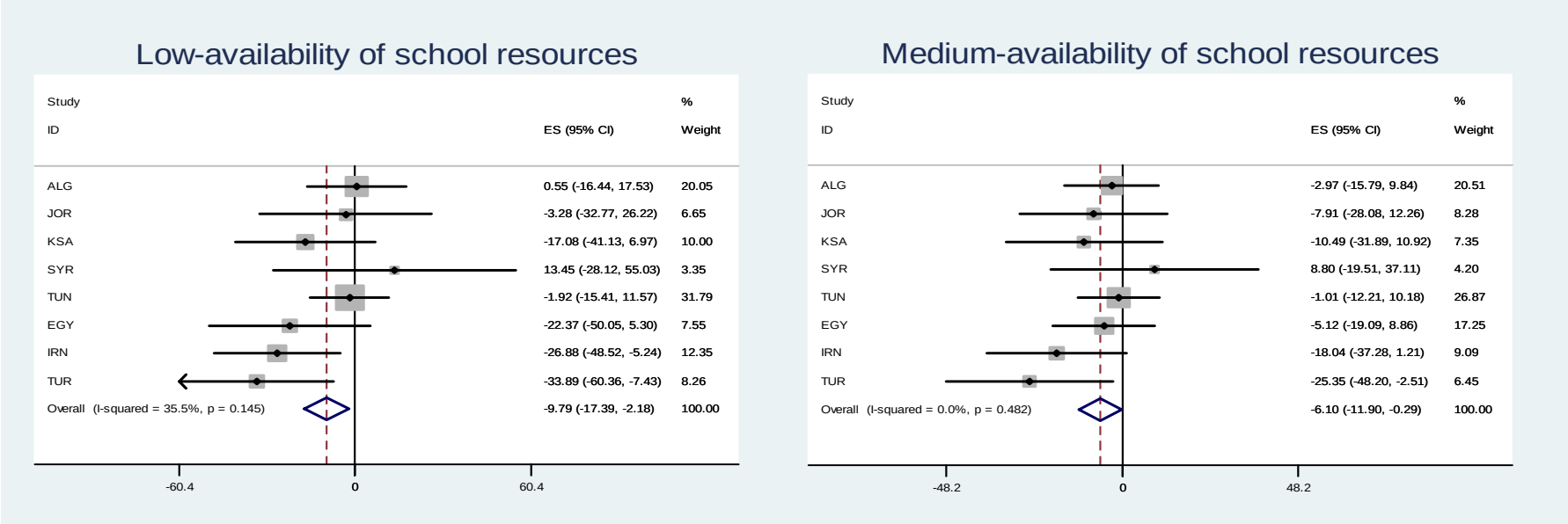


Figure 7: Forest plot displaying an inverse-variance weighted fixed effect meta-analysis for the effect of education determinants on student performance



Notes for Figures 4 to 7: The dotted line represent the average effect, the diamond shape◇ is the effect size and confidence interval, the solid line is the no effect line and the grey box■ is the effect from each study and its size represent its weight in the overall effect. The heterogeneity test, I-squared value, represents the percentage of variation across studies attributable to heterogeneity (Harris et al., 2008). The value of I^2 ranges between 0 (no heterogeneity) to 100%. The estimates of I-squared of all family indicators are high, indicating large variation in the true effects across MENA countries. The p-value of the I-squared test is less important in small studies meta-analysis; however a visual inspection of confidence intervals overlapping is of more importance. The effects are regarded as homogenous if the confidence intervals of all the studies overlap. Nonetheless, larger CI implies an imprecise effect.

Nine home/SES indicators show significant impact on math performance in the meta-analysis; parents level of education (post-secondary but not university and university degree or higher), level of home possessions (high or medium), number of books at student home (one or more than two book cases) as a proxy for SES, student gender, and computer usage (used both at home and school or used only at one place; home or school). The significant effects of the family indicators on student performance from the meta-analysis are positive in all indicators except for computer usage

5.3.2 **Computer usage reduces performance**

The impact of using computers in MENA reduces maths test scores. The aggregate effect of computer usage on maths scores is statistically significant with negative effect. The forest plot shows that this effect has two exceptions, Iran and Turkey, where the effect is positive for the two indicators of computer usage.

Descriptive statistics of computer usage categories across MENA indicates large differences (Table A.2 in the appendix). Considering the two countries with positive effect of computer usage on performance, Iran and Turkey show large differences on the reference group (not using computer at all) shares; Iran more than 45% of the sample do not use computer at all but in Turkey only 4% do not use computer at all. Running regression over the full range of categories does not show much difference.

5.3.3 **The school influence on performance**

The school level variables are mostly insignificant in country context, whereas the meta-analysis indicates general significant effects for teacher's experience, school resources, poverty, and school location on performance. The largest effect is for school resources followed by poverty and community type variables.

Teacher experience increases maths scores by 0.35 point, the effect size mainly driven by Tunisia and Egypt. The heterogeneity test is insignificant (I-squared value) which means 35% of the observed variances between studies is due to real differences in the effect size across countries of low resources. The medium and low school resources affects student attainment in maths negatively compared to students who attend schools with higher school resources. The negative effect size is mainly driven by the large significant effects in Iran and

Turkey. The urban community effect size is increasing maths scores as expected but the heterogeneity is too large (64%) with a p–value of 0.007. As explained above the p-value is not of much power in heterogeneity test with small sample of studies which means one cannot assume homogeneity. The effect size is based on the significant effect in Saudi Arabia, Iran, Jordan and Turkey. Students in disadvantaged areas will attain less in maths by 8 points on average; the heterogeneity test is significant (i.e. we reject the null of heterogeneity).

5.4 **Quantile Regressions:** *Heterogeneity of Covariates Effects by Performance (ability)*

The quantile regression model allows estimating the entire conditional distribution of Y given X. A more complete picture of student characteristics, home background, teachers' characteristics and school inputs effects can be provided by conditional quantile estimations. The estimates are focused on three quantiles .25, .50 and .90. The dependent variable is maths test scores. Sampling weights are employed and jackknife standard errors are reported as shown earlier.

The estimates of the uniform quantile analysis across MENA countries indicate some differences across test scores distributions. Table 3 presents a summary of the quantile estimates, the full estimates are in Appendix Tables A3.1 to A3.8. For student and family background; parents' level of education show large effect differences across quantiles compared to average effects in most of the countries. The home possessions effect is persistent across quantiles for all MENA countries except at top quantile for Iran and Turkey and median for Iran. The computer usage (both home and school) indicates different effects across quantiles for Saudi Arabia, Algeria and Syria. For School inputs and location; teacher experience effect has changed at the median in Egypt and appears to have no effect at all quantiles in Tunisia. The level of school resources availability for maths teaching effect remains for lower and median in Iran and Turkey but not at the top. The community effect is insignificant at the lower quantile in Jordan and both lower and median in Turkey. The poverty effect is insignificant at the median and top quantiles in Iran and at the lower and top quantiles in Jordan.

There are two main findings that might be of policy interest; the school resources effects and computer usage. The school resources, as shown in OLS estimates, affects the performance

negatively in Iran and Turkey if it is below the highest level of availability. The quantile estimates clearly show that the effect is only present at the lower and median quantiles in both countries which could be interpreted as targeting the low and medium resources school and increasing the availability of resources would achieve improvement for low performing students. On the other hand, this finding confirms the insignificant effect of school resources in other MENA countries which might be investigated more from the curriculum point of view. The computer usage works in the same way as school resources, however it significantly reduces the attainment of students in all countries except Iran and Turkey.

The median regression can be viewed as a test of the ordinary least squared results for robustness against outliers. The conditional quantile function at the median minimizes the sum of absolute residuals which is less sensitive to outliers than OLS. In this logic, median regressions may be better depicting the central tendency of the data. As shown from Table 3, in most countries the mean and the median are parallel. Nevertheless, some country estimates do differ between mean and median suggesting biasness due to outliers. For example, home possessions estimates are slightly larger at the median than the average OLS estimates which seems to be a downward bias of the mean estimates.

A more detailed investigation of the quantile regressions reveals more variations along the maths scores distribution. For Saudi Arabia, a parent with university education affects achievements at the median and top quantiles by 18 and 22 points increase of maths test scores (Appendix Table A-3.1) but not at the lower. Number of books at home is significant only at top quantile for one bookcase. Computer usage (both at home and school) is significantly reducing performance at the lower quantile and at median for using at home or school.

For Algeria, student in a home with one bookcase would achieve more at median and top quantile. Home possessions as proxy for wealth affect performance positively along the distribution; a wealthy family's (high home possessions) effect decreases across quantiles, however it increases for the medium home possessions across quantiles.

For Egypt, the effects are parallel to the average estimates except for the student gender effect which is insignificant across quantiles and the number of books at home effect which is significant only at the top quantile for one book case.

For Syria, parents education is only significant at the top quantile, explained as more variation across students' ability distribution. The negative effects of computer usage are insignificant at the lower quantile indicating more variations.

For Iran, the home possessions effect (high or medium) is only significant at the lower quantile, perhaps reflecting a sense of inequity due to home possessions. The other significant change is for school resources at the top quantile, a medium or low school resources would not make any differences of the achievements of top ability student but would significantly reduce the scores of lower and medium ability student. The computer usage increases performance toward the top of the distribution.

For Tunisia, a top ability student would suffer with less educated parents by 14 points less. A medium wealth family would affect student performance at median and top quantile but cannot rescue a low ability student. Computer usage tend to affect the performance along the distribution with increasing rate toward the top performers, however using computer either at home or school does not affect low ability students. The poverty effect tends to be insignificant in quantile analysis compared to least squared analysis. Class size effect with quadratic term indicating an inverted U-shaped relation where the class size increase affects performance negatively till the class size of 21 then it tend to increase performance. A note worth mentioning here is that Tunisia sampled two classes from some schools.

For Jordan, books at home benefit the top performers and more books would benefit the medium and the top performers. Computer usage negatively affects students at the lower and median when used either at home or at school. The large community affect the median and top performers rather than the low ability students. The poverty effect is insignificant at the lower and the median.

Table 3: Quantile Regression Results Summary for MENA

DV: math scores (5pv)	SAUDI			ALGERIA			EGYPT			SYRIA			IRAN			TUNISIA			JORDAN			TURKEY		
	.25	.50	.75	.25	.50	.75	.25	.50	.75	.25	.50	.75	.25	.50	.75	.25	.50	.75	.25	.50	.75	.25	.50	.75
Lower-sec EDC																		-						
Upper-sec							+	+	+					+	+							+	+	+
Post-sec not UNI							+	+	+			+		+	+				+	+	+	+	+	+
University degree		+	+									+	+	+	+		+		+	+	+	+	+	+
Native parents				na	na	na	+	+	+	+	+		+			+	+	+			-	+	+	+
One bookcases			+		+	+			+				+	+	+	+	+	+			+	+	+	+
Two bookcases														+		+	+	+		+	+	+	+	+
Home possess H	+	+	+	+	+	+	+	+	+	+	+	+	+			+	+	+	+	+	+	+	+	
Home possess M	+	+	+	+	+	+	+	+	+	+	+	+	+				+	+	+	+	+	+	+	
Boy Student				+	+						+	+				+	+	+						+
TL spoken ALs							-	-	-				+	+			-	-				+	+	+
PC at H&SCL	-				-		-	-	-		-	-	+	+	+	-	-	-				+	+	+
PC at H/SCL	-	-					-	-	-		-				+		-	-	-	-				
Male teacher																								
T. Experience							+		+															
T. Certificate	na	na	na										na	na	na									
M SCL RCS													-	-								-	-	
L SCL RSC													-	-								-	-	
T. UNI Degree																								
COMMU.>50000	+	+	+										+	+	+					+	+			+
Pov 50% Disadv										-	-	-	-							-		-	-	-
Class size						+											-	-						
Class size Sq																+	+	+						

Note: (+) indicate positive effect, (-) negative effect and (na) not available data for this variable so excluded.

For Turkey, the effects are almost the same across the distribution except for the wealth, school resources, gender and large community indicators. Home possessions and school resources affects the students with lower ability rather than top ability students however the effect works against each other. Gender differences and large community effects are significant only at the top quantile.

6 Conclusion

This research investigates education production functions for students in eight MENA countries school systems. Using TIMSS dataset to identify the determinants of educational achievement (measured as test scores in Maths), what all of the countries have in common is relatively low test scores, compared to other countries of similar income for which TIMSS data are available. Whilst it is not possible to explain why these countries have low scores by global standards we try to draw some inferences by identifying factors that explain differences in performance across students in each country.

The results presented here are the first concrete evidence on educational production functions for the most of MENA countries. The broad evidence is of very low returns to schooling- few school variables are significant and none have effects across countries and quantiles. Two broad types of factors were distinguished: student characteristics including home environment (e.g. gender, parental education, home resources) and school resources (e.g. class size, teacher experience, IT equipment). In general, student characteristics were far more important than school factors in explaining test scores, but there was considerable variability across countries in which specific factors were significant. Certain factors that appeared important in countries with relatively high scores, such as Turkey, were either insignificant or had very low coefficients (small effects) in the other countries so these help account for the low performance.

The meta-regression analysis indicates some common factors and indentifies some variations between MENA countries with respect to those significant influences. Family background proxies, parental education and number of books at home seem to present the largest effect on student's performance in maths in the three top performing countries, Tunisia, Jordan and Turkey. The number of books effect was the lowest in Egypt and Syria. Home

possessions are the most consistent effect across MENA countries. The gender differences of maths performance are significant in MENA, though a lot of variation is notable. In some countries boys do better (Algeria, Syria and Tunisia) whereas in others girls do better (Jordan, Egypt, and Saudi Arabia). Badr et al (2012) investigate the gender differences in detail.

One striking finding is the effect of computer usage on student's maths performance in MENA countries. Computer usage is found to influence student performance negatively in six MENA countries. Only Turkey and Iran are found to have a significant positive effect of computer usage on maths achievements. The computer usage finding has more solid evidence in Turkey where a bigger share of students use computer compared to Iran. This result suggests the importance of directive usage of ICT both at home and school to improve performance, it is not only the availability of ICT which will push the performance up. This begs questions about how computers have been used in those countries compared to Turkey.

In terms of school level effects, there is not much evidence that teachers' qualification cause better performance in MENA. School resources availability is found to have statistically significant effect on performance in MENA countries form meta-analysis, though this effect is driven by the significant effect from Turkey and Iran. Other factors such as community type and disadvantaged students influence student's performance across MENA countries but with only limited significance.

This study covered more detailed analysis on the heterogeneity of the determinants of educational production through quantile regressions. There are two main findings that might be of policy interest; the school resources effects and computer usage. The school resources effect is only present at the lower and median quantiles in Iran and Turkey, which could be interpreted as targeting the low and medium resources school and increasing the availability of resources would achieve improvement for low performing students. The quantile analysis confirms the insignificant effect of school resources in other MENA countries which might be investigated more from the curriculum point of view. The computer usage works in the same way as school resources; however it significantly reduces the attainment of students in all countries except Iran and Turkey.

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Appendix A: Quantile Estimates

Table A-1: Quantile Regression Estimates for Saudi Arabia

DV: Maths test score	.25	s.e	.50	s.e	.75	s.e
Lower-sec EDC	-7.404	(10.191)	0.453	(10.141)	4.166	(7.503)
Upper-sec	-2.942	(9.752)	0.352	(10.433)	-0.771	(10.133)
Post-sec not UNI	10.209	(19.881)	16.058	(13.031)	19.049	(14.038)
University degree	14.449	(10.622)	18.239**	(9.095)	21.532***	(8.081)
Native parents	-9.114	(8.061)	-12.811	(8.482)	-12.602	(10.287)
One bookcases	11.592	(9.259)	14.065	(9.122)	14.706*	(8.497)
Two bookcases	5.508	(8.118)	11.588	(11.559)	12.137	(8.821)
Home possess H	54.145***	(14.627)	52.676***	(9.789)	50.316***	(9.450)
Home possess M	27.121*	(14.023)	26.915***	(9.927)	23.808**	(9.943)
Boy Student	-20.122	(36.454)	-13.768	(33.334)	-11.559	(46.043)
TL spoken ALs	-4.461	(6.945)	-3.005	(6.209)	-6.673	(6.021)
PC at H&SCL	-17.374*	(10.290)	-16.750	(10.710)	-14.816	(9.396)
PC at H/SCL	-15.787**	(6.895)	-15.238*	(7.987)	-13.168	(8.184)
Male teacher	2.131	(36.994)	-1.352	(34.295)	-2.276	(43.288)
T. Experience	0.021	(0.556)	0.216	(0.617)	0.373	(0.447)
M SCL RCS	-11.898	(15.268)	-10.095	(12.024)	-14.391	(11.554)
L SCL RSC	-22.108	(17.420)	-18.444	(13.168)	-17.936	(17.615)
T. UNI Degree/pg	-16.663	(14.220)	-10.626	(19.775)	-12.792	(16.874)
COMMU.>50000	13.536**	(6.041)	14.620*	(8.365)	14.817**	(6.207)
Pov 50% Disadv	-4.972	(8.975)	-3.910	(9.881)	-3.051	(6.863)
Class size	-0.256	(0.804)	-0.759	(0.803)	-0.655	(0.934)
Class size Sq	0.003	(0.009)	0.007	(0.008)	0.005	(0.009)
Constant	302.998***	(25.198)	345.808***	(28.368)	396.445***	(23.452)

- No teaching certificate variable available for Saudi Arabia. All teacher PG merged with university degree for QR.

Table A-2: Quantile Regression Estimates for Algeria

DV: Maths test score	.25	s.e	.50	s.e	.75	s.e
Lower-sec EDC	-3.749	(7.381)	-6.400	(4.304)	-8.885	(5.492)
Upper-sec	3.485	(6.060)	1.947	(5.530)	1.671	(6.147)
Post-sec not UNI	4.773	(7.286)	4.387	(4.647)	5.281	(9.102)
University degree	0.191	(7.383)	-1.230	(5.046)	-1.042	(7.977)
Native parents	-	-	-	-	-	-
One bookcases	9.586	(6.586)	11.583**	(4.675)	14.772**	(7.119)
Two bookcases	2.923	(11.903)	4.596	(7.589)	9.837	(7.406)
Home possess H	17.321**	(6.913)	16.885***	(5.347)	15.656*	(8.656)
Home possess M	12.369*	(6.796)	14.538***	(5.135)	16.173*	(8.328)
Boy Student	6.577*	(3.955)	7.425**	(3.326)	7.449	(4.560)
TL spoken ALs	0.976	(4.217)	1.209	(2.843)	1.123	(4.066)
PC at H&SCL	-15.281	(10.137)	-14.252*	(7.826)	-14.069	(11.949)
PC at H/SCL	-5.602	(5.595)	-2.266	(4.390)	-1.188	(4.891)
Male teacher	3.692	(6.566)	3.754	(5.327)	5.929	(4.542)
T. Experience	-0.261	(0.362)	-0.245	(0.388)	-0.294	(0.398)
T. Certificate	2.544	(7.993)	2.661	(5.459)	4.109	(5.337)
M SCL RCS	-0.110	(11.644)	-3.443	(5.365)	-3.755	(12.196)
L SCL RSC	3.590	(16.950)	0.308	(9.920)	0.378	(12.289)
T. UNI Degree/pg	-5.786	(12.135)	-4.064	(7.234)	-0.389	(10.990)
COMMU.>50000	-1.445	(6.706)	0.376	(4.564)	3.010	(4.892)
Pov 50% Disadv	0.546	(7.251)	1.017	(4.486)	0.231	(4.580)
Class size	1.617	(1.614)	1.452	(0.921)	2.200*	(1.258)
Class size Sq	-0.015	(0.027)	-0.014	(0.016)	-0.026	(0.021)
Constant	298.147***	(30.349)	341.087***	(14.238)	367.868***	(26.688)

- All native Algerian
- All teacher PG merged with university degree for QR.

Table A-3: Quantile Regression Estimates for Egypt

DV: Maths test score	.25	s.e	.50	s.e	.75	s.e
Lower-sec EDC	8.931	(10.951)	8.878	(12.032)	7.759	(10.842)
Upper-sec	25.544**	(10.171)	25.300*	(13.542)	24.096*	(14.636)
Post-sec not UNI	33.534***	(10.027)	35.434**	(14.976)	34.687***	(12.613)
University degree	2.967	(9.799)	2.085	(13.077)	0.641	(13.400)
Native parents	45.989***	(9.423)	52.355***	(11.440)	51.328***	(9.211)
One bookcases	11.487	(8.731)	11.843	(9.084)	12.169*	(7.249)
Two bookcases	-0.423	(10.389)	3.482	(13.610)	6.788	(8.530)
Home possess H	60.950***	(9.901)	59.683***	(11.617)	57.952***	(10.005)
Home possess M	38.920***	(10.570)	42.815***	(10.168)	42.844***	(8.605)
Boy Student	-11.589	(8.082)	-9.281	(8.440)	-9.140	(7.861)
TL spoken ALs	-19.376***	(6.944)	-20.933**	(8.180)	-21.524***	(6.558)
PC at H&SCL	-35.163***	(8.945)	-26.648**	(10.544)	-22.885*	(13.459)
PC at H/SCL	-25.986***	(6.692)	-23.612***	(7.549)	-24.750**	(12.112)
Male teacher	-1.468	(9.925)	1.723	(11.849)	5.781	(8.685)
T. Experience	1.250**	(0.627)	1.109	(0.756)	0.880**	(0.402)
T. Certificate	13.436	(9.907)	6.762	(13.134)	4.158	(10.316)
M SCL RCS	-5.995	(10.090)	-5.935	(11.293)	-4.602	(7.709)
L SCL RSC	-15.226	(23.502)	-20.408	(19.291)	-23.853	(20.405)
T. UNI Degree/pg	-10.262	(34.588)	1.009	(22.969)	-1.168	(23.011)
COMMU.>50000	13.942	(9.484)	9.604	(11.506)	7.068	(6.876)
Pov 50% Disadv	-10.443	(10.676)	-8.960	(12.679)	-8.560	(8.359)
Class size	-1.004	(2.772)	-0.892	(3.836)	-0.158	(2.938)
Class size Sq	0.007	(0.040)	0.007	(0.050)	-0.005	(0.040)
Constant	307.041***	(58.421)	347.608***	(74.460)	403.368***	(59.858)

- All teacher PG merged with university degree for QR

Table A-4: Quantile Regression Estimates for Syria

DV: Maths test score	.25	s.e	.50	s.e	.75	s.e
Lower-sec EDC	0.534	(12.692)	1.043	(11.769)	-1.553	(11.348)
Upper-sec	-2.365	(13.258)	-7.275	(11.828)	-9.211	(8.144)
Post-sec not UNI	15.404	(13.006)	18.147	(14.579)	18.103*	(10.497)
University degree	21.917	(13.447)	20.686	(13.242)	23.127**	(11.676)
Native parents	21.251**	(9.548)	20.183**	(8.589)	19.766	(13.404)
One bookcases	6.497	(6.259)	7.354	(7.359)	6.423	(7.911)
Two bookcases	-1.501	(7.082)	1.787	(9.924)	8.537	(13.094)
Home possess H	39.268***	(12.173)	44.052***	(9.143)	41.066***	(13.219)
Home possess M	28.146***	(10.295)	29.942**	(12.184)	29.724**	(12.190)
Boy Student	17.091	(10.882)	20.590***	(7.175)	20.574**	(8.730)
TL spoken ALs	3.270	(8.940)	2.268	(6.457)	3.312	(9.206)
PC at H&SCL	-9.210	(9.223)	-15.594**	(7.201)	-14.883**	(7.529)
PC at H/SCL	-12.232	(8.762)	-15.023**	(7.546)	-11.887	(8.598)
Male teacher	-1.446	(10.480)	2.696	(8.004)	3.206	(10.695)
T. Experience	0.511	(0.614)	0.445	(0.537)	0.271	(0.679)
T. Certificate	-14.116	(11.262)	-9.847	(10.857)	-4.055	(13.848)
M SCL RCS	7.616	(23.437)	6.438	(13.897)	16.022	(16.544)
L SCL RSC	16.449	(37.976)	13.514	(21.130)	16.145	(25.098)
T. UNI Degree/pg	12.570	(10.856)	11.047	(8.347)	8.308	(10.742)
COMMU.>50000	3.666	(9.176)	-3.917	(10.684)	-14.516	(10.704)
Pov. 50% Disadv.	-19.633**	(9.768)	-21.613**	(9.768)	-29.148***	(10.114)
Class size	-1.953	(3.068)	-2.551	(2.459)	-3.068	(4.565)
Class size Sq	0.019	(0.055)	0.027	(0.042)	0.039	(0.079)
Constant	335.835***	(51.963)	401.073***	(47.209)	453.854***	(75.069)

- All teacher PG merged with university degree for QR

Table A-5: Quantile Regression Estimates for Iran

Iran	.25	s.e	.50	s.e	.75	s.e
Lower-sec EDC	-0.542	(5.808)	5.178	(5.642)	6.260	(7.392)
Upper-sec	8.346	(8.043)	16.169**	(7.799)	19.095*	(9.845)
Post-sec not UNI	10.095	(11.856)	17.748*	(10.588)	25.299**	(11.405)
University degree	28.169*	(15.938)	37.863***	(12.318)	46.421***	(12.996)
Native parents	25.494***	(8.755)	17.944	(13.780)	19.161	(15.640)
One bookcases	21.518***	(7.413)	22.684***	(5.122)	21.629***	(8.282)
Two bookcases	10.123	(9.765)	15.428**	(6.663)	9.362	(10.749)
Home possess H	17.968*	(10.152)	12.969	(11.162)	12.279	(13.708)
Home possess M	14.677**	(5.999)	9.642	(6.510)	9.905	(7.885)
Boy Student	4.549	(14.112)	5.347	(10.612)	9.981	(16.655)
TL spoken ALs	15.698**	(6.229)	15.398***	(5.550)	9.896	(7.286)
PC at H&SCL	54.151**	(24.610)	74.711***	(22.409)	90.767**	(38.980)
PC at H/SCL	10.557	(10.109)	13.968	(10.275)	19.242**	(8.580)
Male teacher	-8.330	(14.373)	-5.092	(10.175)	-7.862	(15.641)
T. Experience	0.362	(0.554)	0.150	(0.372)	-0.141	(0.459)
M SCL RCS	-20.332*	(10.772)	-16.578**	(7.928)	-16.676	(15.522)
L SCL RSC	-29.151**	(13.369)	-26.655***	(9.651)	-25.673	(17.733)
T. UNI Degree/pg	2.576	(5.954)	3.085	(5.073)	2.567	(6.876)
COMMU.>50000	15.148*	(8.383)	16.237**	(6.535)	19.734**	(8.750)
Pov 50% Disadv	-11.796*	(6.128)	-11.011	(7.895)	-10.727	(7.661)
Class size	-0.321	(2.234)	-0.333	(2.331)	-0.324	(1.790)
Class size Sq	0.020	(0.045)	0.012	(0.043)	0.009	(0.039)
Constant	307.385***	(27.777)	362.100***	(30.322)	411.786***	(34.821)

- No teaching certificate variable available for Iran. All teacher PG merged with university degree for QR

Table A-6: Quantile Regression Estimates for Tunisia

DV: Maths test score	.25	s.e	.50	s.e	.75	s.e
Lower-sec EDC	-8.770	(7.736)	-7.827	(5.553)	-14.683**	(6.562)
Upper-sec	-6.828	(6.681)	-5.901	(6.260)	-11.720	(7.725)
Post-sec not UNI	2.507	(10.924)	3.881	(9.531)	-1.083	(7.787)
University degree	7.903	(9.979)	11.284*	(5.947)	10.093	(7.859)
Native parents	25.374***	(8.830)	21.701**	(10.655)	20.963***	(7.961)
One bookcases	13.620**	(6.016)	17.023***	(5.162)	22.755***	(4.621)
Two bookcases	28.728***	(8.272)	37.604***	(7.538)	40.659***	(8.708)
Home possess H	29.803***	(8.205)	36.436***	(7.952)	41.655***	(10.393)
Home possess M	11.814	(8.205)	16.647***	(6.020)	20.447***	(7.655)
Boy Student	23.946***	(4.714)	23.671***	(4.367)	22.341***	(3.710)
TL spoken ALs	-13.951	(9.049)	-13.263**	(5.913)	-14.065**	(5.563)
PC at H&SCL	-29.903***	(10.389)	-33.398**	(13.493)	-37.309*	(19.423)
PC at H/SCL	-9.075	(5.887)	-11.666*	(6.172)	-12.456**	(5.094)
Male teacher	-5.055	(4.578)	-3.739	(5.618)	-5.344	(4.628)
T. Experience	0.491	(0.408)	0.461	(0.399)	0.329	(0.349)
T. Certificate	2.985	(9.218)	1.114	(9.739)	-0.629	(7.048)
M SCL RCS	-1.265	(6.400)	-0.891	(12.976)	-0.338	(9.470)
L SCL RSC	-5.744	(10.296)	-1.540	(13.205)	-0.594	(9.573)
T. UNI Degree/pg	-3.442	(10.322)	-0.860	(13.503)	-6.896	(10.121)
COMMU.>50000	0.510	(6.005)	-0.883	(5.572)	0.148	(5.105)
Pov 50% Disadv	-10.261	(6.523)	-8.209	(6.922)	-5.009	(5.272)
Class size	-4.810	(3.228)	-4.465***	(1.621)	-3.933*	(2.143)
Class size Sq	0.114*	(0.059)	0.107***	(0.037)	0.095***	(0.037)
Constant	377.375***	(54.233)	407.388***	(32.604)	451.905***	(41.376)

- All teacher PG merged with university degree for QR

Table A-7: Quantile Regression Estimates for Jordan

DV: Maths test score	.25	s.e	.50	s.e	.75	s.e
Lower-sec EDC	-7.205	(19.891)	-4.306	(19.318)	2.910	(23.469)
Upper-sec	11.935	(11.697)	11.022	(12.969)	12.019	(16.548)
Post-sec not UNI	43.125**	(17.587)	46.593***	(13.519)	41.512**	(20.075)
University degree	33.046**	(14.499)	35.323**	(14.401)	39.924**	(18.909)
Native parents	-0.793	(7.531)	-4.472	(9.004)	-11.255*	(6.366)
One bookcases	15.397	(10.937)	17.190	(10.626)	17.792***	(6.195)
Two bookcases	22.888	(14.482)	23.689**	(9.861)	21.017***	(7.681)
Home possess H	59.939***	(14.845)	65.609***	(15.913)	61.080***	(17.402)
Home possess M	48.655***	(13.824)	52.980***	(13.358)	56.609***	(17.596)
Boy Student	-16.285	(31.077)	-15.221	(36.095)	-14.538	(17.680)
TL spoken ALs	-11.790	(10.173)	-9.784	(8.132)	-11.720	(7.903)
PC at H&SCL	-0.383	(15.860)	-1.688	(11.288)	-3.600	(19.635)
PC at H/SCL	-29.034**	(14.409)	-23.160**	(11.000)	-20.036	(18.757)
Male teacher	-7.074	(32.837)	-1.470	(36.794)	5.204	(19.093)
T. Experience	0.465	(0.820)	0.597	(0.868)	0.652	(0.676)
T. Certificate	-2.089	(12.059)	-1.103	(10.716)	6.020	(12.183)
M SCL RCS	-10.906	(20.610)	-8.795	(11.095)	-9.263	(11.311)
L SCL RSC	-4.990	(29.674)	-0.432	(19.928)	-3.297	(13.521)
T. UNI Degree	15.224	(29.096)	13.648	(22.369)	3.904	(14.963)
COMMU.>50000	16.593	(14.179)	21.256**	(9.468)	25.813**	(10.375)
Pov 50% Disadv	-19.561	(13.383)	-19.357*	(11.270)	-9.456	(11.017)
Class size	-0.710	(4.245)	-1.371	(2.370)	-0.840	(2.862)
Class size Sq	-0.006	(0.054)	-0.002	(0.031)	-0.009	(0.037)
Constant	353.893***	(95.756)	422.251***	(50.514)	472.493***	(60.542)

- All teacher PG merged with university degree for QR

Table A-8: Quantile Regression Estimates for Turkey

DV: Maths test score	.25	s.e	.50	s.e	.75	s.e
Lower-sec EDC	3.837	(12.674)	8.749	(7.934)	13.433	(11.676)
Upper-sec	26.639*	(14.061)	34.699***	(10.617)	37.741**	(15.185)
Post-sec not UNI	38.910*	(21.543)	51.630**	(25.729)	60.593***	(18.763)
University degree	86.225***	(19.898)	104.110***	(13.679)	104.445***	(15.142)
Native parents	31.970***	(12.216)	43.365***	(14.606)	45.630**	(21.469)
One bookcases	27.837***	(7.465)	25.632***	(7.808)	25.174**	(11.711)
Two bookcases	22.506**	(9.905)	29.453***	(10.659)	31.612***	(10.598)
Home possess H	34.148***	(12.581)	34.843**	(14.143)	21.537	(28.577)
Home possess M	21.483*	(10.995)	24.953**	(10.915)	14.802	(24.770)
Boy Student	6.991	(6.270)	7.603	(6.434)	10.141*	(6.002)
TL spoken ALs	28.518***	(6.942)	30.022***	(8.178)	32.731***	(7.809)
PC at H&SCL	25.929**	(11.145)	29.470**	(11.869)	35.641***	(11.571)
PC at H/SCL	10.024	(10.995)	11.123	(10.146)	13.711	(12.319)
Male teacher	12.182	(9.737)	13.453	(9.982)	6.783	(12.640)
T. Experience	0.668	(1.232)	0.798	(1.114)	0.694	(1.136)
M SCL RCS	-40.726***	(14.639)	-28.674**	(12.426)	-12.878	(14.724)
L SCL RSC	-52.426***	(15.456)	-34.109**	(13.705)	-18.508	(19.348)
T. UNI Degree	8.195	(27.882)	11.546	(20.750)	3.926	(22.950)
COMMU.>50000	12.866	(10.647)	11.465	(10.700)	20.607*	(11.372)
Pov 50% Disadv	-26.298**	(11.485)	-30.549***	(11.714)	-36.133***	(13.957)
Class size	0.254	(1.650)	0.637	(1.956)	0.272	(2.264)
Class size Sq	-0.008	(0.022)	-0.014	(0.024)	-0.008	(0.030)
Constant	287.667***	(53.572)	305.785***	(56.636)	365.433***	(68.029)

- All teacher PG merged with university degree for QR

Table A-9: Models power of explanation

Country	Average R-square	
	Full model	School Fixed Effects (SFE)
Saudi Arabia	.1849	.2881
Algeria	.0471	.1478
Egypt	.2458	.3913
Syria	.1534	.4180
Iran	.2798	.4428
Tunisia	.2370	.3086
Jordan	.2344	.4275
Turkey	.3204	.4552

Table A-10: School fixed effects estimates for MENA

DV: Maths test scores	KSA	se	ALG	se	EGY	se	SYR	se	IRN	se	TUN	se	JOR	se	TUR	se
Lower-sec EDC	-1.482	(4.846)	-7.115***	(2.708)	4.629	(5.449)	3.052	(4.394)	2.246	(4.361)	-13.422***	(4.265)	-9.264	(7.963)	6.911	(4.598)
Upper-sec	-2.030	(4.248)	1.954	(2.743)	16.267***	(6.229)	-4.307	(4.502)	10.281**	(4.702)	-10.788***	(4.187)	3.576	(5.903)	20.502***	(5.842)
Post-sec not UNI	11.723	(9.185)	2.327	(3.407)	23.815***	(6.655)	15.360***	(4.665)	7.091	(7.289)	-3.626	(4.637)	25.353***	(5.949)	21.997**	(9.160)
University degree	14.115**	(5.980)	-2.907	(3.376)	-6.219	(6.504)	16.881***	(5.272)	13.073*	(6.764)	2.631	(5.279)	23.174***	(6.471)	55.928***	(8.037)
Native parents	-10.651**	(4.353)	-	-	45.717***	(3.943)	16.153***	(4.328)	15.746	(9.924)	22.210***	(5.342)	0.000	(3.389)	32.631***	(8.773)
One bookcases	11.681**	(4.990)	11.976***	(2.703)	7.034*	(4.087)	6.080*	(3.113)	15.545***	(3.985)	16.315***	(3.282)	12.066***	(4.595)	18.843***	(3.328)
Two bookcases	5.758	(4.211)	7.023	(4.567)	3.921	(4.136)	3.043	(3.582)	7.170	(5.097)	32.905***	(4.498)	12.163**	(5.118)	23.343***	(5.432)
Home possess H	45.540***	(4.685)	15.949***	(3.965)	40.655***	(4.662)	26.749***	(4.250)	5.623	(6.853)	34.422***	(5.407)	50.797***	(5.978)	17.965**	(7.864)
Home possess M	23.169***	(4.461)	14.344***	(3.519)	32.608***	(4.076)	21.414***	(4.070)	7.260**	(3.680)	17.328***	(4.052)	44.705***	(5.288)	17.383***	(5.806)
Boy Student	27.266	(30.133)	7.134***	(1.734)	1.454	(4.987)	13.700***	(4.341)	24.049**	(11.612)	22.413***	(2.098)	12.721	(10.851)	9.778***	(3.266)
TL spoken AL	-3.148	(3.837)	0.885	(2.060)	-13.976***	(3.734)	-2.309	(3.762)	3.858	(4.343)	-16.986***	(4.331)	-11.479***	(4.410)	28.152***	(4.249)
PC H&SCL	-13.347**	(6.218)	-15.585***	(4.208)	-24.004***	(4.501)	-10.650**	(4.165)	24.215*	(14.482)	-30.723***	(6.543)	-0.766	(6.034)	28.695***	(6.008)
PC H or SCL	-10.362***	(3.917)	-4.033	(2.891)	-19.627***	(3.900)	-8.724**	(3.984)	4.205	(6.405)	-12.418***	(2.662)	-18.735***	(5.908)	12.394***	(4.493)
Male T.											6.264	(14.423)				
T. Experience	0.269	(3.887)									0.964	(1.172)				
T. Certificate											23.822	(21.835)				
M SCL RCS																
L SCL RSC																
T. UNI Degree	-21.716	(25.260)									-45.715	(59.089)				
COMMU.>50 000																
Pov 50% DisAdv																
Class size	-5.012	(31.913)									-7.816	(126.986)				
Class size sq	0.014	(0.455)									0.162	(1.906)				
Constant	454.167	(513.391)	373.854***	(4.638)	332.432***	(19.240)	362.011***	(8.117)	363.076***	(12.633)	473.290	(2,157.811)	382.081***	(12.942)	326.413***	(11.729)

Note: Tunisia sampled two classrooms per school having at least 375 students and Saudi Arabia sampled two classrooms per school having at least 140 students

(Jackknife standard errors), p<0.01, p<0.05, p<0.1 & dummy controls for missing values include