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Equality of opportunity in educational achievement in the Middle East and North Africa

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Abstract This paper is an empirical investigation of inequality of education opportunities in the Middle East and North Africa (MENA). We use student scores from tests administered by the international consortium Trends in Mathematics and Science Study (TIMSS) for a number of MENA countries and over time since 1999 to estimate the effect of circumstances children are born into on their academic achievement in science and mathematics. We find that inequality of opportunities explains a significant part of the inequality in educational achievements in most MENA countries, but there is ample heterogeneity. Family background variables are the most important determinants of inequality in achievement, followed by community characteristics. The results show that, despite great efforts in past decades to invest in free public education, most MENA countries are less opportunity equal in educational achievement than European countries, and several are less so than Latin America and the United States. From the variation in inequality of education opportunities across countries and over time we draw lessons on the influence of different education systems or changes in policy on equality of opportunity.

Keywords Equality of opportunity · Education · Middle East and North Africa

JEL Classifications D63 · I24 · O15 · O53

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1 Introduction

Calls for economic justice figured prominently in the Arab uprisings of 2011, yet income inequality in Arab countries is not particularly high by developing country standards [4, 292], and is considerably lower than in Latin America. Decades ago, following coups and revolutions, several countries of the region implemented large-scale land reforms and funded free public education that laid the foundation for a more equitable society. But, over time, as land and basic education lost their importance in determining economic status, these gains have eroded and other forms of inequality have increased. Inequality of opportunity is one type of inequality that appears to have increased as competition for university education has intensified and private resources have become more influential in determining education success. In this paper we provide evidence on inequality of opportunity in education achievement for 16 countries of the Middle East and North Africa (MENA for short), which indicates disturbing levels of inequality of opportunity.

Understanding the role of inequality of opportunity in inequality of outcomes in the Middle East has acquired greater urgency in light of the social and political tensions that pervade the Arab world. A distinction between good and bad inequality is important in designing policies that reduce inequality of outcomes without sacrificing incentives for effort. Inequality of opportunity has unambiguous social and political appeal because it corresponds to common beliefs about fairness. In a society where economic advantage is largely inherited even low levels of income inequality may cause severe social tensions. In addition, while the impact of equality of outcomes on economic growth is hotly debated, the benefits of a level playing field is less ambiguous because it increases the participation of a wider set of individuals and elicits greater effort from each [21]. A quantitative understanding of the level of inequality of opportunity in education achievement and how it has changed over time is therefore particularly important as Arab societies grapple with issues related to inequality.

To estimate the level of inequality of opportunity (IOP) and its change over time, we use test scores from Trends in Mathematics and Science Study (TIMSS), in which random samples of 8th grade students from MENA countries have participated. We have data for 16 countries in 2007, 10 for 2003, and 4 for 1999. We use the techniques developed in the literature following the seminal work of [24] to measure the share of circumstances that affect a child's learning but are beyond her control, such as the family and the community into which she is born. The circumstances we include are gender, family background (parents' education, computer and the number of books at home), ethnicity (based on language used at home), and community characteristics. Because we only have access to a subset of circumstances available in TIMSS, our estimates of IOP should be regarded as lower bounds. An additional reason why our results should be viewed as lower bounds is inequality of access to the test, which is reflected in the less than universal enrollment rates at the lower secondary level (see Table 1 below). We use parametric measures, developed in [5, 8, 15, 20], which allow inclusion of a larger number of circumstances and are more easily decomposed into subsets of circumstances.

We find high levels of inequality of opportunity in education achievement for several countries, even by standards of Latin America. This may seem surprising in light of the fact that MENA countries provide free public education, some even for the tertiary level, and have high rates of enrollment in basic education. In fact, our highest estimates of IOP are for countries with enrollments rates exceeding 90 % at the primary and lower secondary levels. These developments have produced record rates of increase in average years of schooling in MENA countries [27, 29, 37], but have apparently failed in terms of education quality and equity. Not only do MENA countries perform below the world average in terms

Table 1 Gross enrollment rates, lower secondary school

	Male			Female		
	1999	2003	2007	1999	2003	2007
Algeria	104	106	140	96	100	129
Bahrain	103	102	102	110	105	101
Egypt	88	91	90	80	84	88
Iran	109	109	100	94	97	91
Jordan	92	89	91	93	91	93
Kuwait	102	90	97	102	90	96
Lebanon	87	89	86	95	96	94
Morocco	54	63	81	42	51	68
Oman	89	97	94	85	88	90
Palestine	86	94	96	88	98	99
Qatar	88	102	108	92	104	124
Saudi Arabia		93	105		88	91
Syria	61	81	97	54	74	93
Tunisia	97	99	116	98	99	116
Turkey	86	96	96	64	83	87
UAE	84	85	101	83	83	100

For some countries in some years the nearest available year is chosen

UNESCO education database

of average scores, for several countries TIMSS test scores reveal unfair access to learning opportunities. Egypt, Iran, Lebanon, Qatar, and Turkey exhibit degrees of inequality of opportunity that are higher than similar estimates for Latin America. On the other hand, in several countries, notably Algeria, Kuwait, Morocco, and Syria – inequality of opportunity is considerably lower. We discuss these differences in light of differences in education institutions and public resources devoted to education between these countries.

For most countries in this study family background is the most important determinant of education opportunities, followed by the region of residence. A notable exception is Lebanon where community characteristics account for the largest share of IOP. This finding is in contrast to a recent finding regarding inequality in health opportunities, where community characteristics figure more prominently in several countries [1]. In a few countries for which we have data for more than one year, we are able to learn how inequality of opportunity has been changing. Iran, Lebanon, Saudi Arabia, Tunisia and Turkey show increases in the share of circumstances in total inequality, in Egypt and Jordan the shares declined between 2003 and 2007, and in others it stayed the same.

This paper is organized as follows. The next section introduces TIMSS data and describes their complex methods of rescaling and weighting. Section 3 discusses the methodology for estimating IOP. Section 4 discusses the pattern of average scores in MENA countries and their inequality. Section 5 presents the results of decompositions and tries to interpret the findings in light of inequality of income and public resources for education in the countries under study. Section 7 offers concluding remarks.

2 Data

We use data from three rounds of TIMSS in 1999, 2003 and 2007. TIMSS provides internationally comparable data on students' achievement in mathematics and science at fourth and eighth grade levels. More than 60 nations participated in the 2007 round, 16 of which were MENA countries. In 2003 there were 45 countries of which 10 were from MENA, and in 1999 out of 38 participating countries only 5 were from MENA. The countries participating in the TIMSS 1999 study are Iran, Jordan, Morocco, Tunisia, and Turkey. TIMSS 2003 includes: Bahrain, Egypt, Iran, Jordan, Lebanon, Morocco, Palestinian National Authority, Saudi Arabia, Syria, and Tunisia; and TIMSS 2007 includes Algeria, Bahrain, Dubai, Egypt, Iran, Jordan, Kuwait, Lebanon, Morocco, Oman, Palestinian National Authority, Qatar, Saudi Arabia, Syria, Tunisia, and Turkey.[1]

TIMSS uses a complex assessment design that ensures broad coverage of the cognitive subject matter content even though not all students answer the same set of questions. In particular, in order to test students on what they have been taught in their schools, TIMSS tests is not uniform for all students across schools and countries. Using Item Response Theory (IRT), ex-post scores are scaled and standardized to make them comparable. As a result, the mathematics and science achievement scores generated by the IRT scaling have no inherent metric and are mapped by a linear transformation onto an international achievement scale with an overall mean of 500 and a standard deviation of 100 in 1995 [22, 23]. Placing the results on a common metric allows for comparison of student performance across countries and over time, but creates difficulties for measurement of inequality [16, 17]. TIMSS reports five "plausible values" for test scores in mathematics and science as the relevant measure of educational outcome. These values are highly correlated and produce the same result in decompositions. We perform our decompositions for each plausible value separately and then take the average of the values of the estimates.

TIMSS employs a two-stage sampling design. At the first stage each participating country selects a random sample of schools and at the second stage one or two classes are randomly chosen from each school. All students of the sampled classes are tested in both mathematics and science, resulting in a representative sample of students within each country. Sampled students are roughly equally divided by gender. Working with TIMSS data requires sampling weights, which are provided, and which adjust for the probability of selection of the school and the classroom, as well as for student and school nonresponse. We use these weights throughout the estimations in this paper.

Sample sizes range between 3000-8000 but do not vary by the size of the country. In 1999, Iran, Jordan, and Morocco have about 5000 each while Turkey had over 7800 observations. The range in 2003 is between 2943 in Morocco to 7095 in Egypt; in 2007, the small country of Qatar had the largest sample size (7184) while Morocco had the smallest sample (3060). (For details of sample sizes and all summary statistics reported in this section see [29]). We construct a dataset combining the student standardized test scores in math and science, at the eighth grade, with the student-specific characteristics, information on family background, schooling resources and institutional settings. For estimation purposes, the qualitative survey data were transformed into dummy variables.

[1] Due to difficulties in participation of some schools, the 2007 data for Morocco are incomplete and the results for this year should be taken with caution [23, p. 32].

In addition to the test scores, TIMSS provides information about the students' family, community, and school quality. Family background variables include parents' education, number of books at home, and access to computers and internet and the like. Parents' education is recoded as a categorical variable with three levels: primary or less, secondary and post-secondary, and university. There is wide variation across the countries in parents' education. At the lower end, in 2007, are Iran, Morocco, Oman and Saudi Arabia, where less than 40 percent of mothers and 25 percent of fathers have any secondary education. At the other end are Kuwait, Qatar and Dubai, where about 30 percent of mothers and 35 percent of fathers have completed university education. Parents' education is also high in Jordan, Lebanon and Palestine. We also know if the student or his or her parents were born in the country in which the student resides. We use this variable to distinguish between "natives" and expatriates, which in some countries outperform the local population by a large margin and can bias our equality of opportunity estimates for the local population.[2] For example, in the case of Dubai, where the performance gap between the "native" and expatriate populations is particularly large, when we exclude students whose fathers were not born there, the share of opportunities in total inequality falls from 58 % to 28 %. Evidently, the children in the expatriate community in Dubai perform differently in the tests and much of the difference between their scores and those of the natives is explained by differences in their circumstances, mainly parents' education.[3] Throughout the paper we focus on students whose parents were born in the country ("natives").

TIMSS data include a variable indicating if the test was taken in the language spoken at home. We use this as an indicator of minority status or ethnicity. There are also variables indicating whether the student lives with his or her father and mother or with one stepparent (for TIMSS 1999 only). Finally, TIMSS reports the number of books at the student's home as a categorical variable: 0–10 books, 11–25 books, and more than 25 books. We use it as a proxy for parental taste and how conducive the home environment is for education. Iran, Morocco, Egypt and Saudi Arabia rank poorly according to this measure, while Qatar, Bahrain, Dubai, Kuwait, Jordan and Lebanon fare well.

For community characteristics (where the schools are located) we have community size, which is coded as less than 15000 inhabitants, 15,000–100,000 and more than 100,000. In 1999 the community type was recoded as village or isolated area, outskirts of a city, and close to a city. More than 40 percent of the students in Iran, Saudi Arabia, Turkey and Dubai go to a school in a community with more than 100,000 inhabitants. By contrast, countries such as Kuwait, Lebanon, Oman and Qatar feature a high share (over 40 percent) of schools located in smaller communities.[4]

Schooling resources and class composition have been shown to affect student performance [19, 35]. TIMSS data contain detailed information about school and teacher quality. We use these data at the level of community because at the school level they can be endogenous to student performance. If a child is performing well in school, parents (or the school system) may decide to send her to a better school with better teachers. So, to avoid bias due to endogeneity, we use averages of the school-level variables computed at the sampling

[2]We call them "natives" though the criterion we use may exclude some natives who were born outside the country.

[3]Surprisingly, the drop in the case of Qatar is much smaller – from 31 % to 30 % – perhaps because its expatriate community is smaller and not of the same type as in Dubai.

[4]The community variable for Qatar shows that only about 7 % of the students in the sample lived in a community with more than 500,000 inhabitants, which is surprising since Doha, the capital city, has about 450,000 people and accounts for about a third of Qatar's population.

zone level. These community characteristics may be reasonably assumed to be exogenous to student effort because, unlike in the United States, parents in the Middle East rarely make residential choices across regions based on school quality. Hausman tests for endogeneity support this assumption. The set of circumstances thus includes averages for class size; teacher characteristics such as age, gender, years of experience, and education; an indicator of teacher shortage; and the social and economic background of the student's classmates measured by the percentages of students coming from economically disadvantaged and affluent homes.

A potential selection problem arises for TIMSS data collected in developing countries because the students who take these tests are clearly those who have entered and remained in school until grade 8 [12, 16]. Since students from lower social backgrounds are more likely to drop out of school earlier, the TIMSS sample may be more homogeneous than the population of 13 and 14 year olds, lowering the level of total inequality in achievement. This seems to be less of a problem in the case of the countries in our sample because grade 8 is part of compulsory education and, with the exception of Morocco, lower and upper secondary school enrolment rates are quite high. Table 1 shows gross enrolment rates at the lower secondary level for the countries under study. Based on these numbers we do not expect selection to be a serious issue for the comparison across countries, and much less of a problem for comparison over time. Nevertheless caution is advised in interpreting too finely the differences between countries; in particular, Morocco's status as the second most opportunity equal of the countries we study may be due to selection.

Finally, as with most samples, there are missing observations that need to be treated with caution. The questionnaires reporting on family background are filled by students, who sometimes cannot recall their parent's education correctly, so there are quite a few missing values for these variables. While for the whole set of countries the percentage of missing values for family background variables does not exceed 13 percent in TIMSS 1999 and 7 percent in TIMSS 2003 and 2007, in some countries data on father and mother's education and on community size are missing for more than 25 percent of observations in TIMSS 1999 and 15 percent in TIMSS 2003 and 2007. Besides the reduction in sample size, dropping all students with missing data on these variables – working with the so-called complete case sample– would disregard information available on the other variables for these students, and would likely introduce bias because missing values are not completely random.

Dealing with missing values generated by nonresponse is a well-known problem in survey-based research (see [9, 26], and [11]), more so in the biomedical literature than in economics. We follow the procedure suggested by [25], known as Multiple Imputations Chained Equations (implemented in STATA with the ICE command), in which multiple imputations of missing data are generated as new data sets, stacked, and then used in estimation.[5] This method is built on the so-called "missing at random" assumption, which means that "any systematic difference between the missing values and the observed values can be explained by differences in observed data" [31]. This is a less stringent assumption than complete randomness, which is unlikely to fit the TIMSS data. For example, missing values of parental education are more likley to occur for weaker students, which is non-random and explainable by observed values. Clearly, why an observation has missing values matters

[5]Dardanoni et al. [11] argue that because this method treats observed and imputed data in the same manner it may lead to bias. Their proposed method of combining observed and imputed data, implemented in STATA with the gmi command, yielded similar results to those obtained by ice, but we preferred to stick with the latter because it can handle the use of weights and clusters. This procedure is considered particularly useful for large datasets with complex data structures, such as TIMSS.

for how it is "filled in", and the bias from a particular method may be worse than using the complete case data. The literature does not offer clear guidance on how to judge the size of this bias. Fortunately, while the size of the estimates of IOP change, our main conclusions do not depend on how we treat missing values. In [29], which uses the same data but marks the missing values of independent variables with dummy variables, the estimates of IOP are generally higher than what we report here, by about one-third, but the rankings of the countries according to IOP and how IOP changes over time remains the same.

3 Method of decomposition

Roemer's interpretation of the philosophical and ethical theory of equality of opportunity has fostered an empirical literature on measuring the extent of equality of opportunity that has rapidly expanded in recent years (see, for example, [5, 8, 15, 20]). Roemer argued that opportunities for advancement are equal if outcomes ("advantages") that people seek are distributed independently of factors that lie beyond their control ("circumstances"). This condition can be written in terms of the distribution of outcomes as:

$$f(y|C) = f(y), \tag{1}$$

where y is the outcome of interest and C represents circumstances beyond individual control. Once the elements of C are agreed upon, the determination of inequality of opportunity is a matter of statistical strategy. The goal of the various empirical approaches to measurement of inequality of opportunity is to decompose the inequality of outcomes into inequality due to observed circumstances and inequality resulting from other factors – individual effort, choices, talent, and luck – which for convenience we call effort.

What particular variables are considered as circumstances depends on the purpose at hand. From a philosophical or moral point of view, it is often a question of whether the responsibility for adverse outcomes lie with the individual or society. Only that part of inequality of outcomes for which responsibility is assigned to society calls for social action. From this perspective, inequality due to differences in innate ability is not a compelling reason for egalitarian social action even though it is clearly beyond individual control because society may not wish to take responsibility for the resulting inequality. Many may also consider inequality due to luck, which is neither a circumstance nor something for which individuals can be held responsible for, outside the purview of egalitarian social policy [20]. But from an empirical and practical point of view the choice of what to include in C is more straightforward because the set is limited by availability of data or method of estimation. Non-parametric methods often limit the number of elements that can be included in C to an even smaller set than what data make available because they partition the data into cells whose number quickly grows with the addition of circumstances reducing the number of observations in each cell below what is needed for precise estimation. Parametric methods are regression-based and can easily incorporate more circumstances into the analysis.

Non-parametric methods divide individuals into homogenous groups based on either their circumstances or effort [15]. The grouping based on circumstances, sometimes called the ex-ante approach, first divides the population into "types", which are groups with the same circumstances, and then compares the level of inequality of outcomes (income or education) between and within these groups. The distribution of outcomes within each type is referred to as the opportunity set open to individuals of that type. Differences in opportunity sets offer an intuitive interpretation of inequality of opportunity. The grouping based on effort, known as the ex-post approach, collects individuals with different circumstances

but with the same level of effort into "tranches", and then measures the level of inequality between them, attributed to circumstances, as inequality of opportunity. This method begins with "types" first and then defines effort by the position of the individuals in the distribution of outcomes within each type. The tranche method, developed in [7] and [8], is closer in spirit and construction to Roemer's original formulation as its starting point is to identify individuals by their effort before looking at how their outcomes differ based on circumstances. Its drawback is that it demands much larger data sets in order to be able to characterize the distributions within each cell accurately. The two non-parametric methods do not necessarily yield the same result, but in our experiments (see [29]) we get the same general picture using either method.

In this paper we rely on the parametric approach to measure inequality of opportunity. This approach usually starts with a linear functional form to describe the relationship between outcomes and circumstances, which is estimated with micro data ([5] and [10]). A typical formulation is:

$$y_i = C_i\beta + \epsilon_i, \tag{2}$$

where C includes the circumstance variables as well as the constant, and ϵ_i represents all other factors that affect the score but are not observed. The latter include student effort and luck, which are assumed to be randomly distributed given the circumstances in C. We include in C individual characteristics such as gender and ethnicity (as indicated by how often the language of the test is used at home); family background information such as parental education, the presence of books, computer and internet at home; and the size of the community and its characteristics, such as the quality of its schools. As noted earlier, to avoid endogeneity, we use averages of teacher and other school characteristics in the sampling zone defined by TIMSS. In 2007 there were 75 zones with 20–350 students in each, depending on the country and sample size.

Equation 2 can be interpreted as the reduced form equation from a more complicated model in which circumstances also affect outcomes indirectly through effort [5]. Effort is in principle endogenous and responds to how it is rewarded, which may be a function of family background and other circumstances. An obvious way to measure the share of inequality of opportunity is to compare the inequality in y_i, denoted by $I(y_i)$, with the inequality in a synthetic distribution of y_i obtained by equalizing the individual outcomes within each type – that is, assume away inequality due to effort and luck. This is the *smoothed* distribution, which is obtained by using the predicted values of outcomes based on circumstances in Eq. 2 while ignoring the remaining variation in the residuals:

$$\tilde{z}_i = C_i\hat{\beta}. \tag{3}$$

Inequality in $\tilde{z}_i$ is naturally lower than the total inequality in y_i and can be compared to it using this indicator of inequality of opportunity:

$$\theta_d = \frac{I(\tilde{z}_i)}{I(y_i)}, \tag{4}$$

The subscript d denotes that inequality of opportunity is estimated directly by eliminating the contribution of effort and luck to outcomes.

The parametric decomposition can also be done with the help of a *standardized* synthetic distribution in which the observed circumstances are set to be equal so that the remaining variation in outcomes is due to effort and luck or to unobserved circumstances. To do so we predict the scores using the mean values of circumstances and then add the residuals from the estimated (2):

$$\tilde{y}_i = \bar{C}\hat{\beta} + \hat{\epsilon}_i, \tag{5}$$

where $\bar{C}$ is a set of fixed values of circumstances representing, say, a female whose parents have the mean value for education and who lives in an urban area, and $\hat{\epsilon}_i = y_i - C_i\hat{\beta}$ are the residuals from the above regression. The variation in $\tilde{y}_i$ can be interpreted as the influence of effort and luck because circumstances are set to be equal for all individuals. In this case the measure of inequality of opportunity is:

$$\theta_r = 1 - \frac{I(\tilde{y}_i)}{I(y_i)}, \tag{6}$$

where the subscript r denotes that IOP is measured as a residual.

In choosing the appropriate index $I(.)$ for estimating θ there are a few important restrictions. According to [15], the General Entropy (GE) class yield estimates with desirable properties. In the case of TIMSS scores, because of the way they are standardized, a further restriction applies: only GE(2), which is more sensitive to inequality at the top end of the distribution, is appropriate.[6] Unfortunately, GE(2) is not path independent, in the sense that estimates of θ arrived at from the direct and the residual methods do not always produce the same estimates of inequality of opportunity. In our case, θ_r and θ_d turn out to be quite similar, so to preserve space we report the results for the residual method only. In addition, because of the presence of a number of dummy variables in the regression, the direct method produces distributions that are less smooth and therefore yield less reliable inequality measures.

4 Average test scores and their inequality

Reporting on results for three rounds of TIMSS tests and as many as 16 countries for math and science can take a lot of space. To make the presentation manageable, in this paper we focus on a comparative perspective of the test scores and their decompositions and leave the details on summary statistics and the regression results to a companion paper, [29].

Table 2 compares the mean scores across the countries by gender in 1999, 2003, and 2007. There is a wide variation in the performance of 8th graders across the region. Students from Bahrain, Jordan, Lebanon, Tunisia and Turkey did consistently better than the rest, while those from the richest country in the region (and the world), Qatar, did the worst. but for the most part MENA countries fall below global average achievement (for standard deviations of these means see [29]). In 2007, average scores in none of the 16 MENA countries reached the Intermediate International Benchmark of 475, and 5 were even below the Low International Benchmark of 400.[7]

A noteworthy pattern in Table 2 is the gender gap, in both math and science, in favor of girls in oil-rich countries. In Algeria, Egypt, Iran, Lebanon, Morocco, and Turkey, the distribution of scores for boys and girls are basically the same. In Syria and Tunisia boys do better, while in the oil-rich nations of the Persian Gulf, and in Jordan and Palestine girls do significantly better than boys. The gap in math scores in favor of girls in Bahrain, Dubai, Oman, Qatar, and Saudi Arabia, all of whom enjoy large rent incomes from oil

[6] In a more recent paper, [16] recommend simply using the R^2 from the regression (2) instead of GE(2).

[7] The TIMSS benchmarks describe four levels of student achievement in each subject based on the kinds of skills and knowledge students would need to successfully answer the mathematics and science questions. For example, reaching the Intermediate Benchmark for 8th graders in science means that the student "can recognize and communicate basic scientific knowledge across a range of topics [23].

Table 2 TIMSS mean scores over time, 8th grade

	Boys			Girls		
	1999	2003	2007	1999	2003	2007
Mathemathics						
Algeria			389.4			384.1
Bahrain		385.8	383.3		417.4	415.4
Dubai			395.5			410.6
Egypt		415.8	405.5		415.5	403.8
Iran	432.1	410.1	401.6	408.9	418.6	407.4
Jordan	413.7	409.0	413.2	421.1	438.0	436.4
Kuwait			345.4			364.0
Lebanon		442.0	461.9		435.0	446.3
Morocco	345.8	398.7	389.7	327.9	383.8	378.5
Oman			350.0			402.1
Palestine		392.1	355.7		398.3	388.3
Qatar			279.9			317.3
Saudi Arabia		337.8	317.2		324.6	339.4
Syria		360.9	409.9		354.4	391.1
Tunisia	460.5	424.0	434.4	436.3	399.7	411.8
Turkey	429.5		434.7	427.8		433.0
Science						
Algeria			407.8			408.4
Bahrain		423.9	437.4		452.2	499.5
Dubai			436.5			448.5
Egypt		432.5	411.1		432.4	423.3
Iran	461.2	454.8	454.8	430.8	455.7	465.9
Jordan	431.3	460.8	463.6	451.2	487.8	499.1
Kuwait			395.5			441.1
Lebanon		399.7	425.0		400.3	413.6
Morocco	334.2	407.0	404.4	315.5	397.2	404.9
Oman			396.4			455.3
Palestine		434.7	394.9		445.3	426.6
Qatar			274.1			332.0
Saudi Arabia		393.0	383.0		407.3	423.8
Syria		418.6	464.1		405.4	451.7
Tunisia	442.7	417.4	458.2	417.3	393.4	437.0
Turkey	434.8		454.3	431.7		457.5

Includes only students whose parents are born in the country

and gas, raises interesting questions about incentives to learn for boys who are generally favored in government employment and access to rent income. Evidently, these countries can provide them with the resources in terms of money and parental education but not with the incentive to learn. A similar gap is observed in the rates of enrolment of men and women in universities in these countries.

Several MENA countries that participated in TIMSS for more than one year offer a view of changes in average achievement over time. Iran, Jordan, Morocco, and Tunisia have three rounds of surveys (Iran also participated in 1995), and exhibit different trends. Iranian average scores show a steady decline in boys' math scores and improvement in girls' science scores. In Jordan, boys have improved their scores in science but not in math, whereas girls show improvement in both subjects. Moroccan boys and girls show significant improvement during 1999-2003, but not thereafter. In Tunisia, the performance of boys and girls declined during 1999-2003 but improved in 2007. For the group of countries that participated only in the last two rounds, the results are also mixed. In Egypt, Palestine, and Saudi Arabia nearly all scores declined slightly, the only exception being science scores for girls in Saudi Arabia, while Lebanese and Syrian students improved their performance. Turkey, which participated in 1999 and 2007 only, has seen modest gains across gender and subjects.

The inequality of test scores also varies considerably across MENA countries. In 2007, Algeria and Qatar are at the two extremes of inequality of achievement as represented by the GE(2) for math. Figure 1 plots these values against the Gini index of income inequality, showing a weak positive correlation with inequality of achievement. It is not too surprising that countries will greater inequality of income are more likely to be those with higher inequality of educational achievement. We notice a slightly stronger correlation between income inequality and inequality of opportunity, to which we now turn.

5 Decomposition results

In this section we present estimates of inequality of opportunity (IOP) using the parametric method of decomposition. We use a set of circumstances that are available for all countries and for all three years of TIMSS surveys – gender, ethnic background (as indicated by the

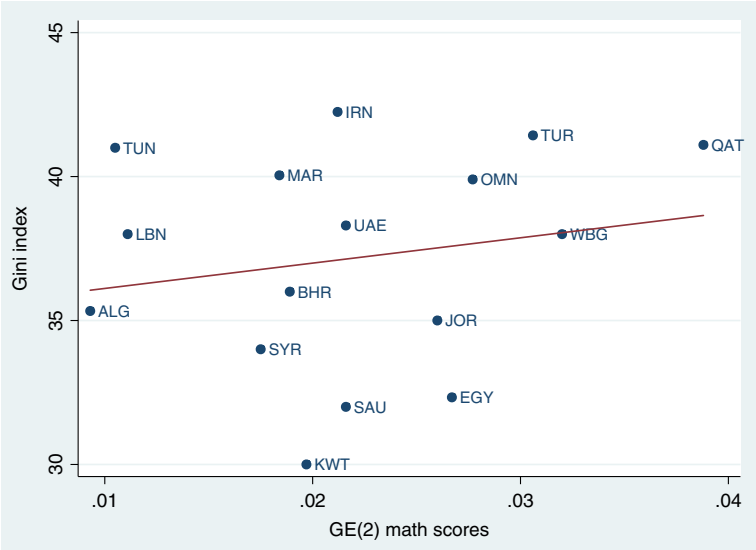

Fig. 1 Inequality of incomes and math scores in 2007. *Source*: GE(2) numbers are authors' calculations, and Gini data are from World Bank World Development Indicators Database and [4]

variable that codes how frequently the language of the test is spoken at home), parental education, the number of books at home, access to a computer and the internet (no information on internet for 1999), and the characteristics of the community. Table 3 offers a summary of these results for all countries in all years. More detailed results showing the total measure of inequality of opportunity as well as the contribution of key individual factors are found

Table 3 Parametric estimates of inequality of opportunity in educational achievement, 1999–2007 (percent)

	1999		2003		2007	
	Math	Science	Math	Science	Math	Science
Algeria					4.6	4.4
					(0.0012)	(0.0012)
Morocco	0.100	0.119	0.064	0.085	0.127	0.094
	(0.00015)	(0.0017)	(0.0101)	(0.0022)	(0.0034)	(0.0024)
Syria			0.130	0.099	0.161	0.156
			(0.0018)	(0.0014)	(0.0023)	(0.0023)
Kuwait					0.164	0.210
					(0.0056)	(0.0030)
Palestine			0.159	0.154	0.183	0.184
			(0.0095)	(0.0096)	(0.0079)	(0.0031)
Bahrain			0.206	0.168	0.192	0.248
			(0.0259)	(0.0106)	(0.0032)	(0.0033)
Jordan	0.188	0.188	0.231	0.220	0.202	0.240
	(0.0027)	(0.0028)	(0.0028)	(0.0029)	(0.0096)	(0.0033)
Tunisia	0.153	0.127	0.177	0.129	0.208	0.159
	(0.0020)	(0.0019)	(0.0022)	(0.0020)	(0.0030)	(0.0029)
Oman					0.209	0.230
					(0.0029)	(0.0029)
S. Arabia			0.107	0.117	0.210	0.233
			(0.0023)	(0.0025)	(0.0031)	(0.0031)
Qatar					0.239	0.387
					(0.0027)	(0.0031)
Dubai					0.251	0.181
					(0.0062)	(0.0059)
Egypt			0.321	0.272	0.282	0.260
			(0.0144)	(0.0019)	(0.0028)	(0.0026)
Iran	0.172	0.176	0.217	0.158	0.297	0.309
	(0.0035)	(0.0020)	(0.0127)	(0.0354)	(0.0128)	(0.0029)
Lebanon			0.257	0.238	0.295	0.351
			(0.0054)	(0.0171)	(0.0184)	(0.0023)
Turkey	0.128	0.115			0.340	0.311
	(0.0025)	(0.0016)			(0.0031)	(0.0031)

Estimates using the residual method. Bootstrapped standard errors in parenthesis

Tables 5–10

in Tables 5–10 in the Appendix. The estimated regressions on which these decompositions are based are available in [29].

The summary results in Table 3 are arranged by the level of IOP estimated from math scores in 2007. There is a fair amount of consistency in the results across years and subject matter as well as a large degree of heterogeneity across countries. All differences between countries and most differences across time are significant based on the bootstrapped standard errors included in the table. The pattern of inequality of opportunity is similar whether viewed from the perspective of math or science scores. Qatar exhibits a significantly larger level of IOP in science than in math scores, as do Bahrain, Lebanon, and Jordan though to lesser extents. Looking at either set of scores, there is a wide range of estimates of IOP across the region. Algeria appears to be by far the most opportunity-equal country in MENA, with only 4.6 % (4.4 %) of its inequality in math (science) achievements due to circumstances, with Morocco a distant second with IOP shares of 12.7 % in math and 9.4 % in science. The 2007 results for Morocco should be treated with caution because of low enrollment rates (see Table 1) that cause selection bias, and because TIMSS reports note some inconsistency in following the standard sampling procedures. We have more difficulty understanding or explaining the very low estimate for Algeria based on the available information. We do not have access to other surveys with which to corroborate the IOP results for Algeria, nor did Algeria participate in TIMSS in any other round. However, the family and community characteristics as recorded by TIMSS are consistent with other sources. For example, the distribution of parental education in the TIMSS sample for Algeria is very similar to that for adults in [3]. Family characteristics also seem consistent with other variables; for example, more educated parents have more books at home. The fact that scores do not seem to depend much on family background (the average scores for the children of university-educated parents are lower than for children whose parents only completed high school), though difficult to explain, does not seem to question the validity of the sample. One possible take from the low IOP of Algeria, given the general perception of its economy, is that low IOP is not necessarily a good thing if it is achieved by suppressing the incentives for high performance, as is likely the case with Algeria which has one of the least competitive economies in the region. At the other extreme are Iran, Lebanon, Qatar, and Turkey with IOP shares around 30 % in math and science, followed by Dubai, Egypt, and Tunisia. The results from the complete case estimates which are more comparable to the available estimates of inequality of education opportunities for other countries are even higher (see [29]).

Next we turn to the partial contributions of two groups of circumstances, family background and community characteristics. Being able to distinguish between these sources of inequality of opportunity is important for formulating policies that reduce it. The parametric approach allows the estimation of the partial effects of individual circumstances on outcomes, by fixing one or a group of circumstances at their mean values in the estimated Eq. 2 while allowing others to vary. Table 4 summarizes these partial effects of family background and community characteristics. We should note that this division is not always clean because family background can influence the place of residence, so the share of family background may be underestimated. With this caveat in mind, we find the variation in the shares of family and community characteristics interesting and in conformity with our priors. For example, in Lebanon, where the society is more segmented along sects and tribes and public education is limited, we find that the contribution of community variables exceeds that of family background (19.7 % compared to 14.4 %). In Morocco, too, community characteristics are more important (in Syria the difference is not significant). For most countries, however, family background variables explain a greater share of the IOP than community

Table 4 The contribution of family background and community characteristics to IOP, mathematics 2007

	Algeria	Bahrain	Palestine	Iran	Jordan	Kuwait	Lebanon	Morocco	Oman	Qatar	S. Arabia	Syria	Tunisia	Turkey	Egypt	Dubai
All circumstances	0.046	0.192	0.183	0.297	0.202	0.164	0.295	0.127	0.209	0.239	0.210	0.161	0.208	0.340	0.282	0.251
Contribution of combined circumstances																
Family Background	0.029	0.123	0.077	0.242	0.113	0.088	0.144	0.061	0.082	0.122	0.127	0.049	0.158	0.287	0.133	0.148
Community variables	0.011	0.062	0.057	0.125	0.047	0.043	0.197	0.053	0.044	0.099	0.042	0.068	0.053	0.136	0.075	0.149

characteristics. In the high IOP countries, such as Iran, Turkey and Tunisia, the share of family background is 2–3 times that of community characteristics. The same is true of countries with moderate IOP's such as Oman and Saudi Arabia.

Gender relations in the MENA region are often described as a source of inequality of opportunity, but the evidence for educational achievement suggests a different view. The enrollment data in Table 1 show gender equality in enrollment, and the TIMSS scores in Table 2 show that, in terms of average math and science scores, girls do at least as well as boys in most countries, especially in 2007, and in several countries they do better. Even in Saudi Arabia, where women have the least amount of rights, in 2007 girls did better than boys in math and science. The IOP results show that in most countries gender no longer plays an important role in equality of opportunity. The share of gender in IOP in 2007 is near zero in the largest countries of the region – Egypt, Iran, and Turkey – though it is relatively high in the oil-rich countries of the Persian Gulf, but there it is mainly because girls score higher than boys. Surprisingly, in Tunisia gender seems an important factor, because girls do worse than boys (see Tables 9 and 10).

The quality of the home environment, captured by the number of books and access to a computer and the internet at home, appear to matter in most countries. The share of the number of books at home is about one quarter of total inequality of opportunity across the region as a whole, but varies between 38 % in Algeria and 4.6 % in Egypt. Other studies have found even greater influence of books at home [18, 35, 36]. Schutz et al. [30] use only the number of books, arguing that they are a stronger predictor of scores than parents' education, but we find that for all MENA countries mother's and father's education explain as much as twice the variation explained by the number of books. The share of computers at home in inequality of opportunities varies from zero in Algeria and Syria to about 20 % in Jordan, Oman, Qatar, and Tunisia.

Turning to the changes in IOP over time, we see no strong pattern. Comparing the results for 1999, 2003, and 2007 in Table 3, we can conclude that there is certainly no trend towards greater equality of opportunity. Only in Egypt do we notice a small decrease in IOP between 2003 and 2007. In four of the five countries that participated in all three TIMSS rounds under consideration, inequality of opportunity has increased. Of this group, only Jordan has managed to stay about the same in terms of the share of circumstances in inequality of scores. In Jordan the share of inequality of opportunity increased from 0.27 to 0.32 between 1999-2003 and then fell to 0.25 in 2007. For several countries we observe large increases in IOP over time, notably Saudi Arabia and Turkey. Turkey, which seemed most opportunity equal in 1999, in 8 years had become the most opportunity unequal in MENA, doubling its share of inequality of scores that is explained by the set of circumstances we include in our decomposition. Iran and Tunisia have also experienced noticeable deterioration in inequality of opportunity. In Tunisia, the increase in IOP occurred along with an increase in the contribution of family background and a decrease in the contribution of community characteristics. In Iran and Turkey, the increase in IOP seems to have occurred as a result of greater influence of both sets of factors. In Saudi Arabia, gender has played a large role in worsening IOP, though not for the usual reason – being a boy was more of a disadvantage in 2007 than it was in 2003!

6 IOP and country characteristics

Does the wide range of estimates of IOP in education achievement presented in the preceding section correspond to any known characteristic of the countries involved? This

is short of asking the more ambitious question of what explains the level of inequality of opportunity in these countries. Answers to the latter question have obvious value in design of policies to combat inequality, but it is beyond the scope of this paper. Below we pursue a more modest aim of graphically exploring the correlates of IOP in MENA countries.

First we ask if in countries with greater inequality of scores a greater share of inequality is attributable to circumstances. Figure 2 suggests that such a relationship may exist, but only weakly. The fitted line from the bivariate regression of IOP on the GE(2) index of math test scores has a positive slope, but it is not significant at 5 % level. MENA countries with higher inequality of achievement in math in 2007, as measured by GE(2), are also more likely to have higher IOP. Algeria has the lowest inequality of achievement and the lowest share of the inequality accounted for by circumstances. At the other extreme is Turkey with both highest inequality and highest inequality of opportunity in math achievement.

Next we look at the correlation between inequality of income and IOP in achievement. We expect countries with greater inequality of income to have higher IOP in achievement and, again, this conjecture is only weakly supported by the data presented in Fig. 3, which plots the estimates of IOP against the Gini index of inequality of income and per capita expenditures. The two countries with the highest levels of income inequality also have the highest values of IOP in math in 2007, but there are also countries with high income inequality that have low IOP (Morocco) as well as those with low income inequality and high IOP (Egypt).

We observe a closer correlation between IOP and country characteristics when we look more closely at the relationship between resources and IOP. Public education can play an important role in leveling the playing field in education. As a measure of resources for public education we use per pupil public expenditures on education as percentage of GDP per capita. The actual values of expenditures on public education does not show any relationship

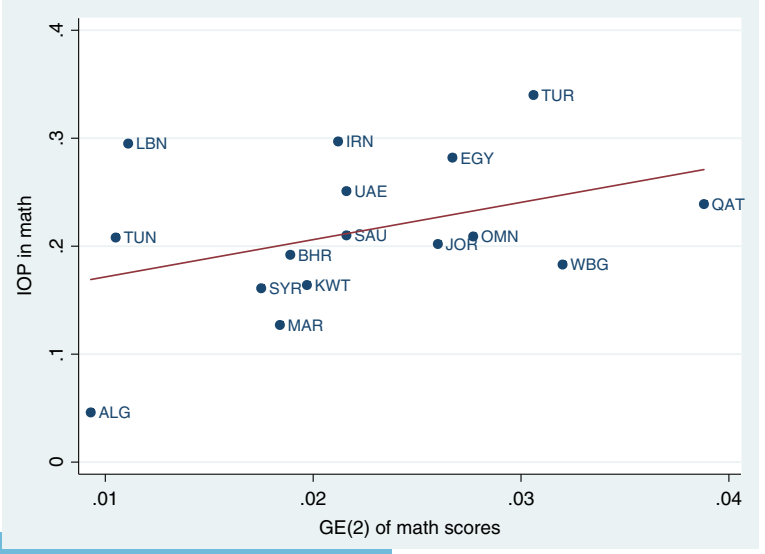

Fig. 2 Inequality of scores and IOP in mathematical achievement in 2007. *Source*: Table 4

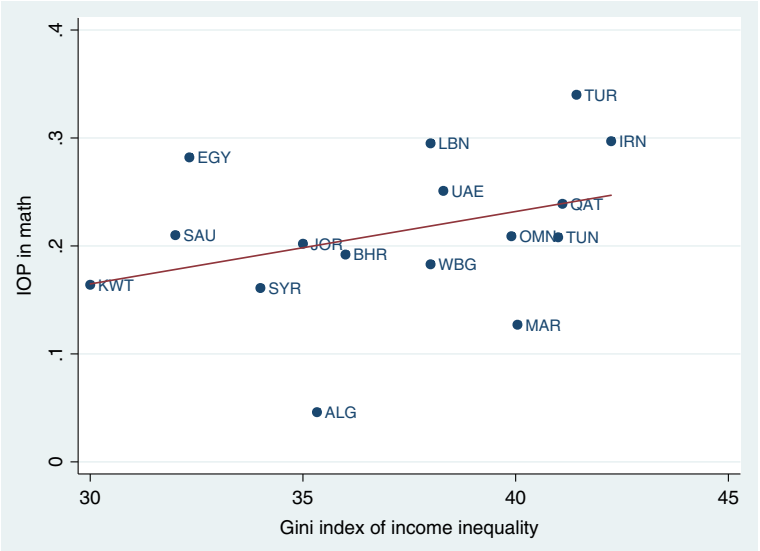

Fig. 3 Inequality of incomes and IOP for math scores in 2007. *Source*: Table 4, [4], and [38]

with IOP but when normalized by GDP per capita it does (see Fig. 4). The level of education expenditures relative to GDP per capita is a better indicator of the relative strength of public vs. private spending on education, and therefore a better candidate as a determinant of equality of opportunity. So, for example, per pupil public expenditures on education in Kuwait and Morocco that are about the same relative to their per capita GDP – 25 % – are expected to have similar impacts on IOP despite the fact that Kuwait is much richer

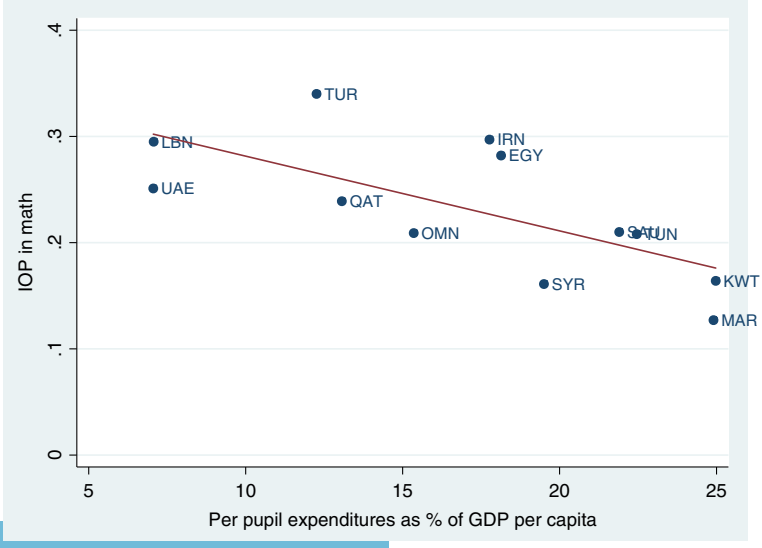

Fig. 4 Public expenditures per pupil and IOP for math scores in 2007. *Source*: Table 4 and [38]

and per pupil spends about 10 times more than Morocco. There is also a close negative association between public expenditures on education and the share of community characteristics in IOP, as seen in Fig. 5 (in both cases the regression coefficients are significant at the 5 % level). In MENA countries whose governments spent more on education per student relative to their GDP per capita equality of opportunity in educational achievement was higher and, more importantly, community characteristics played a less important role in the determination of those opportunities.

Hard information about the institutional features of the education systems in MENA countries is not readily available. Data are not readily available on the proportion of students who attend private schools, the prevalence of private tutoring, and whether or not success – as in getting into a top university – is based on a national test, which encourages heavy investments in privately supplied test preparation. We distributed a questionnaire to about 400 regional experts asking them to rank countries low, medium, and high in various measures related to educational institutions. While the response rate was not high, the answers we received were consistent, allowing us to construct a general picture of the institutional features of the MENA countries, but they were short of producing an index with which we could rank countries based on the degree to which institutions contribute to IOP. We therefore summarize our finding from this exercise.

Several features of the education systems in MENA are potential explanations of high IOP. First is a high share of private education, which allows children from better off families to attend private schools that recruit better teachers, and provide them with the incentives to teach. Second is the importance of private tutoring, which thrives in several countries and turns parental resources into higher achievement in tests. Both of these advantages are available in larger cities, which may explain the high contribution of community characteristics to IOP where public expenditures are low, as seen in Fig. 5. Dubai, Qatar, and Lebanon all have a large proportion of private education and high IOPs. A recent survey conducted by

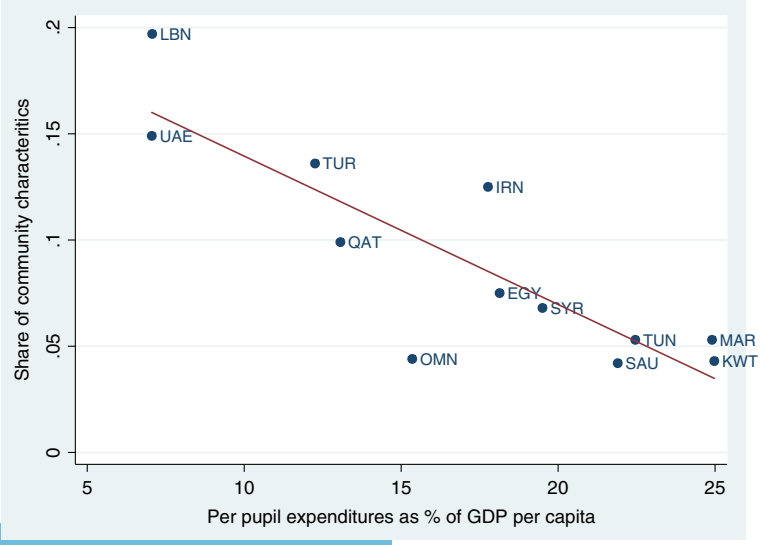

Fig. 5 The share of community characteristics in IOP and education expenditures. *Source*: Table 4 and [38]

the Dubai School of Government found that more than 65 % of Emirati students in grade 12 attend private tutoring lessons [14]. In Egypt, Jordan, Iran, and Turkey, all high IOP countries, the share of private schools is smaller but all have thriving private tutoring sectors that offer test preparation for their competitive national tests [13, 33]. Algeria, with the puzzlingly low IOP, is the country with virtually no private education and limited private tutoring. Syria, with relatively low IOP, was also at the lower end of private schooling spectrum that our experts reported. Finally, with the exception of Lebanon, MENA education systems select students into universities through highly competitive and centrally administered entrance examinations, which can promote inequality of opportunity [32]. In the case of Italy, [6] have argued that the centralized and egalitarian tertiary education system in Italy does not necessarily help children from poorer families, and may actually "take away from them a fundamental tool to prove their talent and to compete with rich children."

7 Conclusion

Education is by no means a comprehensive measure of welfare. Income and consumption track individual welfare more closely, and education usually leads to greater earnings. However, in MENA countries education is more than an intermediate input into income generation; it is often the most important measure of personal achievement and the path to social mobility. Therefore, education outcomes offer a more comprehensive view of the overall level of equality of opportunity in MENA than in other countries.

In the past three decades, nationalist MENA governments have promoted access to schools and expanded enrollments, resulting in the fastest rate of increase in average years of schooling of any region in the world, but average learning in MENA lags behind the rest of the world [27, 34]. Their success in increasing the quantity of education has not been matched by improvements in its quality. TIMSS test scores in math and science for 8th grade students in MENA countries are below the intermediate international benchmarks specified by TIMSS. In the poorer countries low achievement is the result of low spending on education, expecially at the primary level, and in richer countries probably because of lack of incentives. Qatari students, especially their boys, have the lowest average scores in math and science in the region and rank second from below globally.

In this paper we report evidence of failure in another dimension, namely in providing equality of opportunity in achievement. We find that differences in achievement of 8th grade students have a lot to do with circumstances beyond their control–who their parents are and where they grow up. Our estimates of the share of inequality in achievement due to family background and community characteristics are high by global standards. Since we are only able to account for a subset of these circumstances our estimates are lower bound.

To reach a fairer society, which was a key demand of protesters across the region in recent years, education policies should change. MENA education systems are centralized, merit based, and highly competitive. They receive just praise for allowing children from poor and rich backgrounds to compete in national tests for coveted positions in top public universities without regard to family background. They are considered objective because of their reliance on computerized assessment, but they are far from fair. As we show in this paper, parental resources play a critical role for placing a child in the top ten percent of her 8th grade class, an achievement that is highly correlated with attending university a few years later. Reacting to the low quality of public schools and the limited slots in top

universities, better off parents pay for superior education quality in private schools and for private tutoring at home.

Policies to promote private schools, often under the non-profit banner, have the potential to increase IOP. As [2] write:

> It should now be clear why private schools do not do better at educating the average child: their entire point is to prepare the best-performing children for some difficult public exam that is the stepping-stone toward greater things, which requires powering ahead and covering a broad syllabus.

In several countries with high IOP, and a few with increasing IOP, private resources spent on private schools or private tutoring play an increasing role in children's success in entering university. In most of these countries a large proportion of these successful students absorb a large proportion of the public resources for education. In this sense, even public resources are contributing to higher inequality of opportunity.

Governments may not be able to do much in the near future to counterbalance the effect of unequal parental resources, but they can reduce the extent to which a child's success depends on where she grows up. This is an area where public policy is most effective in leveling the playing field. Our estimates show that community characteristics play a large role in IOP in many countries of the region and that their share in IOP of achievement is correlated with public education expenditures.

There is a temptation to view the low IOP in Algeria, if it is indeed validated by other evidence, in a positive light, but that would be misleading. The Algerian solution is to lower IOP by reducing the ability of the more well off parents to invest in their children's education rather than by giving the poor a greater chance to succeed. There are no private schools and little evidence of private tutoring in Algeria. The Algerian economy is sluggish enough – it has the highest youth unemployment rate in the Arab region [28] – and the average scores of its 8 graders in TIMSS low enough to warrant caution in presenting its education system as a model for others to follow.

Appendix

Table 5 Inequality of opportunity shares for achievements in mathematics, 1999

	Iran	Jordan	Morocco	Tunisia	Turkey
All circumstances	0.172***	0.188***	0.10***	0.153***	0.128***
	(0.0035)	(0.0027)	(0.0015)	(0.0020)	(0.0025)
Partial shares					
Gender	0.0104***	−0.0164	0.0089***	0.037***	−0.00223
	(0.0098)	(0.0042)	(0.0006)	(0.0011)	(0.0061)
Mother's Education	0.028***	0.034***	0.0089***	0.0225***	0.0266***
	(0.0093)	(0.0020)	(0.0008)	(0.0013)	(0.0057)

Table 5 (continued)

	Iran	Jordan	Morocco	Tunisia	Turkey
Father's Education	0.0324***	0.0396***	0.0171***	0.0271***	0.0393***
	(0.0093)	(0.0020)	(0.0010)	(0.0014)	(0.0055)
Number of books at home	0.0511***	0.0391***	0.010***	0.0293***	0.0334***
	(0.0108)	(0.0016)	(0.0006)	(0.0011)	(0.0067)
School's community location	0.0471***	0.00874***	0.0086***	0.0243***	0.0065
	(0.0119)	(0.0010)	(0.0005)	(0.0010)	(0.0067)
Computer at home	−0.00236	−0.00029	−3.4E-05	0.0012	0.006
	(0.0090)	(0.0005)	(0.0002)	(0.0008)	(0.0058)
Total Family Background	0.128***	0.162***	0.089***	0.11***	0.101***
	(0.0021)	(0.0035)	(0.0013)	(0.0019)	(0.0014)
Total Community	0.041***	0.0369***	0.0152***	0.0636***	0.0452***
	(0.0025)	(0.0019)	(0.0008)	(0.0015)	(0.0012)

Table 6 Inequality of opportunity shares for achievements in science, 1999

	Iran	Jordan	Morocco	Tunisia	Turkey
All circumstances	0.176***	0.188***	0.119***	0.127***	0.115***
	(0.0020)	(0.0028)	(0.0017)	(0.0019)	(0.0016)
Partial circumstances shares of IOP	0.0125***	−0.012	0.0196***	0.0371***	−0.0015
Gender	(0.0013)	(0.0035)	(0.0011)	(0.0012)	(0.0002)
Mother's Education	0.035***	0.0283***	0.01134***	0.0162***	0.0273***
	−0.001686	−0.002108	(0.0008)	(0.0012)	(0.0011)
Father's Education	0.0316***	0.0389***	0.0148***	0.02***	0.04***
	−0.00166	−0.001988	(0.0011)	(0.0012)	(0.0012)
Number of books at home	0.043***	0.048***	0.0176***	0.013***	0.024***
	(0.0013)	(0.0017)	(0.0009)	(0.0009)	(0.0008)
School's community location	0.0293***	0.0112***	0.0075***	0.031***	0.005***
	(0.0011)	(0.0009)	(0.0007)	(0.0011)	(0.0005)
Computer at home	0.003***	0.0003	−0.0000968	−0.0061	0.0023***
	(0.0007)	(0.0005)	(0.0003)	(0.0005)	(0.0005)
Total Family Background share	0.138***	0.164***	0.103***	0.088***	0.096***
	(0.0021)	(0.0034)	(0.0016)	(0.0017)	(0.0014)
Total Community Share	0.0145***	0.038***	0.024***	0.0521***	0.0313***
	(0.0023)	(0.0018)	(0.0011)	(0.0014)	(0.0010)

Table 7 Inequality of opportunity shares for achievements in mathematics, 2003

	Bahrain	Palestine	Iran	Jordan	Lebanon	Morocco	S. Arabia	Syria	Tunisia	Egypt
All circumstances	0.206***	0.159***	0.217***	0.231***	0.257***	0.064***	0.107***	0.130***	0.177***	0.321***
	(0.0259)	(0.0095)	(0.0127)	(0.0028)	(0.0054)	(0.0101)	(0.0023)	(0.0018)	(0.0022)	(0.0144)
Partial circumstances shares of IOP	0.042**	0.001	0.006	0.020***	0.008	0.009	−0.004	0.004***	0.038***	0.000
Gender	(0.0147)	(0.0021)	(0.0046)	(0.0035)	(0.0153)	(0.0195)	(0.0034)	(0.0004)	(0.0011)	(0.0081)
Mother's Education	0.035**	0.051***	0.029***	0.041***	0.068***	0.008	0.034***	0.044***	0.017***	0.143***
	(0.0116)	(0.0051)	(0.0049)	(0.0022)	(0.0151)	(0.0191)	(0.0016)	(0.0014)	(0.0021)	(0.0200)
Father's Education	0.039***	0.056***	0.039***	0.037***	0.04**	0.018	0.039***	0.049***	0.055***	0.170***
	(0.0085)	(0.0058)	(0.0057)	(0.0022)	(0.0151)	(0.0207)	(0.0023)	(0.0013)	(0.0018)	(0.0235)
Number of books at home	0.045**	0.023***	0.068***	0.042***	0.070***	0.003	0.031***	0.019***	0.034***	0.018*
	(0.0137)	(0.0039)	(0.0055)	(0.0015)	(0.0161)	(0.0181)	(0.0014)	(0.0009)	(0.0014)	(0.0092)
School's community location	0.010	0.007***	0.070***	0.001	0.004	0.003	0.013***	0.013***	0.015***	0.039**
	(0.0087)	(0.0017)	(0.0038)	(0.0008)	(0.0156)	(0.0213)	(0.0011)	(0.0007)	(0.0011)	(0.0144)
Computer at home	0.019	0.021***	0.011*	0.038***	0.012	0.000	0.011***	−0.001	0.006***	0.047**
	(0.0116)	(0.0041)	(0.0056)	(0.0016)	(0.0157)	(0.0224)	(0.0013)	(0.0004)	(0.0013)	(0.0146)
Internet at home	0.013	−0.005	0.007	0.001	−0.008	0.000	0.000	0.000	0.000	0.000
	(0.0110)	(0.0016)	(0.0048)	(0.0012)	(0.0153)	(0.0227)	(0.0000)	(0.0000)	(0.0000)	(0.0115)
Total Family Background share	0.119***	0.111***	0.127***	0.121***	0.157***	0.025	0.082***	0.084***	0.090***	0.283***
	(0.0168)	(0.0101)	(0.0084)	(0.0023)	(0.0146)	(0.0219)	(0.0019)	(0.0016)	(0.0019)	(0.0253)
Total Community Share	0.022*	0.038***	0.127***	0.060***	0.150***	0.006	0.019***	0.061***	0.079***	0.038**
	(0.0109)	(0.0047)	(0.0083)	(0.0058)	(0.0180)	(0.0201)	(0.0031)	(0.0013)	(0.0016)	(0.0139)

Table 8 Inequality of opportunity shares for achievements in science, 2003

	Bahrain	Palestine	Iran	Jordan	Lebanon	Morocco	S. Arabia	Syria	Tunisia	Egypt
All circumstances	0.168***	0.154***	0.158***	0.220***	0.238***	0.085***	0.117***	0.099***	0.129***	0.272***
	(0.0106)	(0.0096)	(0.0354)	(0.0029)	(0.0171)	(0.0022)	(0.0025)	(0.0014)	(0.0020)	(0.0019)
Partial circumstances shares of IOP										
Gender	0.036	0.0017	−0.0020912	−0.006866	0.0041	0.0089***	0.015***	0.0009***	0.039***	0.0000651
	(0.0400)	(0.0074)	(0.0363)	(0.0108)	(0.0146)	(0.0008)	(0.0034)	(0.0002)	(0.0011)	(0.0003)
Mother's Education	0.032	0.045***	0.026	0.041***	0.069***	0.002**	0.021***	0.034***	0.001	0.123***
	(0.0337)	(0.0082)	(0.0418)	(0.0074)	(0.0129)	(0.0008)	(0.0014)	(0.0011)	(0.0015)	(0.0037)
Father's Education	0.04	0.052***	0.03448	0.042***	0.046***	0.011***	0.032***	0.041***	0.040***	0.156***
	(0.0345)	(0.0080)	(0.0446)	(0.0076)	(0.0150)	(0.0010)	(0.0017)	(0.0012)	(0.0014)	(0.0032)
Number of books at home	0.03004	0.01486	0.0473	0.041***	0.084***	0.005***	0.027***	0.009***	0.028***	0.002
	(0.0375)	(0.0085)	(0.0559)	(0.0074)	(0.0120)	(0.0007)	(0.0012)	(0.0006)	(0.0011)	(0.0018)
School's community location	0.001	0.005	0.046	−0.001	0.007	0.008***	0.005***	0.014***	0.006***	0.035***
	(0.0356)	(0.0076)	(0.0553)	(0.0091)	(0.0183)	(0.0010)	(0.0007)	(0.0007)	(0.0008)	(0.0017)
Computer at home	0.011	0.025**	−0.007	0.025**	0.020	−0.001	0.009***	−0.004	−0.008	0.038***
	(0.0374)	(0.0087)	(0.0499)	(0.0094)	(0.0179)	(0.0003)	(0.0010)	(0.0003)	(0.0010)	(0.0028)
Internet at home	0.007	0.000	0.000	0.009	−0.006	0.000	0.000	0.000	0.000	0.000
	(0.0375)	(0.0081)	(0.0530)	(0.0087)	(0.0197)	(0.0002)	(0.0001)	(0.0000)	(0.0000)	(0.0001)
Total Family Background share	0.097**	0.091***	0.105*	0.121***	0.169***	0.016***	0.063***	0.064***	0.055***	0.231***
	(0.0334)	(0.0088)	(0.0518)	(0.0116)	(0.0114)	(0.0012)	(0.0017)	(0.0012)	(0.0015)	(0.0020)
Total Community Share	0.010	0.038***	0.091*	0.046***	0.125***	0.034***	−0.018	0.047***	0.050***	0.037***
	(0.0300)	(0.0099)	(0.0558)	(0.0092)	(0.0189)	(0.0016)	(0.0091)	(0.0011)	(0.0013)	(0.0024)

Table 9 Inequality of opportunity shares for achievements in mathematics, 2007

	Algeria	Bahrain	Palestine	Iran	Jordan	Kuwait	Lebanon	Morocco	Oman	Qatar	S. Arabia	Syria	Tunisia	Turkey	Egypt	Dubai
All circumstances	0.046***	0.192***	0.183***	0.297***	0.202***	0.164***	0.295***	0.127***	0.209***	0.239***	0.210***	0.161***	0.208***	0.340***	0.282***	0.251***
	(0.0012)	(0.0033)	(0.0079)	(0.0128)	(0.0096)	(0.0056)	(0.0184)	(0.0034)	(0.0029)	(0.0028)	(0.0031)	(0.0023)	(0.0030)	(0.0031)	(0.0028)	(0.0062)
Partial shares																
Gender	0.0021***	0.0120***	0.033**	0.000	0.015***	0.020	0.010	−0.003	0.074***	0.039***	0.013***	0.0134***	0.026***	−0.002	0.001*	−0.009
	(0.0003)	(0.0030)	(0.0131)	(0.0073)	(0.0030)	(0.0142)	(0.0072)	(0.0041)	(0.0024)	(0.0019)	(0.0043)	(0.0007)	(0.0012)	(0.0003)	(0.0004)	(0.0039)
Mother's Education	0.0068***	0.036***	0.028*	0.057***	0.043***	0.034*	0.060***	0.019***	−0.002	0.039***	0.032***	0.020***	0.041***	0.077***	0.048***	0.054***
	(0.0006)	(0.0021)	(0.0141)	(0.0088)	(0.0047)	(0.0143)	(0.0117)	(0.0045)	(0.0007)	(0.0016)	(0.0026)	(0.0012)	(0.0029)	(0.0038)	(0.0031)	(0.0051)
Father's Education	0.0112***	0.043***	0.033*	0.089***	0.042***	0.029*	0.061***	0.031***	0.007***	0.036***	0.036***	0.027***	0.048***	0.121***	0.068***	0.078***
	(0.0006)	(0.0022)	(0.0141)	(0.0066)	(0.0044)	(0.0151)	(0.0106)	(0.0044)	(0.0011)	(0.0018)	(0.0029)	(0.0012)	(0.0028)	(0.0034)	(0.0028)	(0.0056)
Number of books	0.0108***	0.051***	0.018	0.058***	0.028***	0.011	0.037***	0.012*	0.045***	0.036***	0.044***	0.008***	0.074***	0.096***	0.013***	0.046***
	(0.0006)	(0.0020)	(0.0156)	(0.0075)	(0.0029)	(0.0170)	(0.0104)	(0.0053)	(0.0019)	(0.0014)	(0.0023)	(0.0008)	(0.0026)	(0.0027)	(0.0015)	(0.0036)
Community size	0.0032***	0.000	0.012	0.083***	0.004	0.002	0.043***	0.0126**	0.012***	0.064***	0.012***	0.003***	0.006***	0.034***	0.005***	0.031***
	(0.0004)	(0.0007)	(0.0159)	(0.0063)	(0.0029)	(0.0174)	(0.0092)	(0.0051)	(0.0010)	(0.0023)	(0.0012)	(0.0007)	(0.0012)	(0.0017)	(0.0021)	(0.0044)
Computer at home	−0.001	0.004***	0.027*	0.042***	0.036***	0.027	0.023*	0.018**	0.040***	0.035***	0.012***	−0.001	0.044***	0.021***	0.015***	−0.011
	(0.0002)	(0.0007)	(0.0155)	(0.0091)	(0.0038)	(0.0169)	(0.0109)	(0.0053)	(0.0016)	(0.0014)	(0.0015)	(0.0006)	(0.0024)	(0.0024)	(0.0020)	(0.0028)
Internet at home	0.000	0.01***	0.008	0.028**	0.004	0.011	−0.010	−0.003	0.015***	0.003**	0.036***	0.006***	−0.007	0.026***	−0.003	0.004*
	(0.0001)	(0.0014)	(0.0168)	(0.0094)	(0.0026)	(0.0180)	(0.0082)	(0.0056)	(0.0012)	(0.0011)	(0.0021)	(0.0006)	(0.0018)	(0.0024)	(0.0021)	(0.0023)
Family Background	0.029***	0.123***	0.077***	0.242***	0.113***	0.088***	0.144***	0.061***	0.082***	0.122***	0.127***	0.049***	0.158***	0.287***	0.133***	0.148***
	(0.0010)	(0.0027)	(0.0139)	(0.0122)	(0.0097)	(0.0141)	(0.0156)	(0.0044)	(0.0022)	(0.0021)	(0.0027)	(0.0015)	(0.0029)	(0.0032)	(0.0027)	(0.0055)
Community charac.	0.011***	0.062***	0.057***	0.125***	0.047***	0.043*	0.197***	0.053***	0.044***	0.099***	0.042***	0.068***	0.053***	0.136***	0.075***	0.149***
	(0.0007)	(0.0025)	(0.0154)	(0.0074)	(0.0058)	(0.0187)	(0.0215)	(0.0044)	(0.0057)	(0.0037)	(0.0051)	(0.0016)	(0.0020)	(0.0031)	(0.0023)	(0.0059)

Table 10 Inequality of opportunity shares for achievements in science, 2007

	Algeria	Bahrain	Palestine	Iran	Jordan	Kuwait	Lebanon	Morocco	Oman	Qatar	S. Arabia	Syria	Tunisia	Turkey	Egypt	Dubai
All circumstances	0.044***	0.248***	0.184***	0.309***	0.240***	0.210***	0.351***	0.094***	0.230***	0.387***	0.233***	0.156***	0.159***	0.311***	0.260***	0.181***
	(0.0012)	(0.0032)	(0.0031)	(0.0029)	(0.0033)	(0.0030)	(0.0023)	(0.0024)	(0.0029)	(0.0027)	(0.0031)	(0.0023)	(0.0029)	(0.0031)	(0.0026)	(0.0059)
Partial shares	0.000	0.105***	0.025***	0.000	0.035***	0.075***	0.003***	−0.002	0.094***	0.058***	0.065***	0.006***	0.028***	−0.001	0.003***	−0.005
Gender	(0.0001)	(0.0031)	(0.0014)	(0.0006)	(0.0027)	(0.0027)	(0.0003)	(0.0004)	(0.0030)	(0.0026)	(0.0049)	(0.0006)	(0.0013)	(0.0002)	(0.0005)	(0.0045)
Mother's Education	0.008***	0.031***	0.028***	0.067***	0.054***	0.022***	0.095***	0.005***	−0.003	0.033***	0.021***	0.018***	0.025***	0.059***	0.037***	0.038***
	(0.0006)	(0.0017)	(0.0016)	(0.0048)	(0.0025)	(0.0013)	(0.0026)	(0.0015)	(0.0006)	(0.0018)	(0.0021)	(0.0011)	(0.0021)	(0.0035)	(0.0025)	(0.0040)
Father's Education	0.012***	0.028***	0.031***	0.092***	0.050***	0.020***	0.089***	0.025***	0.008***	0.028***	0.026***	0.016***	0.035***	0.120***	0.054***	0.045***
	(0.0007)	(0.0018)	(0.0017)	(0.0042)	(0.0025)	(0.0014)	(0.0026)	(0.0014)	(0.0012)	(0.0019)	(0.0025)	(0.0009)	(0.0021)	(0.0032)	(0.0027)	(0.0041)
Number of books	0.012***	0.043***	0.026***	0.071***	0.032***	0.027***	0.058***	0.006***	0.043***	0.044***	0.050***	0.014***	0.048***	0.088***	0.014***	0.045***
	(0.0007)	(0.0017)	(0.0014)	(0.0033)	(0.0020)	(0.0014)	(0.0018)	(0.0010)	(0.0019)	(0.0020)	(0.0024)	(0.0009)	(0.0020)	(0.0026)	(0.0014)	(0.0036)
Community size	0.001***	0.000	0.008***	0.072***	−0.002	0.004***	0.050***	0.009***	0.015***	0.101***	0.010***	0.000	0.003***	0.029***	0.009***	0.023***
	(0.0003)	(0.0008)	(0.0008)	(0.0029)	(0.0012)	(0.0009)	(0.0014)	(0.0010)	(0.0011)	(0.0026)	(0.0011)	(0.0005)	(0.0010)	(0.0018)	(0.0018)	(0.0036)
Computer at home	−0.001	0.001**	0.020***	0.040***	0.037***	0.019***	0.033***	0.007***	0.045***	0.017***	0.006***	0.002***	0.006***	0.025***	0.011***	0.000
	(0.0002)	(0.0004)	(0.0014)	(0.0037)	(0.0018)	(0.0012)	(0.0016)	(0.0011)	(0.0017)	(0.0009)	(0.0012)	(0.0005)	(0.0017)	(0.0022)	(0.0017)	(0.0027)
Internet at home	0.000	0.004***	0.012***	0.014**	0.004**	0.002**	−0.020	0.001	0.013***	−0.001	0.028***	−0.001	−0.013	0.018***	−0.004	0.004*
	(0.0001)	(0.0009)	(0.0012)	(0.0040)	(0.0012)	(0.0006)	(0.0015)	(0.0006)	(0.0012)	(0.0016)	(0.0018)	(0.0004)	(0.0012)	(0.0023)	(0.0018)	(0.0020)
Family Background	0.028***	0.090***	0.078***	0.263***	0.146***	0.074***	0.215***	0.040***	0.084***	0.261***	0.104***	0.046***	0.100***	0.271***	0.104***	0.093***
	(0.0009)	(0.0021)	(0.0024)	(0.0032)	(0.0028)	(0.0023)	(0.0022)	(0.0016)	(0.0021)	(0.0028)	(0.0026)	(0.0014)	(0.0025)	(0.0031)	(0.0024)	(0.0047)
Community charac.	0.012***	0.075***	0.060***	0.115***	0.056***	0.066***	0.218***	0.050***	0.054***	0.167***	0.049***	0.055***	0.046***	0.110***	0.066***	0.106***
	(0.0007)	(0.0046)	(0.0029)	(0.0032)	(0.0048)	(0.0036)	(0.0022)	(0.0019)	(0.0059)	(0.0039)	(0.0085)	(0.0016)	(0.0018)	(0.0030)	(0.0020)	(0.0051)

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