# Education policy issues in Turkey

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ABSTRACT

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Since the mid-1990s, public education provision in Turkey has been in constant transformation, a result of modernization efforts connected to the political determination of governments to complete Turkey's accession to the European Union. During this period two nation-wide reforms stand out due to their dramatic impact on children, students, teachers and the education system as a whole. First, the Compulsory Education Law enacted in 1997 required that all the children enrolled in grade 4 or lower must stay in school until the completion of the eighth grade. Second, in 2002, the Ministry of National Education (MONE) abandoned recruiting teachers based on lottery and started to use teachers' test scores instead. Following new legislation, the Center of Measurement, Selection and Placement (ÖSYM) launched a central examination process which is known as the Public Servant Selection Examination (KPSS).

This dissertation provides an econometric evaluation of the impact of these interventions on education outcomes in Turkey. The dissertation seeks to establish a causal link between the enactment of KPSS and student achievement. It presents evidence indicating that teacher recruitment via a meritocratic, test-based assessment instead of a lottery may have a positive impact on student achievement. The research also shows that the increase in the average student achievement displayed by Turkey in international assessments such as PISA (Programme of International Student Assessment) and TIMSS (Trends in International Mathematics and Science Study) may be partially explained by the inception of KPSS.

The identification strategy for this assessment is based on the fact that the TIMMS data includes information on teachers and test scores for each student sampled in Turkey in both1999 and 2007, that is, before and after KPSS was enacted in 2002. This allows the estimation of a difference-in-differences model with student fixed effects. The findings highlight that students whose teachers were recruited after the enactment of KPSS perform 0.2 standard deviations higher than their counterparts whose teachers were recruited before the enactment of KPSS. This finding remains stable in several sensitivity and robustness checks.

The dissertation then turns to analyzing an earlier intervention, the Compulsory Education Law of 1997. The research estimates the impact of the Compulsory Education Law on the years of schooling of women aged between 18 and 29. For this purpose, the dissertation uses the Turkey Demographic Health Survey 2003 and 2008. The identification strategy is based on the fact that, first, cohorts born after 1986 (children enrolled in grade 4 in the1996-1997 school year and later) were subject to the Compulsory Education Law and earlier cohorts were not, and, second, the intensity of the intervention varied between regions. Hence the investigation exploited the between-cohort and between-region variation in intensity of the intervention to estimate the causal impact of the Compulsory Education Law on years of schooling. The findings suggest that the Compulsory Education Law led to a 34 percentage point increase in the probability of completing eight years of schooling and an additional 1.5 years of schooling. Also, the econometric results indicate that the Compulsory Education Law affected high school completion rates, i.e. eleven years of schooling.

The analysis of the impact of the Compulsory Education Law is extended to a two-stage least-squares (TSLS) estimation of the impact of completing eight years of schooling/additional years of schooling on teenage marriage and fertility. The between-cohort and between-region variation

in intensity of the intervention are used to instrument completing eight years of schooling and additional years of schooling. However, in contrast with the existing research on this issue in Turkey, these TSLS estimations did not supply any evidence in favor of the presence of a causal link between completing eight years of schooling/additional years of schooling and teenage marriage and fertility.

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To my lovely wife, Sedef.

# CHAPTER 1. INTRODUCTION

The most up-to-date version of the main official public planning document of Turkey, the Ninth Development Plan: 2007-2013, emphasizes political determination towards establishing a society which is growing in stability, sharing more equitably, globally competitive and in coherence with the principles of the European Union. The document stresses the strengthening of human development as one of the key axes of development and directly connects other major areas of transformation, i.e. competitiveness, employment, social solidarity, regional development and quality and effectiveness of public services, to strengthening human development. Moreover the Ninth Development Plan 2007-2013 considers enhancing the public education system as one of the main domains of strengthening human development (State Planning Organization, 2006). This transformation perspective on policy, which is closely linked to a European Union-centered modernization framework, is also documented in detail in earlier versions of development plans since the mid-1990s (State Planning Organization, 1995), a period which also marks the beginning of the acceleration of the integration initiatives of Turkey with the European economies. Between mid-1990s and mid-2000s this political process generated significant outcomes. In 1996, Turkey became part of the European Customs Union. In 1999 Turkey was granted candidate member status by the EU and official accession talks were launched between Turkey and EU in 2005.

In this period, the governments of Turkey focused on strengthening human development and especially reforming the public education system so as to address the wide educational gap, both in terms of quality and quantity, between the EU countries and Turkey. The World Bank reports that average years of schooling of adults in 1995 was 5.4 years in Turkey, 8.6 years in France

and 9.2 years in Germany.[1] The gap in years of schooling of the adult female population between Turkey and these countries was even more striking (4.3 vs. 8.4 years of schooling). Similarly, according to the Trends in International Mathematics and Science Study (TIMSS) of 1999, mean performance of eighth grade students in Mathematics in Turkey was 0.5 standard deviations below that in Italy, the worst performing country among European participants (Ina V.S. Mullis et al., 2000). Thus, public efforts started to grow in the mid-1990s to improve access to education and to raise the quality of schooling. Ever more public resources were devoted to education provision. As a direct outcome of this effort, the share of the budget of the Ministry of National Education (MONE) in the central government budget increased from 8.02 % in 1997 to 11.2 percent in 2012 and its share in GDP increased from 1.74% in 1997 to 2.75 % in 2012 (Ministry of National Education, 2012b).

Not surprisingly, the MONE undertook many initiatives to reform different aspects of public education in Turkey. Therefore this period offers a number of natural experiments and these experiments constitute fertile ground to be studied with the perspectives and tools of economics of education. Two of these initiatives stand out due to their potentially dramatic impact on children, students, teachers and the education system as a whole. First, the Compulsory Education Law enacted in 1997 required that all the children enrolled in grade 4 or lower must stay in school until the completion of the eighth grade. Extending compulsory years of schooling from five to eight years necessitated a dramatic increase in teacher capacity. In line with the needs of the policy change, the MONE increased the number of primary school teachers by more than 100 thousand between the1996-1997 and 2002-2003 school years. In addition, regions with low enrollment rates prior to 1997 received systematically more teachers per school-age

[1] http://databank.worldbank.org/ddp/home.do?queryId=189

children. Second, the teacher selection regime was changed fundamentally. In 2002, the MONE abandoned the recruitment of teachers based on lottery and started to use a more meritocratic measure, i.e. test scores of teachers. Following the new legislation, the Center of Measurement, Selection and Placement (ÖSYM) launched a central examination process which is known as the Public Servant Selection Examination (KPSS); teacher recruitment was tied to performance in the KPSS.

This dissertation begins with a general discussion of the transformation of the education system of Turkey since the mid-1990s in Chapter 2. The structure of the education system, access and quality issues in pre-primary, primary and secondary education levels are presented with a critical perspective. Chapter 3 provides an evaluation of the impact of the reforms attached to the KPSS on student achievement, using quasi-experimental methods by making use of data obtained from the Turkey samples of the TIMSS 1999 and 2007. Chapter 4 presents an analysis of the effect of the Compulsory Education Law of 1997 on years of schooling in Turkey; then demonstrates the impact of completing eight years of schooling and additional years of schooling on teenage marriage and fertility by making use of an instrumental variable approach using data from the Turkey Demographic and Health Survey (TDHS) 2003 and 2008 data sets. Chapter 5 states the dissertation's conclusions and discusses the policy implications.

# CHAPTER 2. THE EDUCATION SYSTEM IN TURKEY

## I. Organization

Two characteristics of the education system in Turkey stand out. First, private provision of education is very limited. The share of enrollment accounted for private education institutions is 9.4 percent at the pre-primary level, 2.8 percent at the primary level and 3.6 percent at the secondary level (Ministry of National Education, 2012b). By contrast, as of 2010, on average in OECD countries the share of private education institutions in total enrollment is 38 percent at the pre-primary level, 8.9 percent at the primary level and 19.5 percent at the upper secondary level (OECD, 2012b).

Second, the education system is highly centralized. Public schools are run by the MONE which is responsible for all dimensions concerning public education provision. The MONE hires, assigns and pays principals and teachers, maintains school buildings and other educational facilities, and administers programs. Education provision is directly financed via the central government budget; public schools are free of charge at primary and secondary level; however there are private fees ranging between 50 to 200 Turkish Lira (TL) per month for each child at the pre-primary level. As for private education, individuals, corporations, associations or foundations can establish and administer for-profit private schools based at the pre-primary, primary and secondary levels. Private schools are only accessible to those who can afford it. Average regional private school fees vary between 4000 and 16000 TL depending on the educational level and region where the private school locates. Given that GDP per capita in Turkey is around 17300 TL, as of 2011 it could be said that access to private schooling is very

much limited by affordability.[2] On the other hand private education institutions are subject to the same regulations that public institutions have in terms of curricula, teacher qualifications, working schedule, assessment, progression, diploma, etcetera (EACEA, 2011b). Thus, schools in Turkey operate with very limited autonomy and are designed for delivering the curriculum which is just another centrally developed and monitored component of education provision in the country. In this context, the MONE and its provincial and district offices are the sole decision-makers, regulating and monitoring education provision in public schools and in private schools as well. The OECD reports that 61 percent of all decisions in public lower secondary education in Turkey are taken at the central level and 20 percent at the provincial/district level. On average in OECD countries, 36 percent of all decisions in public lower secondary education are taken at the central level and 6 percent at the provincial/district level (OECD, 2012a).

The education system in Turkey is divided into various levels. Pre-primary education is not compulsory and covers children aged between 36 and 72 months. Primary, lower secondary and upper secondary levels constitute compulsory education (grades 1-12). Primary education consists of four years of schooling (grades 1-4) in primary schools. This is followed by lower secondary education with another four years (grades 5-8) of schooling in middle schools. Then upper secondary education is provided in high schools for a period of four years (grades 9-12).

There are different tracks that can be followed within the lower secondary and upper secondary education levels. Program differentiation during lower secondary education starts as early as age 11 (grade 5) in the form of religious middle schools. The curriculum of these schools contains extra courses on varying religious themes in addition to the general academic program followed by lower secondary education institutions. Upper secondary education consists of academic and

[2] Author's calculations from TURKSTAT's website, http://www.tuik.gov.tr/.

vocational/technical schools. Students attending vocational/technical schools can receive a vocational/technical diploma in different fields such as electricity, accounting, health, tourism among other technical areas. As of 2011-2012, 44 percent of students in secondary education attended vocational programs and 56 percent attended academic programs (Ministry of National Education, 2012b). In addition to differentiation of program types, education institutions at the upper secondary level also differ in terms of selectivity. Students aiming to attend selective public academic and vocational high schools have to take a centralized examination and are assigned to selective high schools based on their examination ranking and their preferences. As of 2011, 19 percent of high school students attended selective academic schools and 10 percent attended selective vocational schools (Ministry of National Education, 2012b). At the primary and lower secondary levels student-school matches are based on school location; however at the upper secondary level students are free to choose any type of high school.

The third level of Turkish education corresponds to tertiary education. Education at this level is provided by universities and higher technology institutes. These institutions usually consist of faculties, graduate schools and vocational higher schools. Faculties serve undergraduate education, scholarly research and publications whereas graduate schools give graduate education in the fields of health, natural sciences and social sciences. Vocational higher schools provide vocationally oriented programs which usually take two to four years to complete. These may be considered as post-secondary education programs.

Only a fraction of high school graduates are able to get a seat in tertiary education institutions and as of 2011-2012, the net enrollment rate in tertiary education is 36 percent (Ministry of National Education, 2012b). Admission to tertiary education institutions requires taking a central examination conducted annually by the ÖSYM and the seats are allocated on the basis of the

applicants' ranking in the centralized exam as well as lists of ranked preferred programs submitted by applicants. Thus the transition from high school to university is subject to fierce competition in Turkey and tutoring provided by private test preparation centers is very prevalent (EACEA, 2011a).

It should be noted that the current structure of primary and secondary education is relatively new. On 30 March 2012, in response to Law numbered 6287, compulsory years of schooling were increased from eight to twelve. Thus, high school attendance became mandatory. The Law numbered 6287 also restructured primary and lower secondary education. Between the 1997-1998 and 2010-2011 school years primary education had an integrated organization of primary and lower secondary education and eight years of compulsory primary education which allows direct access to upper secondary education were provided under the same school building; thus there were no middle schools for lower secondary education and eight years of compulsory primary education did not offer any differentiation of program types, i.e. tracking. The Law numbered 6287 established middle schools for lower secondary education and introduced religious middle schools. Lastly, following these policy changes The MONE announced the elimination of centralized examinations for selective academic and vocational high school access starting with the 2013-2014 school year. The Minister also declared that the number of program types at the upper secondary level will be reduced. However the future mechanisms for student-school matching, and the future of selective academic and vocational schools, are still undefined (Ministry of National Education, 2012a).

## II. Curriculum and instructional time

The curricula at the pre-primary and compulsory education levels in Turkey are nationally supervised and under the control of the Board of Education of the MONE. In primary and middle

schools, courses vary by grade and compulsory courses include Turkish, Mathematics, Science and Technology, Social Sciences, History, Foreign Languages, Religion and Ethics, Drawing, Music, Physical Education and Traffic and First-aid Training. Computer education, Drama, Speech and Writing, Tourism and Agriculture and Animal Husbandry are elective courses offered at this level. The Board of Education also has the last say on textbooks. Teachers' preferences do not play any role regarding the selection of those textbooks. Thus instructional styles of teachers differ only within the limitations of textbooks selected by the government (EACEA, 2011a). At the primary and lower secondary education levels annual instructional time is 864 hours, which is slightly higher than the OECD average of 843 hours at the primary level and lower than the OECD average of 924 hours at the lower secondary level (OECD, 2012a).

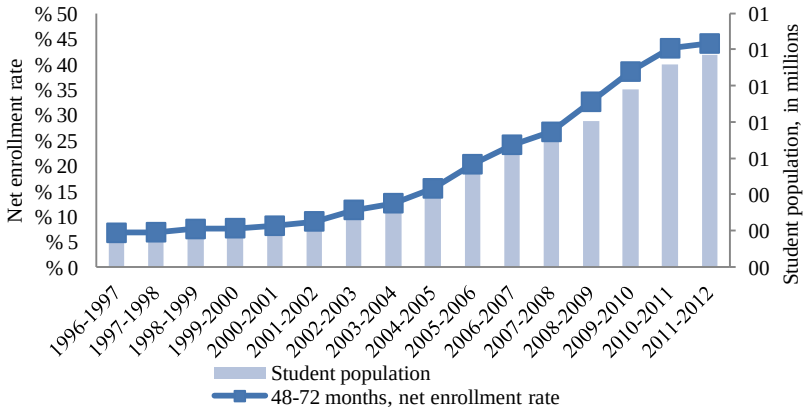
At the upper secondary level, the Board of Education regulates the content of courses and the weekly instructional time by program type. Average weekly instructional time lies between 30 and 45 hours. Curricula contain core courses in general culture, field courses, elective courses and field-based elective courses. Core courses are compulsory and include Turkish Language and literature, Religious Culture and Ethics, History, Geography, Mathematics, Biology, Physics, Chemistry, Hygiene, Foreign Language and Physical Education. In academic high schools, field courses prepare students for the program they plan to attend at the tertiary level whereas in vocational schools field courses aim to develop occupational skills (EACEA, 2011a). At the upper secondary education level, annual instructional time is 810 hours which is considerably lower than OECD average of 949 hours (OECD, 2012a).

# III. Access

## A. Pre-primary level

The student population aged between 48 and 72 months at the pre-primary level rose dramatically from two hundred thousand in the 1996-1997 school year to one million two hundred thousand in 2011-2012 school year, as shown in Figure 1. This reflected a rising net enrollment rate, which climbed from below 10 percent in 1996-1997 to over 40 percent in recent years. However, having reached about 44 percent, the net pre-primary enrollment rates appears to have stopped growing in the 2010-2011 and 2011-2012 school years (Ministiry of National Education, 2012).

**Figure 1: Student population and net enrollment rate at pre-primary level**

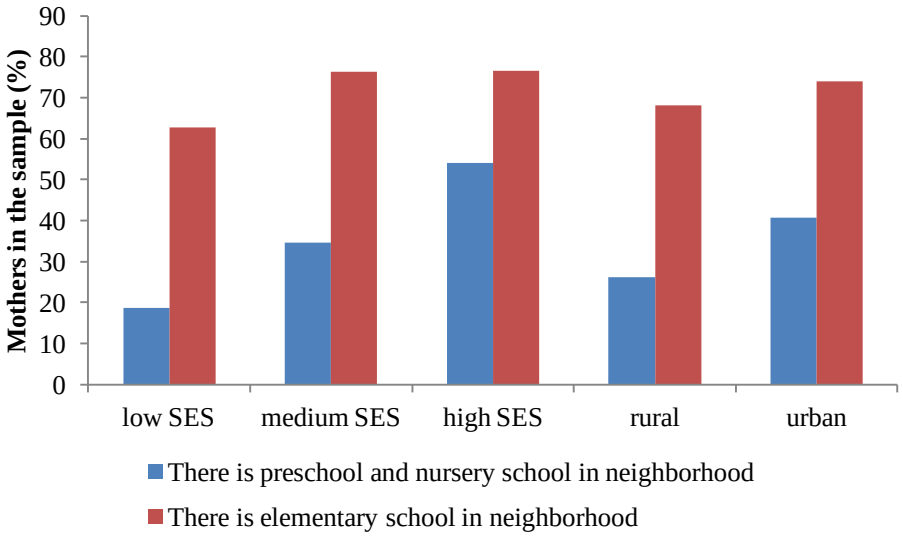



Source: Education Reform Initiative (2012)

This recent development imply that Turkey may be unlikely to sustain the expansion of pre-primary schooling without either providing targeted financial assistance to families for pre-schooling or abolishing school fees. The monthly private fee of 50 to 200 TL charged by pre-schools is not a negligible amount, especially for poor families. The poverty line for a family of four is around 700 Turkish Lira a month (Hentschel et al., 2010). Moreover, access to pre-

primary education is limited not only by socio-economic status but also by location and geography, as the data in Figure 2 clearly shows. The Study of Early Childhood Developmental Ecologies in Turkey reported by Hentschel et al. (2010) concludes that more than 80 percent of mothers with low socioeconomic status does not have access to preschool or nursery schools in their neighborhood while more than 50 percent of mothers with high socioeconomic status have access to these facilities. The same gaps are observed for families according to their urban-rural locations.

**Figure 2: Access to pre-primary education by SES status and urban/rural location**

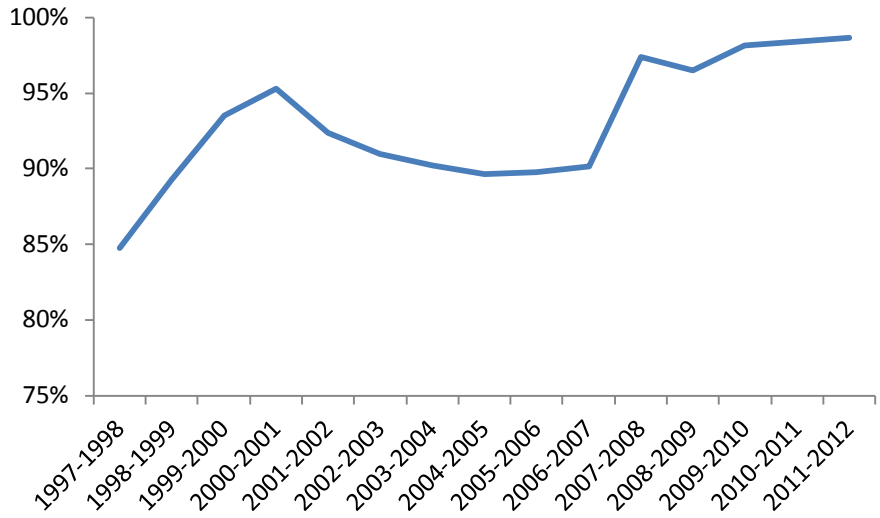



Source: Hentschel et al. (2010)

## B. Primary and lower secondary levels

As explained earlier, the Compulsory Education Law of 1997 increased the compulsory years of schooling from five to eight years. Following this policy change, net enrollment rates in primary education increased rapidly. As Figure 3 shows, the net enrollment rate in primary education rose from 89.51 percent in 1997 to 98.67 percent in 2011 (Ministry of National Education, 2012b).

**Figure 3: Net enrollment rate, primary education**



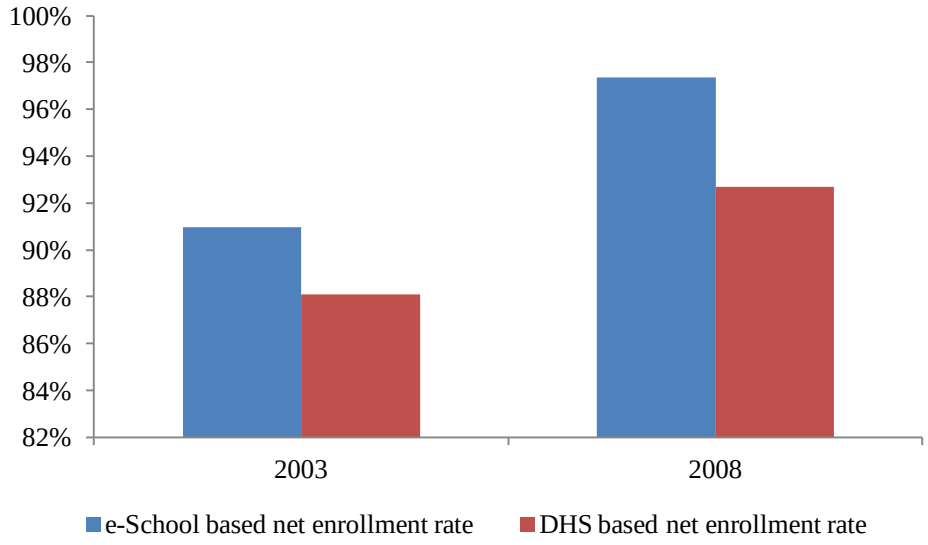

Source: Ministry of National Education (2012)

Still, universal enrollment in primary and lower secondary levels have not been achieved and there are still more than 100 thousand children without access to basic education. More importantly, these numbers hide regional and ethnic differences. The net enrollment rate is 99.53 percent in Istanbul whereas in central eastern Anatolia the net enrollment rate is 94.19 percent (Ministry of National Education, 2012b). Thus regional differences as well as urban/rural gaps may be associated with access to basic education. In terms of ethnicity UNESCO (2012) reports that 13 percent of the Kurdish speaking population aged between 7 and 16 do not have even one year of schooling compared to 1.7 percent among the corresponding Turkish-speaking population. Finally, enrollment rates of girls and boys show only very little regional variation.

It should also be noted that these net enrollment rates may not reflect actual access because, since 2007, the Ministry of National Education gathers enrollment data via an education management information system known as the e-School. The e-School is linked to the administrative population database and assigns each compulsory school age child to his/her

primary school in his/her local catchment area automatically. Thus even if children never attend schools they remain as registered in the e-School database. Significant discrepancies from the data provided by the e-School system have emerged once survey-based estimates of enrollment rates are compared with the official enrollment rates based on the e-School. For example, based on the nationally-representative Demographic and Health Survey of 2008, the net primary enrollment rate in Turkey is 92.7 percent whereas the corresponding net enrollment rate reported via the e-School is 97.4 percent, as Figure 4 reports (Hacettepe University Institute of Population Studies, 2009; Ministry of National Education, 2012b).

**Figure 4: Administrative records vs. survey based computation of net enrollment rates**



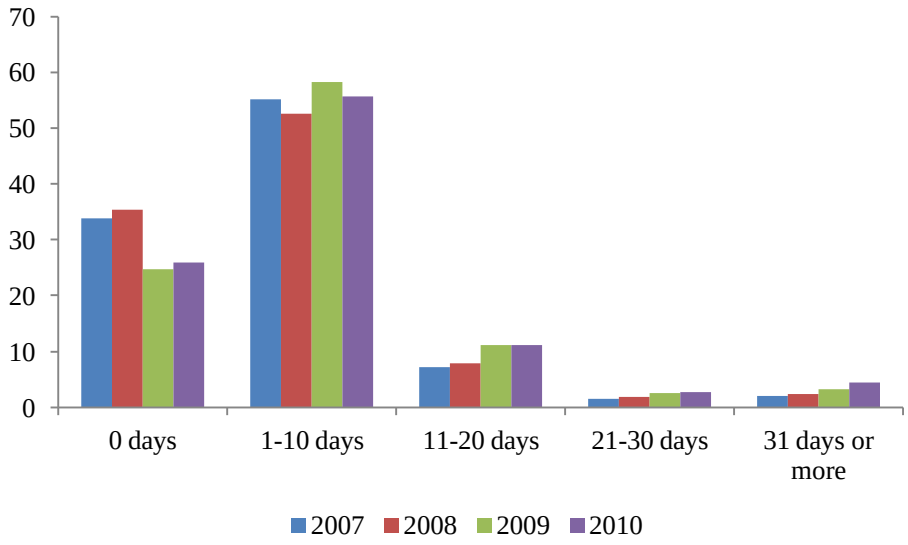

Source: Ministry of National Education (2012), Hacettepe University Institute of Population Studies (2009)

Another serious issue concerning access to basic education in Turkey is growing student absenteeism. The average unexcused student non-attendance between grades 1 and 5 was 3.2 days in 2007, but this increased by over 80 percent to 5.8 days in 2011. Additionally, the average of unexcused student non-attendance between grades 6 and 8 was 7.8 days in 2007, which had

grown to 11.6 days in 2011. Similarly, as Figure 5 shows, the ratio of students who did not attend school for more than 30 days in an academic year quadrupled between 2007 and 2011 (Bakış, Börkan, Levent, Pelek, & Dereli, forthcoming, 2012).

Concern over the growing absenteeism is magnified by the fact that it disproportionately affects the poor. A report examining the factors driving student non-attendance using four years of panel data from the e-School database concludes that academic achievement and family income are closely linked to absenteeism. In particular, the report finds that the economic recession affecting Turkey in 2009 affected students from disadvantaged socioeconomic backgrounds disproportionately and this, in turn, was reflected in higher absenteeism (Bakış, et al., forthcoming, 2012).

**Figure 5: Unexcused student absenteeism (%, 2007-2010)**




Source: Bakış, et al. (forthcoming, 2012)

Serious regional disparities also exist in student non-attendance. Between grades 6 and 8, in Diyarbakır and Şanlıurfa, provinces in relatively poor and predominantly Kurdish Southeast

Anatolia, the average days of unexcused student non-attendance is 15.6 days in an academic year, whereas the average falls to 5.2 days in Antalya, Isparta and Burdur, provinces in the relatively rich Mediterranean and Aegean regions.

### C. Upper secondary education

As of the 2011-2012 school year, the net enrollment rate at the upper secondary level was 67 percent. This constitutes an increase of almost 30 percentage points when compared to its level in the 1997-1998 school year, which was 38 percent. This increase in net enrollment rates is likely to continue in the following years given that upper secondary level became a part of compulsory education beginning with the 2012-2013 school year. However it should be noted that these aggregate figures hide substantial regional differences. In the western provinces, net enrollment rates are much higher than in the eastern provinces. For example, in Bilecik and Bolu net enrollment rates exceed 90 percent whereas in Muş and Ağrı net enrollment rates are just above 30 percent.

The major issues regarding access to the upper secondary level are gender disparity and high drop-out rates. The female enrollment rate as a percentage of the male enrollment rate at this level improved substantially from 1997 to 2011, rising from 75 to 93 percent. However, gender still plays a role in enrollment at some upper secondary education institutions (Uysal & Güner, forthcoming, 2012). Additionally, the difference between male and female enrollment rates vary across provinces, reaching more than 15 percentage points in most of the Southeastern provinces, which are relatively poor, rural and predominantly Kurdish.

The latest administrative data on drop-out rates at the upper secondary level are for the 2009-2010 school year and they show a drop-out rate of 8.2 percent. However, again, this aggregate

figure conceals differences by gender and program types. Males are much more likely to drop out, with a drop-out rate of 10.2 percent and students in vocational/technical programs are also more likely to drop out, with a drop-out rate of 9.4 percent. On the other hand, administrative data on drop-out rates do not show any striking differences across regions.

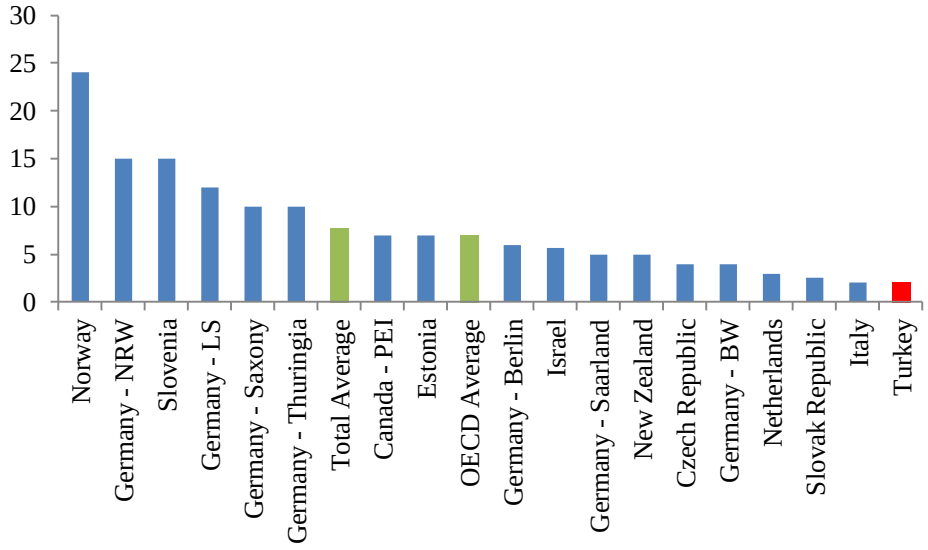
# IV. Quality

## A. Pre-primary level

There are no studies or projects explicitly analyzing the quality of pre-primary education across countries through outcome-based measures. Thus it is not possible to compare, for example, the level of school readiness of students at pre-primary level in Turkey and in other countries. However internationally comparable data on school resources at the pre-primary level are available and this allows to make some rough cross-country assessments.

The ratio of student to teaching staff at the pre-primary level in Turkey is 27.4 whereas the average ratio of student to teaching staff at this level in OECD countries is 14.7 (OECD, 2012a). Additionally, the minimum standards regarding the ratio of student to teaching staff is 20 in Turkey but it is on average equal to 15 in countries for which data are available. Similarly minimum standards regarding outdoor space per student are 2 square meters in Turkey and 8 square meters in countries for which data are available, on average (Figure 6) (OECD, 2012c).

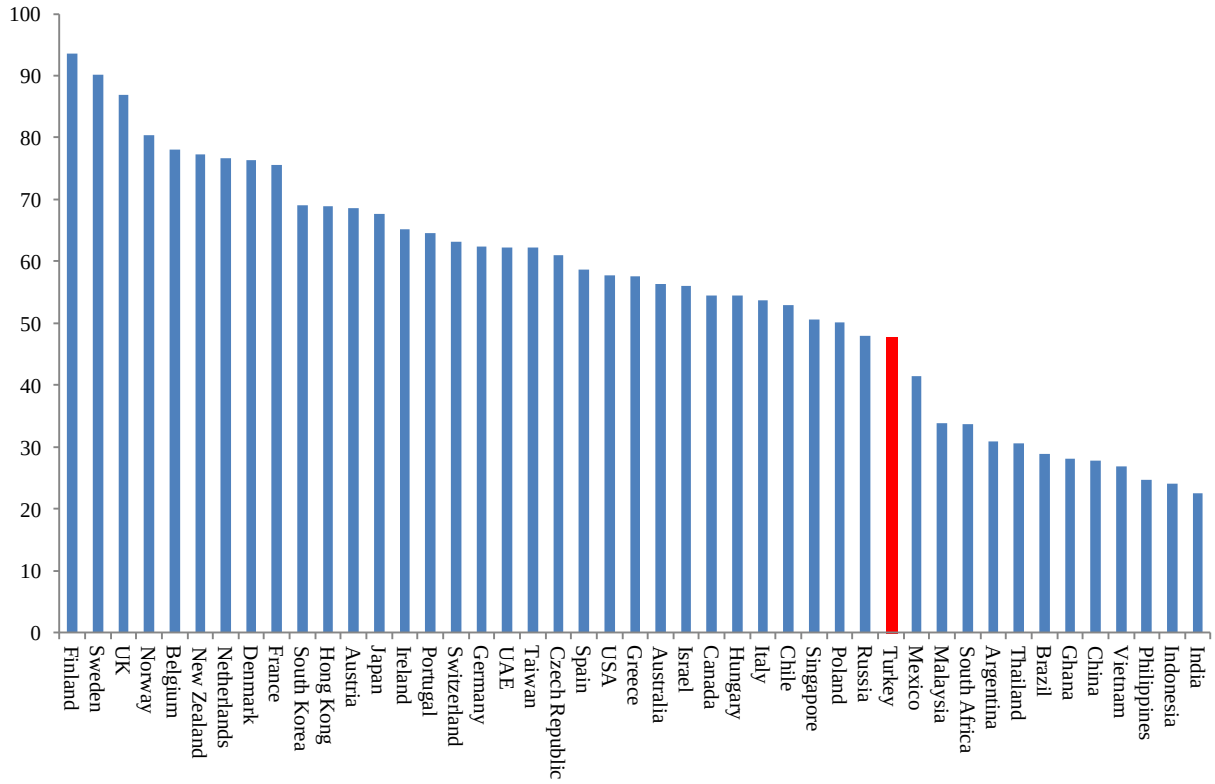
**Figure 6: Regulated minimum outdoor space requirement in square meters per child**




Source: OECD (2012c)

A very recent research programme conducted by the Economist Intelligence Unit (EIU) and commissioned by the Lien Foundation ranks the preschool environments for 45 countries in three domains: availability, affordability and quality, for each of which an index is constructed. The quality index is composed of 1) the average student-teacher ratio in preschool classrooms, 2) average preschool teacher wages, 3) curriculum guidelines, 4) preschool teacher training, 5) health and safety guidelines, 6) data collection mechanisms, 7) linkages between preschool and primary school, and 8) parental involvement and education programmes. As Figure 7 shows, Turkey ranks 33rd in the quality domain among the 45 countries. The EIU study highlights that although there are no clear rights to preschool education nor any effective subsidies that reach underprivileged families in Turkey, teachers in early childhood education are relatively well-trained and curriculum and health and safety standards are well-defined (Economist Intelligence Unit, 2012).

**Figure 7: Index of quality of pre-primary education**




Source: EIU (2012).

## B. Quality of basic education (primary, lower secondary and upper secondary levels)

In contrast to the pre-primary level, there are national as well as international measures which provide information regarding academic competencies of students at the primary, lower secondary and upper secondary levels. Table 1 provides a complete list of the studies designed specifically to assess student proficiency in different subjects. There are two other examinations that are not presented in Table 1. These are student selection examinations conducted to manage transition from middle to high schools and from high school to tertiary education institutions. These examinations are not intended to be nationally representative and their primary purpose is to rank students and allocate seats to students seeking to continue their schooling at the upper

education levels. The potential selectivity issue prevents the use of these examinations as a measure of quality of education in Turkey.

**Table 1: National and international studies of student assessment**

| | Coverage | Sampling/Universal | Subjects | Years | International/National |
|---|---|---|---|---|---|
| Evaluation Exam of Student Achievement | 4/5/6/7/8 grades | Sampling | Turkish, Mathematics, Science and Technology, Social Sciences | 2002, 2005, 2008 | National |
| PIRLS | 4 grade | Sampling | Reading | 2001 | International |
| TIMSS | 4 (2011) /8 grades | Sampling | Mathematics, Science | 1999, 2007, 2011 | International |
| PISA | 15 year-old student population | Sampling | Reading, Mathematics, Science | 2003, 2006, 2009 | International |

The Evaluation Exam of Student Achievement is a national attempt to assess competencies of students between grades 4 and 8. The sample sizes vary between 30 to 100 thousands and students are tested in Turkish, Mathematics, Science and Technology and Social Sciences. Average achievement of students in this examination exhibits an increase between 2002 and 2008 independently of subject matter. As Table 2 shows, the increase is more less the same in Turkish, Mathematics and Social Sciences between 2002 and 2005 and 2005 and 2008. However the rise in the achievement of students in Science and Technology is much more pronounced between 2005 and 2008 when compared to 2002 and 2005. MONE links this pattern of post-2005 achievement increase in Science and Technology with curriculum reforms in primary education undertaken in 2005. A more comprehensive discussion of this issue will be provided in the following chapters.

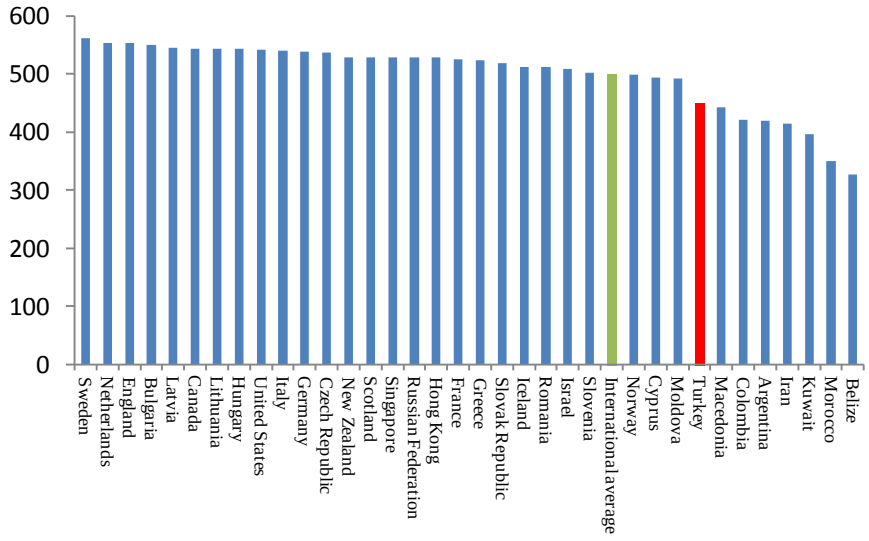
**Table 2: Absolute achievement in Evaluation Exam of Student Achievement**

| | Turkish | | | Mathematics | | | Science and Technology | | | Social Sciences | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Grade | 2002 | 2005 | 2008 | 2002 | 2005 | 2008 | 2002 | 2005 | 2008 | 2002 | 2005 | 2008 |
| 4 | 43 | 46 | 50 | 40 | 45 | 53 | 40 | 45 | 63 | 41 | 47 | 49 |
| 5 | 51 | 59 | 62 | 46 | 49 | 52 | 46 | 49 | 47 | 43 | 48 | 52 |
| 6 | 45 | 50 | 55 | 38 | 37 | 35 | 38 | 37 | 48 | 36 | 42 | 49 |
| 7 | 48 | 51 | 51 | 36 | 37 | 40 | 36 | 37 | 44 | 40 | 41 | 47 |
| 8 | 53 | 59 | 63 | 41 | 45 | 46 | 41 | 45 | 49 | 47 | 50 | 51 |

Source: Celik (2012)

The Progress in International Reading Literacy Study (PIRLS) is an assessment of students' reading achievement at the 4th grade in a cross-section of countries. PIRLS evaluates a range of reading comprehension skills and a wide spectrum of questions requires students to construct and write their answers. PIRLS was conducted in 2001, 2006 and 2011 and 4th graders in Turkey participated in the 2001 PIRLS. In this assessment, the average score of students in Turkey was almost a half standard deviation below the international average and on par with students in Macedonia, Colombia and Argentina, as Figure 8 shows. Only 2 percent of students in Turkey reached the top 10 percent benchmark and only 9 percent of students reached the upper quarter benchmark in reading comprehension (I.V.S. Mullis, Martin, Gonzalez, & Kennedy, 2003).

**Figure 8: Average scale scores in reading comprehension (PIRLS, 2001)**



Source: Mullis, Martin, Gonzalez, & Kennedy (2003)

Ten years later, 4th graders were tested again for the Trends in International Mathematics and Science Study (TIMSS) of 2011. TIMSS is an international evaluation of mathematics and science student achievement at the 4th and 8th grades. TIMSS has been conducted since 1995 in four-year cycles. TIMSS 2011 represented the fifth cycle and it assembled nationally representative samples of 4th and 8th grade students in 63 countries. Note that countries have the option to participate in the fourth grade assessment, the eighth grade assessment, or both. In TIMSS 2011, Turkey participated in both the fourth and eighth grade assessments.

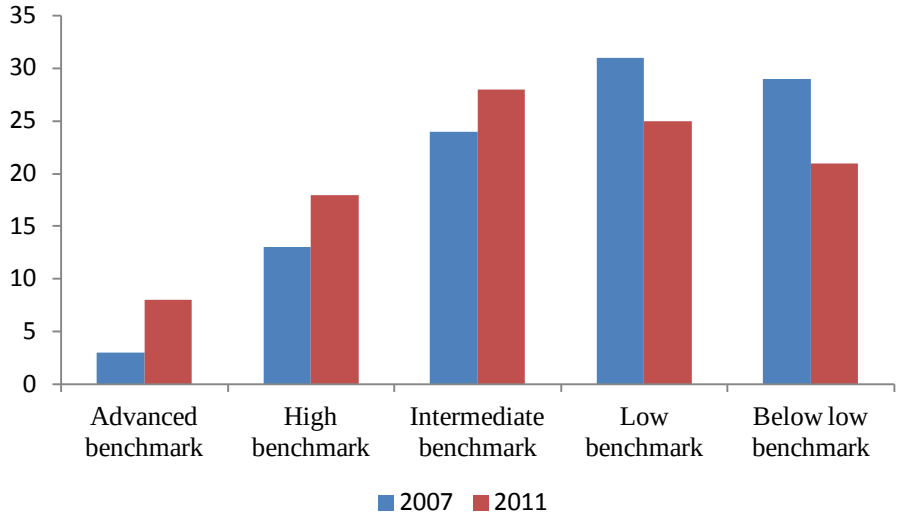
Turkey's average mathematics scale score of 4th grade students ranked 37th out of 52 countries evaluated. The score was on par with Romania, Poland, Azerbaijan and Chile and it was approximately 0.3 standard deviations below the international average. In science, the average score of students in Turkey ranked 38th among 52 countries, on par with Chile, Thailand, Georgia and Iran and approximately 0.4 standard deviations below the international average (Martin, Mullis, Foy, & Stanco, 2012; I.V.S. Mullis, Martin, Foy, & Arora, 2012).

The average mathematics and science performance of 8th graders in Turkey, as reported by TIMSS, does not differ much from the average mathematics and science performance of 4th graders. The average mathematics scale score of 8th graders in Turkey ranked 24th among 45 participating countries and stands more than half a standard deviations below the international average. Similarly, the average science scale score of 8th graders in Turkey ranked 21st among 45 participating countries and stands more than 0.2 standard deviations below the international average (Martin, et al., 2012; I.V.S. Mullis, et al., 2012).

Is there a change over time in the performance of students in Turkey relative to other countries? Eighth graders in Turkey participated in the 1999, 2007 and 2011 TIMSS, so it is possible to compare student achievement over time using these data. Even though the learning outcomes of 8th graders in Turkey are much lower than international benchmarks, the data for 2011 does reflect an improvement when compared with the previous assessment in 2007. Indeed, the average mathematics score of eighth graders in Turkey was 0.7 standard deviations below the international average in 2007 (compared to about 0.5 standard deviation in 2011), and the science average score in 2007 was 0.45 standard deviations below the international average (compared to 0.2 standard deviations in 2011) (Martin, Mullis, Foy, & Olson, 2008a, 2008b).

A closer look at the achievement distribution of 8th graders in Turkey highlights the fact that the increase in learning outcomes was much more pronounced at the lower end of the achievement distribution. From 2007 to 2011, the percentage of 8th graders who scored below the low benchmark in the science test went down from 29 percent to 21 percent. Likewise, as Figure 9 shows, the percentage of students scoring at the low benchmark in science decreased from 31 to 25 between 2007 and 2011 in science achievement.

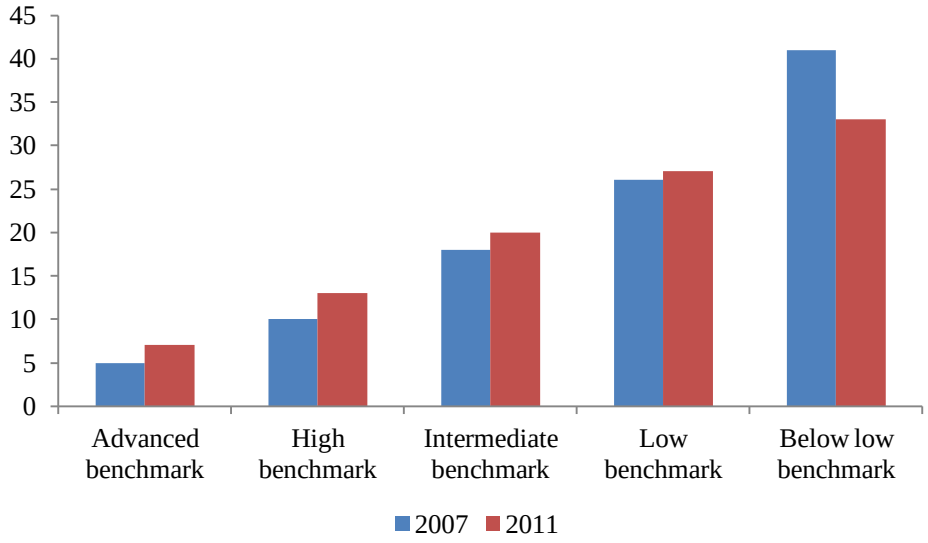
**Figure 9: Percentage of 8th graders in Turkey by TIMSS science achievement benchmarks**




Source: Martin, et al. (2012), Martin, Mullis, Foy, & Olson (2008b)

A similar pattern can also be seen in mathematics achievement. However the reduction in those who failed to reach the low benchmark is much higher when compared to the science test. From 2007 to 2011, the percentage of 8$^{th}$ graders who failed to reach the low benchmark in mathematics declined from 41 percent to 33 percent. On the other hand, as Figure 10 displays, there is not much change in the percentage of those students that just met the low benchmark in the mathematics test: the percentage of students at the low benchmark in mathematics slightly increased from 26 percent to 27 percent between 2007 and 2011.

**Figure 10: Percentage of 8th graders in Turkey by TIMSS mathematics achievement benchmarks**



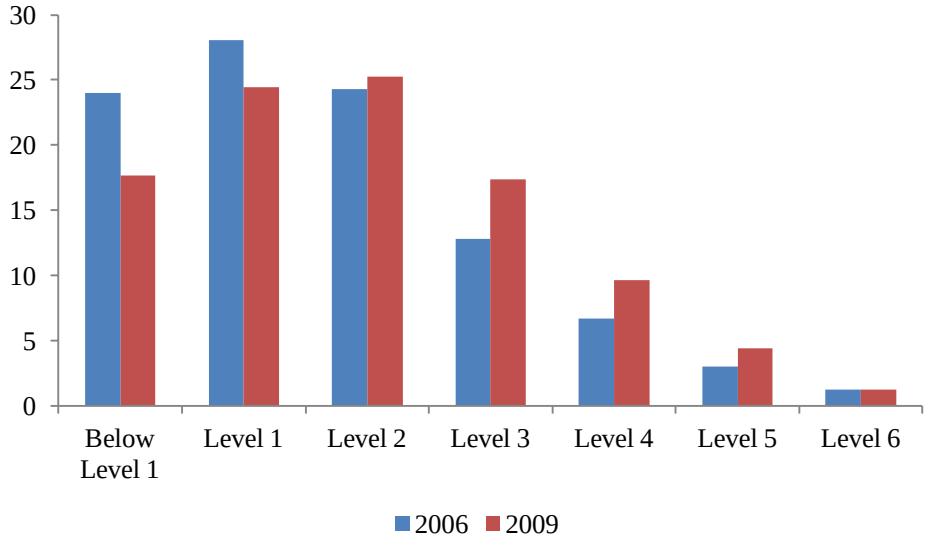

Source: Mullis, et al. (2012), Martin, Mullis, Foy, & Olson (2008a)

Not surprisingly, the findings from PISA 2003, 2006 and 2009 run parallel to what has just been described regarding student achievement in Turkey and its trend from the early 2000s to the late 2000s. However, note that PISA evaluates the skills of a different age group: 15 year-olds. In terms of grade levels, a significant majority of the student population that took the PISA assessment in Turkey were in $9^{th}$ and $10^{th}$ grades, the first and second grades of high school.

The tests are in reading, mathematics and science literacy. The average reading, mathematics and science achievements of the 15-year old student population in Turkey were 0.8, 0.6 and 0.7 standard deviations below the OECD average in PISA 2003, respectively (OECD, 2004). In all of these subjects, the achievement gap diminished by approximately 0.2 standard deviations by 2009. Therefore, although there is still a significant distance between average student achievement in Turkey and in OECD countries as a whole, students in Turkey have been approaching their counterparts in the OECD (OECD, 2004, 2010b).

A closer look at the achievement distributions in the three subject areas also reveals that the percentage of students at the lower levels of proficiency went down between PISA 2006 and 2009. As Figure 11 depicts, in mathematics, those who could not reach Proficiency Level 1 decreased from 24 percent to 18 percent and those who could only reach Proficiency Level 1 dropped from 28 percent to 24 percent (OECD, 2007, 2010b) (Figure 11).

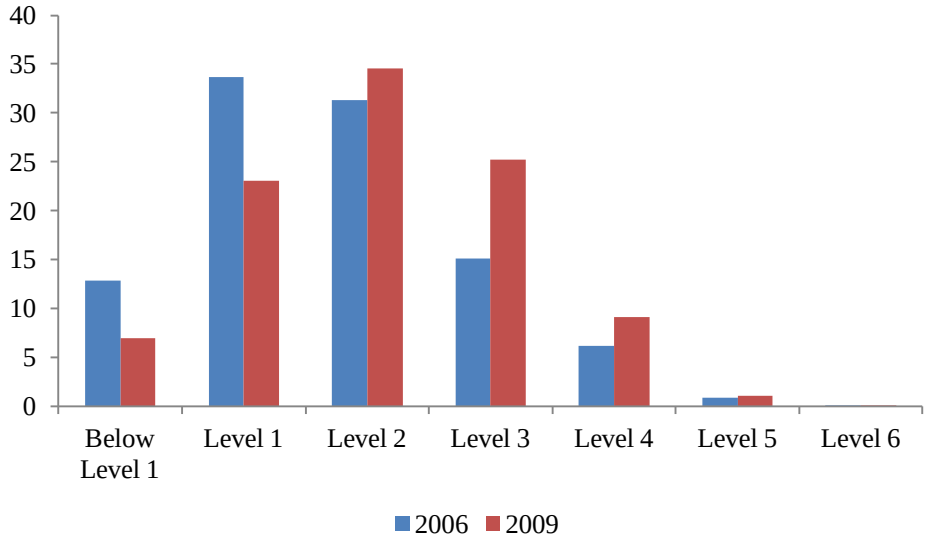
**Figure 11: Percentage of students at the different levels of mathematics proficiency**




Source: OECD (2007, 2010b)

The drop in the percentage of students at the lower levels of science proficiency is even more dramatic. As Figure 12 shows, from 2006 to 2009 those who could not reach Proficiency Level 1 in science declined from 13 percent to 7 percent and those who could only reach Proficiency Level 1 decreased from 34 percent to 23 percent (OECD, 2007, 2010b).

**Figure 12: Percentage of students at the different levels of science proficiency**

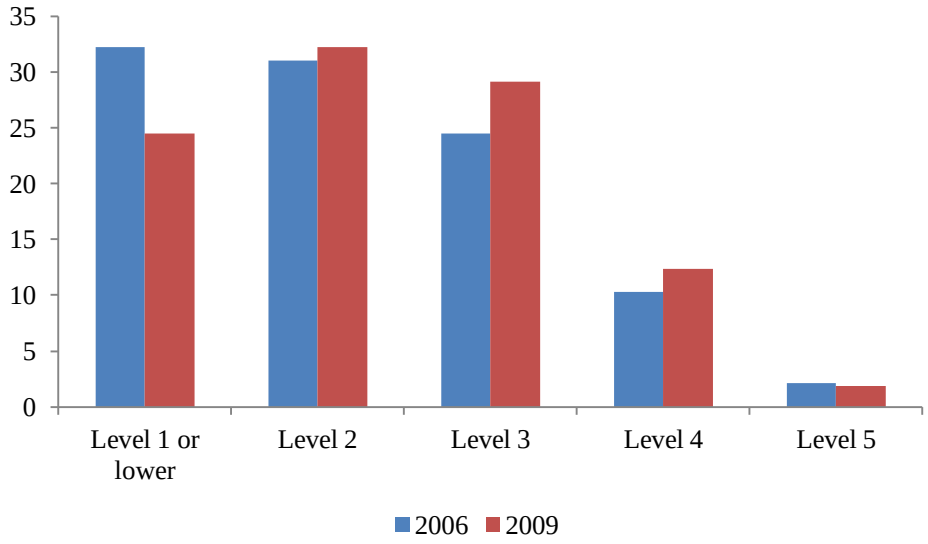



Source: OECD (2007, 2010b)

By contrast, the improvement in the reading achievement of 15-year old students in Turkey is not predominantly concentrated at the lower end of the achievement distribution. Although the percentage of students who lie below Proficiency Level 1 has dropped from 32 to 25, there is no remarkable change in the percentage of students who reach only Proficiency Level 1. And as Figure 13 presents, there are also noteworthy increases at the higher end of the achievement distribution: the percentage of students who reached Proficiency Level 3 increased from 24 to 29 (OECD, 2007, 2010b). The relatively lackluster improvements in reading achievement at the lower proficiency levels, when compared to the more significant improvements in science and math may be related to the ethno-linguistic diversity in Turkey and the concentration of poverty among linguistic minorities. This question cannot be answered by using the PISA data sets because their comparably small samples do not provide reliable information on which language students speak at home. In fact, in the PISA Turkey data sets only approximately 2 percent of

students report that they do not speak Turkish at home whereas the more comprehensive UNESCO (2012) study reports that 18.2 percent of the population in Turkey speaks Kurdish.

**Figure 13: Percentage of students at the different levels of reading proficiency**

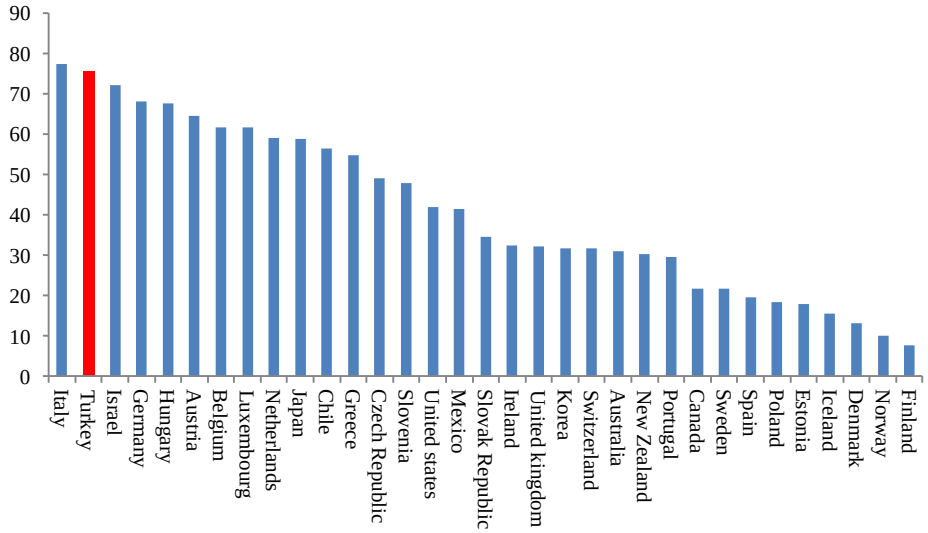



Source: OECD (2007, 2010b)

The overall increased learning outcomes at the lower end of the achievement distribution exhibited via TIMSS and PISA can be interpreted as an improvement in the equity of learning outcomes of 8$^{th}$ graders or the 15-year old student population. However, as Figure 14 shows, Turkey still tops the charts when it comes to variation in academic performance between schools, i.e. an important indicator of inequality in the quality of schools or student-school sorting based on academic performance (OECD, 2010c). It should be also noted that schools' socio-economic background is very strongly associated with academic performance in Turkey while students' socio-economic background has been found to play a lesser role, especially when compared to OECD countries overall. As Figure 15 displays, in OECD countries, 55 percent of the variation in student academic performance is associated with schools' socio-economic background and 4 percent of the variation in academic performance is associated with students' socio-economic

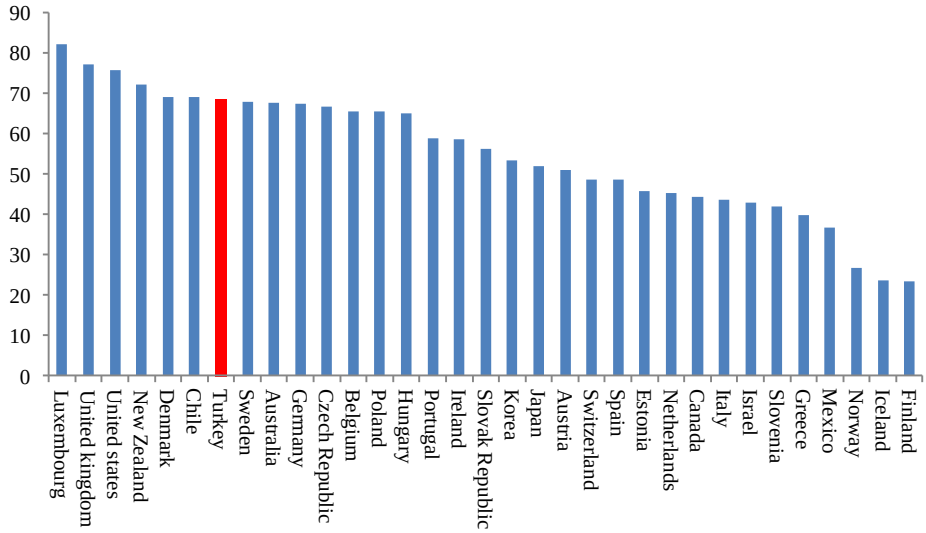
background. In Turkey 68 percent of variation in academic performance is associated with schools' socio-economic background and 2 percent of the variation in academic performance is associated with students' socio-economic background (OECD, 2010c). On the other hand variation in academic performance within schools in Turkey is below the OECD average.

**Figure 14: Variation in reading performance between schools (expressed as a percentage of the variance in student performance across OECD countries)**




Source: OECD (2010c)

**Figure 15: Variation in reading performance explained by schools' socio-economic background (expressed as a percentage of the variance in student performance across OECD countries)**




Source: OECD (2010c)

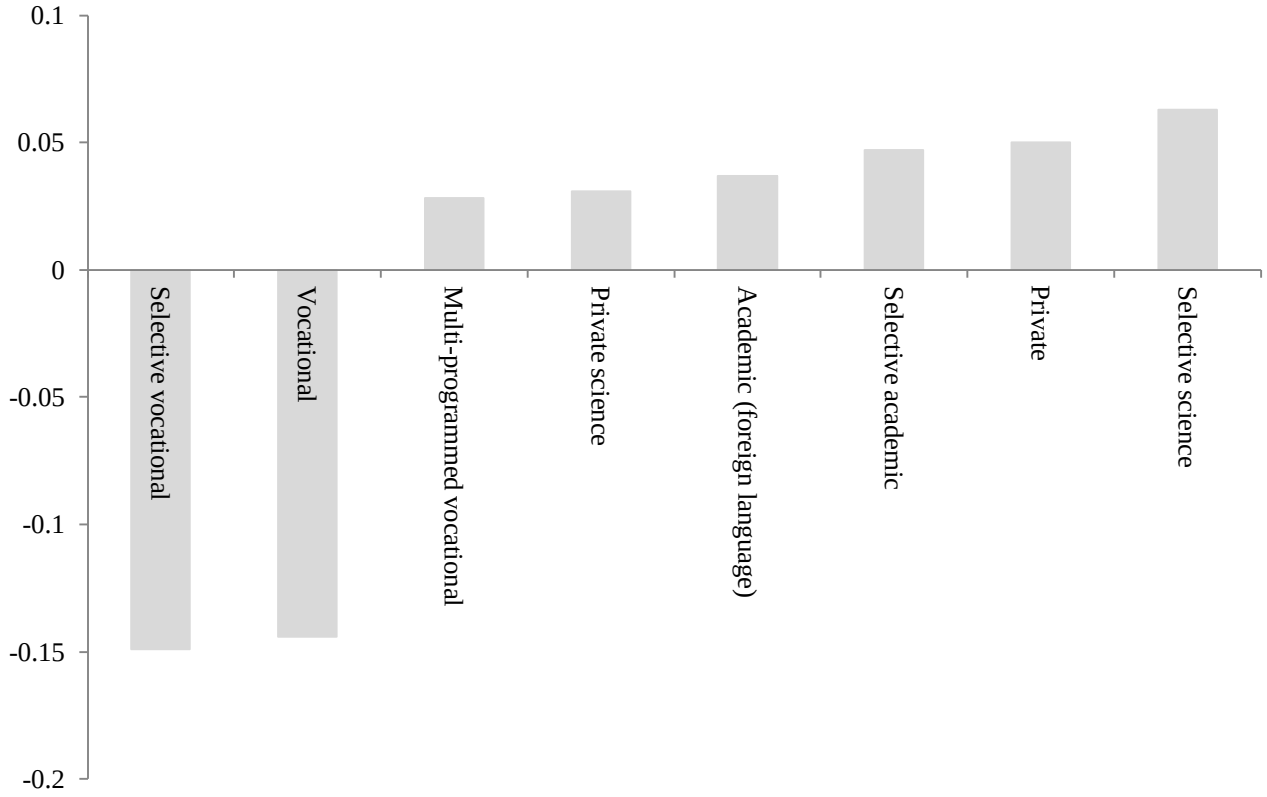
Regarding this issue, the centralized testing mechanism managing the transition from 8$^{th}$ to 9$^{th}$ grade in Turkey deserves special emphasis. As mentioned earlier, students who wish to attend 9$^{th}$ grade in a selective vocational or academic high school are subject to selection through the use of a centralized test. Thus it may be argued that this selection mechanism is the main driver of the high between-school variance in academic performance presented via the PISA data, which covers mainly 9$^{th}$ and 10$^{th}$ graders. Additionally, some of the high explanatory power of schools' socio-economic background on academic performance may be attributed to this selection mechanism because students targeting the more competitive institutions usually attend private tutoring centers. Annual costs associated with enhanced test preparation may exceed 12000 TL.[3] Therefore, family income prevails as one of the key predictors of selective high school attendance.

[3] http://t24.com.tr/haber/ogrencilerin-dershane-fiyati-can-yakiyor/66269

On the other hand, little is known regarding the differentiation of educational quality across program types in Turkey. Indeed there is only one econometric study which utilizes a value-added specification and provides estimates of value added for program types (Alkan, Çarkoğlu, Filiztekin, & İnceoğlu, 2008). In this study, researchers matched university entrance examination scores with high school examination scores for 1.8 million individuals. The study included also additional detailed information for a subsample of 12,838 students. For this subsample information was collected by survey and added to the database. Then researchers estimated a value added specification where the dependent variable was percentile ranking in the university entrance examination, and in which a large set of controls were added, including the high school examination scores, student effort, parental income and education, and school fixed effects. Following this exercise, they regressed estimated school fixed effects on program type dummies.

Figure 16 presents estimates for program types obtained in this final regression. Non-selective academic programs constitute the comparison category. The findings highlight the fact that there are considerable differences across program types in terms educational quality, as measured by percentile ranking in the university entrance examination. Students who attend selective science high schools, a branch of academically selective public high schools, have on average more than 6 points higher percentile rankings whereas students who attend vocational and selective vocational programs have 14-15 points lower in percentile rankings when compared to students attending non-selective general high schools.

**Figure 16: Value added estimates of program types**




Source: Alkan, Çarkoğlu, Filiztekin, & İnceoğlu (2008)

These estimated impacts are very significant because there are approximately 430 thousand seats in four year university programs and more than 2 million applicants take university entrance exam. Thus those ranked below the 21$^{th}$ percentile have very little chance to get a seat in a four year university program and those who attend a vocational and selective vocational high school have a handicap of 14-15 percentile points. Thus, differences in educational quality across program types appear to be highly influential in determining the likelihood of university attendance. However this finding should be considered as suggestive given the study of Alkan, Çarkoğlu, Filiztekin, & İnceoğlu (2008) is not based on a quasi-experimental approach and may be subject to a variety of endogeneity issues.

# V. Conclusion

The education system in Turkey is full of intriguing questions. At the pre-primary level, there is very limited research on the determinants of access and the impact of preschool attendance on school readiness and later educational and social outcomes. At the primary, lower secondary and upper secondary levels, there are no econometric evaluations of private/public school effectiveness as well as analyses of the determinants of school and teacher quality. Additionally, policy changes made over the last 20 years –combined with increased availability of data-- provide fertile ground for research in the field of economics of education. Looking to the future, the education reform in 2012, i.e. the restructuring of basic education, the establishing of middle schools and religious middle schools, and the expansion of compulsory years of schooling from eight to twelve years, provide natural experiments for potential research.

This dissertation is focused on an econometric examination of two major policy developments of the last two decades. First, it tries to understand whether the change in teacher selection regime in 2002 made a contribution to the significant gains in learning outcomes of $8^{th}$ graders and 15-year old students between 1999 and 2009, as shown earlier in this chapter. For this purpose, an identification strategy based on a difference-in-differences strategy coupled with student fixed effects will be utilized using the TIMSS 1999 and 2007 Turkey micro data sets.

Chapter 4 analyzes the impact of another major policy change discussed earlier: the increased years of compulsory education in 1997. The research aims to give an insight on the impact of increasing compulsory years of schooling from five to eight years on the actual years of schooling of the target population. It intends to assess the effectiveness of the policy change. For that purpose, the identification strategy is based on a difference-in-difference-in-differences strategy which makes use of variation in time (across cohorts) as well as regional variation of

treatment intensity. This analysis sets the first stage for a two stage least square specification aiming to get causal estimates of additional years of schooling and completing eight year primary education on teenage marriage and motherhood. This investigation utilizes the Turkey Demographic and Health Surveys of 2003 and 2008 and administrative records of regional teacher assignments, i.e. treatment intensity measure, from MONE's statistical yearbooks.

# CHAPTER 3. TEACHER SELECTION AND EFFECTIVENESS IN TURKEY: TEACHER TESTING AND QUALITY

## I. Introduction

In 2002, the MONE undertook a major reform of its teaching recruitment strategy. The existing teacher selection system based on a lottery was replaced with a teacher selection model which operates based on a teacher examination called the Public Servant Selection Examination (KPSS). This chapter seeks to determine the impact of this reform on student achievement in Turkey.

In order to examine the role played by the teacher selection reform on the effectiveness of the education system, this thesis uses data on student achievement available before and after the reform. The Trends in International Mathematics and Science Study (TIMSS) and the Program for International Student Assessment (PISA) periodically measure student achievement on an international scale and it is possible to track student achievement in participating countries over time and make cross-country comparisons with the help of these projects.

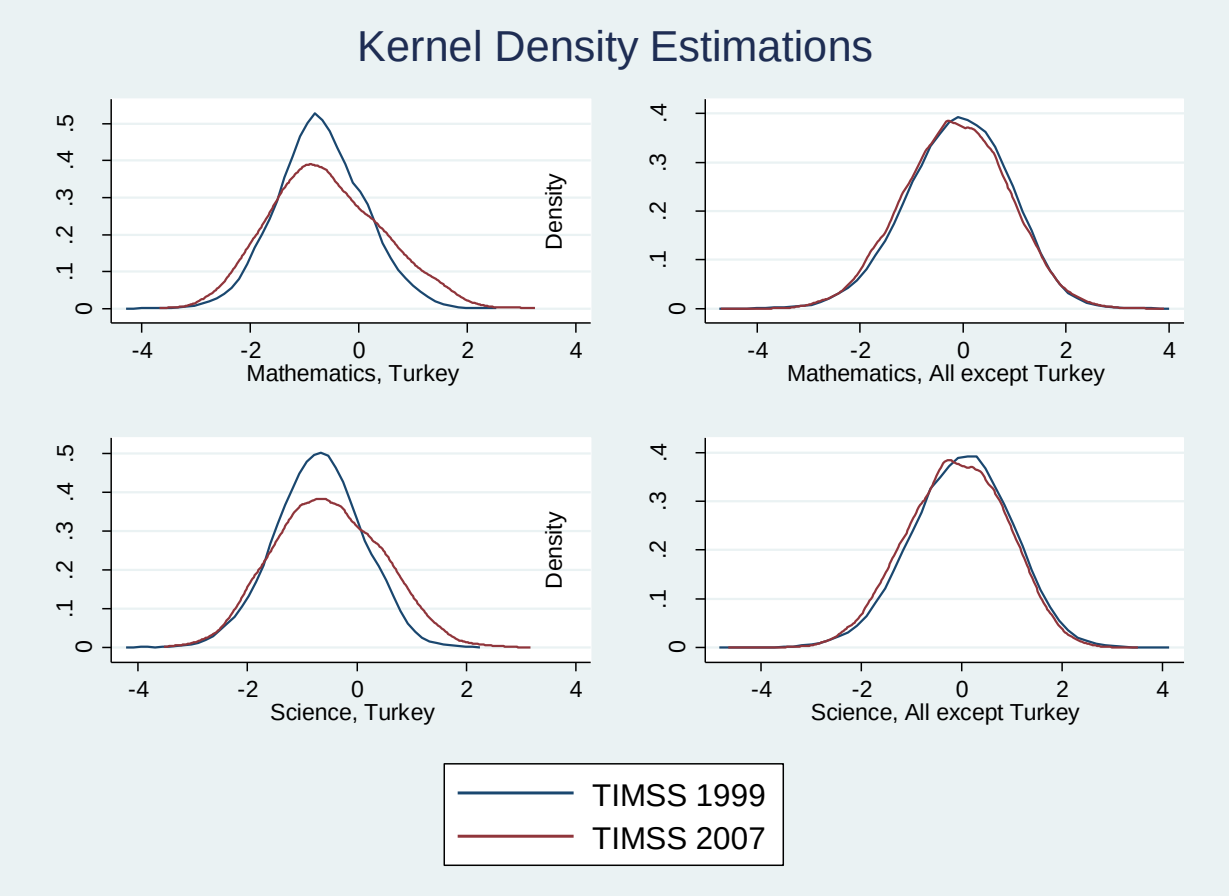
Students in Turkey participated in TIMSS in 1999 and 2007 and PISA in 2003, 2006 and 2009. TIMSS covers a representative set of $8^{th}$ graders and measures their mathematics and science skills whereas PISA focuses on a representative set of the 15-year old student population and measures reading, mathematics and science literacy.

The average TIMSS mathematics and science achievement of students in Turkey in 1999 and 2007 are not directly comparable in time[4]. However one may standardize mathematics and science test scores for a set of common countries which took part in TIMSS in 1999 as well as 2007 with mean 0 and standard deviation 1 for each year and then compare achievement distributions in 1999 and 2007 and draw inferences about the relative achievement of students in Turkey. Such a treatment suggests that the average mathematics achievement in Turkey increased by 0.17 standard deviations between 1999 and 2007 and the average science achievement increased by 0.21 standard deviations during this time period.

Figure 17 presents kernel density estimations of standardized mathematics and science scores in Turkey and all of the other countries. These estimations demonstrate two important points: First, the density of the distribution of students in Turkey who perform below the cross-country average was much higher in 1999 than in 2007. Second, the density of the distribution of students in Turkey who performed above the cross-country average was much lower in 1999 than in 2007.

[4] Turkey is one of the few countries that experienced hardship in translating trend items from English to Turkish in 2007. Therefore the validity of the trend items in the TIMSS 2007 application of Turkey is questionable and in-time comparison of average achievement of students in Turkey was not reported by the IEA. This information is obtained via an email exchange with Ebru Erberber, a collaborator of TIMSS 2007 at IEA.

**Figure 17: Achievements of students in Turkey, TIMSS 1999 and 2007**




PISA offers more definitive information about the trend of learning outcomes of students in Turkey. The mathematics achievement of students is comparable between 2003 and 2009 and the science achievement of students is comparable between 2006 and 2009 (OECD, 2010a). During the 2003 and 2009 time period, the average mathematics score of 15-year old students in Turkey increased by 22 points, as is depicted in Figure 18. This corresponds to more than 0.2 standard deviations. The average science score of 15-year old students in Turkey increased by 30 points between 2006 and 2009 which is approximately 0.3 standard deviations, as depicted in Figure 19 (OECD, 2010a).

**Figure 18: Score point change in mathematics between 2003 and 2009, PISA**

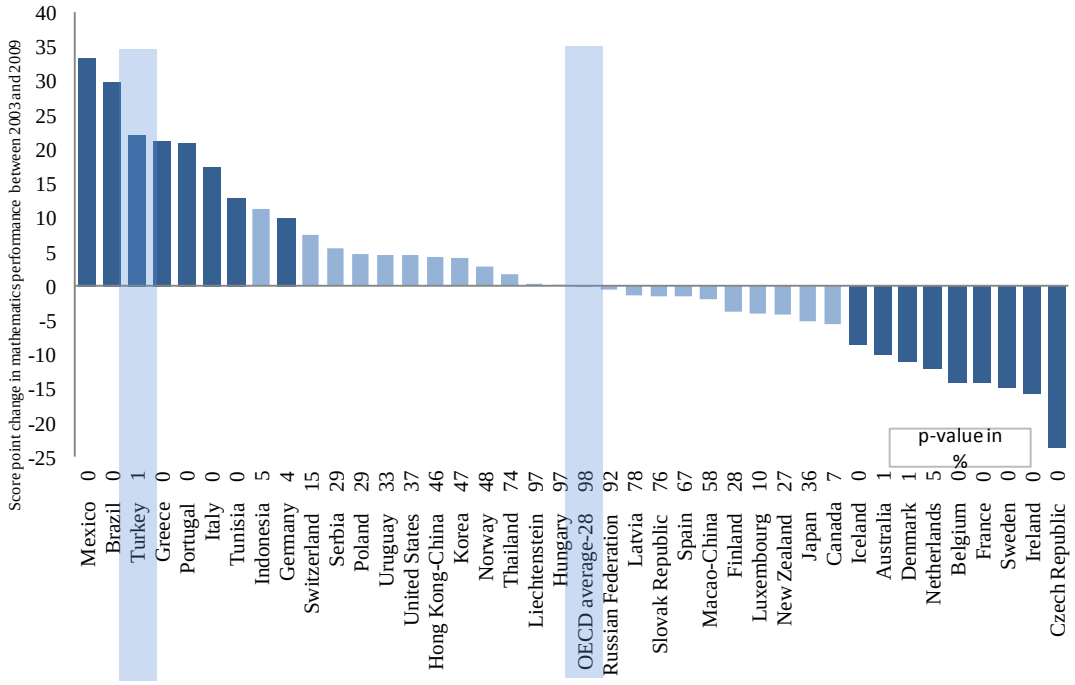
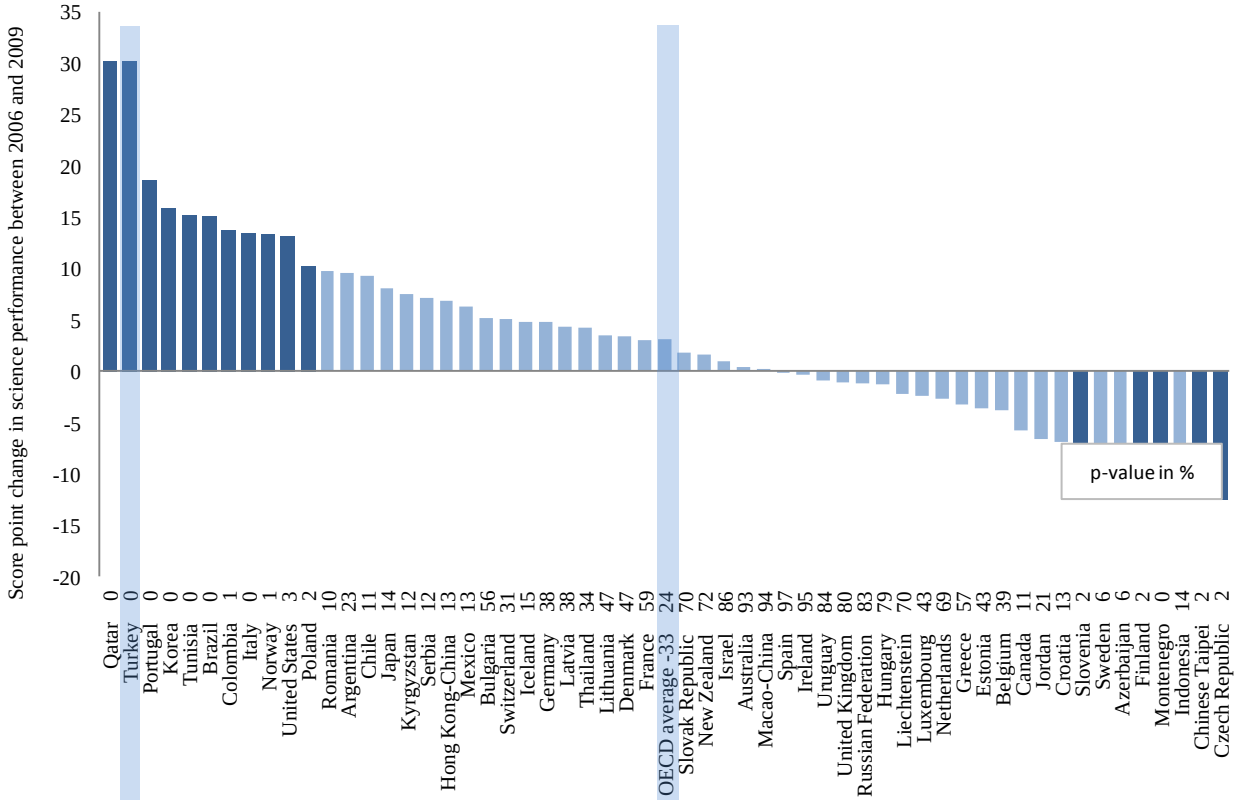
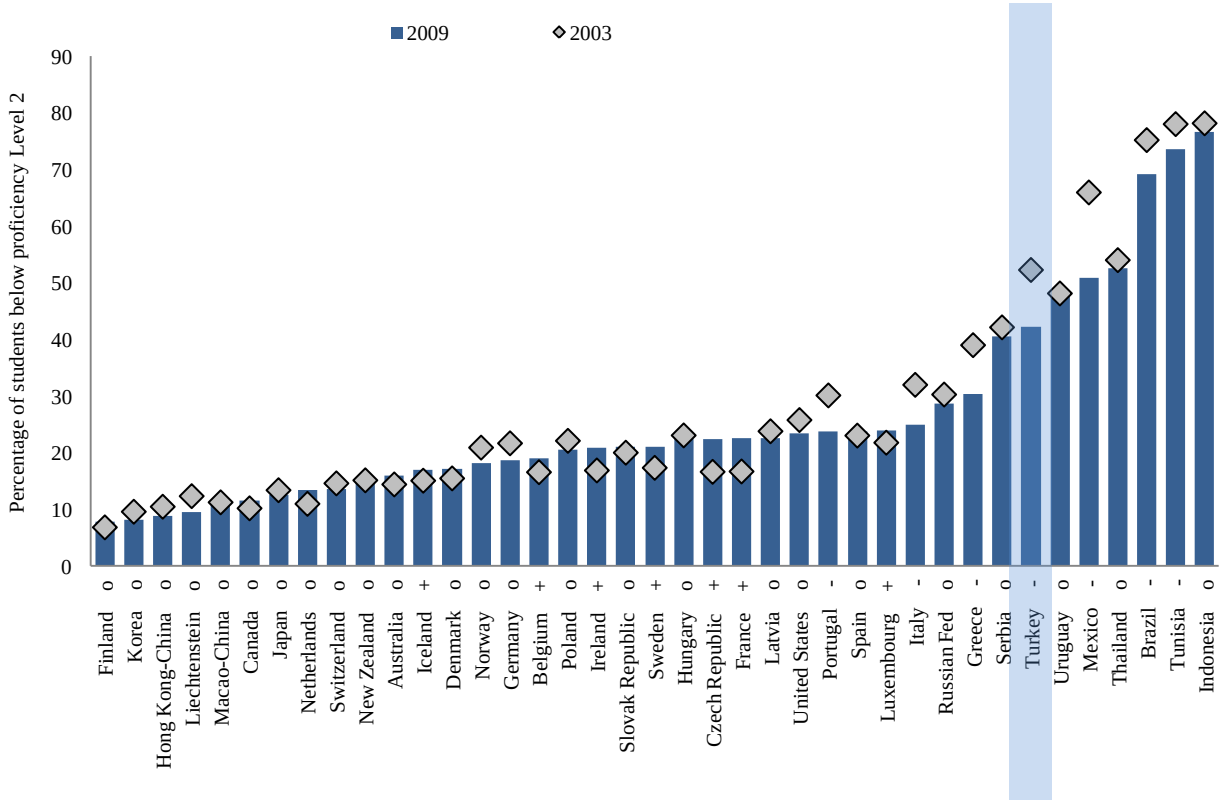



**Figure 19: Score point change in science between 2006 and 2009, PISA**



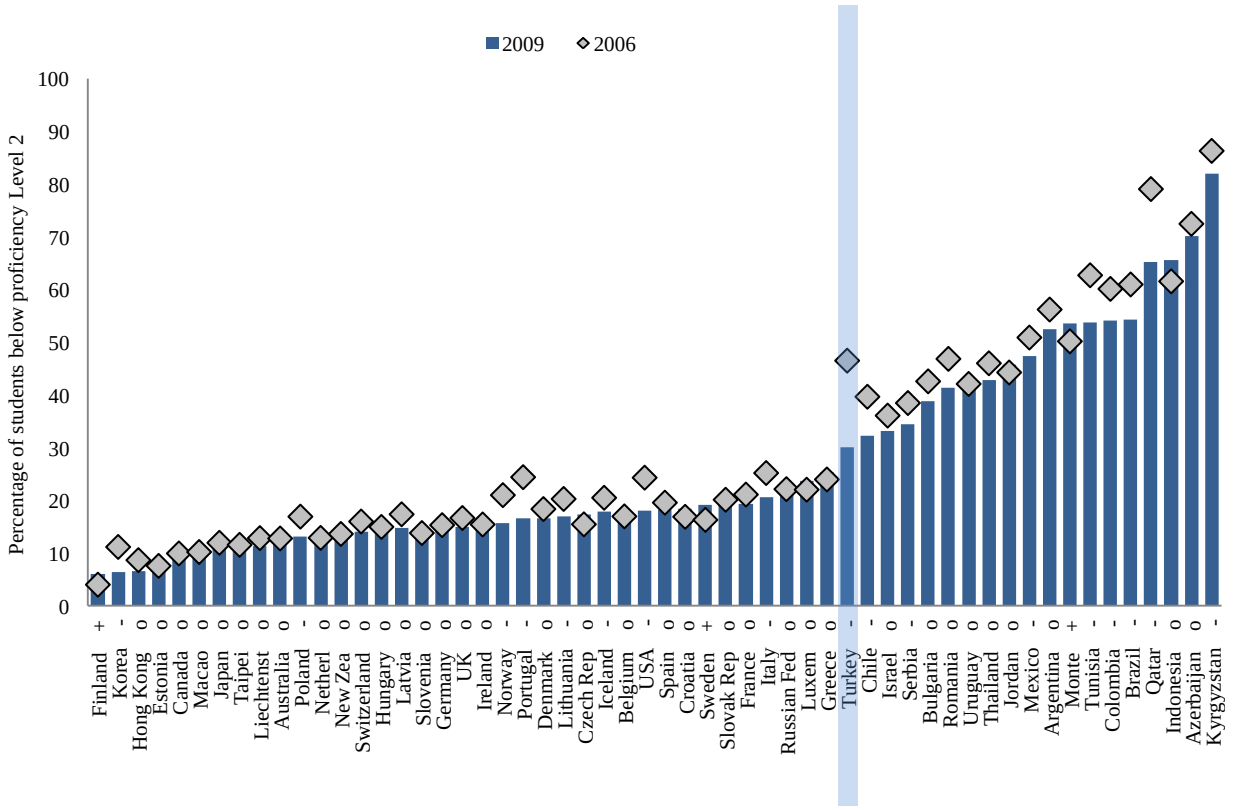
However these improvements did not occur uniformly. The percentage of students that falls below the proficiency level 2 decreased from 52 percent to 42 percent in mathematics (Figure 20) and from 47 percent to 30 percent in science[5] (Figure 21). On the other hand, the percentage of top performers did not show any increase or decrease between the two respective periods.

**Figure 20: Percentage of students below proficiency level 2, mathematics, PISA 2003 and 2009**




[5] In mathematics literacy students at proficiency level 2 can understand and discern situations in contexts that require no more than direct inference. Students at this level can make use of basic algorithms, formulae, procedures, or conventions. They are competent of direct reasoning and literal interpretations of the results. In science literacy students at proficiency level 2 have sufficient scientific knowledge to offer possible explanations in familiar contexts or draw conclusions based on uncomplicated investigations. They are competent of direct reasoning and literal interpretations of the results (OECD, 2010d).

**Figure 21: Percentage of students below proficiency level 2, science, PISA 2006 and 2009**




These trends in average student achievement in mathematics and science in Turkey highlight three important facts. First, for a period which follows 1999, average student achievement in mathematics and science is increasing, as determined from the international assessments for the student population which is either in grade 8 or 15 years old. Second, this increase in average student achievement is not uniform. Indeed, it is more intensive in the lower part of the student achievement distribution. Third, these improvements are not due to inflation in test score scales; average performance of students in Turkey is converging to international benchmarks as they are defined either by TIMSS or PISA.

These facts immediately raise several questions: Primary and secondary education systems in Turkey have been undergoing a restructuring since the late 1990s in response to swift developments in its economy and the demographics of its young population. One of the main

goals of this restructuring is to increase the quality of education in the country (Aksit, 2007). Are these changes in student achievement related to the restructuring of the education system in Turkey? If yes, is it possible to identify the channels through which the policy intervention leads to increases in student achievement?

## A. Hypotheses explaining rising student achievement

This dissertation examines whether these improvements in student achievement are connected and can be explained by a specific component of the education reform efforts. The teacher selection policy for public schools in Turkey was changed in 2002 and a teacher hiring system operating through a lottery was replaced with a teacher selection model that operates through competitive centralized testing of teachers. Thus this study hypothesizes that this policy change affected teacher effectiveness positively and this change in teacher effectiveness has been the main driving force of improvements manifested in TIMSS and PISA outcomes.

However, this shift in teacher selection policy was part of a much wider reform framework known as the Basic Education Programme (BEP). This World Bank-supported programme defined the framework of reforms in education according to the Law No. 4306[6] which was enacted in August 1997. The main objectives of this program were expanding primary education for children aged 6-14, enhancing the quality of their education and overall student outcomes, closing the performance gap between boys and girls, and providing equal opportunities (MONE, 2005). In line with these goals the MONE launched a series of interventions. These can be listed very roughly as matching the performance indicators of the European Union, developing school libraries, increasing the efficiency of the education system, ensuring that qualified personnel

[6] http://mevzuat.meb.gov.tr/html/24.html

were employed, integrating information and communication technologies into the education system and creating local learning centers, based in schools, that are open to everyone[7].

In response to these efforts, the attendance rate in the eight-year primary education system soared from 85 percent to 99 percent. Similarly, the attendance rate in the pre-primary education system increased from 10 percent to 25 percent. These increases led to an expansion of the education system by 3.5 million pupils. These quantitative expansions were accompanied by qualitative improvements: During the same period, average class size was reduced from approximately 40 to 30; conditions were improved in all rural schools and computer laboratories were established in every primary school. On the other hand, the cost of the Basic Education Program exceeded 11 billion USD dollars (OECD, 2010a) and Turkey's public spending on education rose from 2.3% of its GDP in 1995 to 3.1% in 2004[8].

The OECD (2010a) as well as the MONE also highlight the recent curriculum change in mathematics and science (TTKB, 2008) as the main driving force behind the increase in PISA performance: To support the objectives defined in the Basic Education Program, the government initiated massive and rapid curriculum revisions (DPT, 2003) and the transformation of teaching methods from teacher centered practices to constructivist and student centered practices (MONE, 2005). The new curriculum was launched in the 2006-2007 school year, starting from the 6th grade. The mathematics and language curriculum were also updated, starting with the 9th grade, and in the 2008-2009 school year a new science curriculum was in force. According to the Board of Education (TTKB) the aim of this transformation was to update the content of school education as well as to modernize the teaching philosophy and culture within schools.

[7] http://www.meb.gov.tr/Stats/Apk2002/502.htm
[8] http://stats.uis.unesco.org

Although the curriculum change is the preferred explanation provided by the MONE and some other research institutions in Turkey[9] for the rising learning outcomes, there are problems with this specific explanation: First, given that TIMSS covers the period between 1999 and 2007, the new curriculum, which was implemented after 2007, cannot not explain the improvement in learning outcomes which is evident in TIMSS data. Second, although the rise in math achievement in PISA between 2006 and 2009 is presented as evidence of the impact of the curriculum changes, the fact is that average achievement in mathematics in PISA is not comparable between 2006 and 2009 and cannot be used to support this hypothesis. And although the PISA science scores are indeed comparable between 2006 and 2009, the students who were subject to the curriculum change in science were 9th graders, which constitute only a portion of the PISA 2009 sample; moreover this portion experienced the new curriculum only for two semesters. It is not clear whether these students may drive a 0.3 standard deviation increase in science for the whole student population between 2006 and 2009.

As mentioned earlier, an alternative to the curriculum changes as an explanation for the rising student achievement is the change in teacher quality. One of the targets of the BEP was to ensure that more qualified personnel were employed in teaching. In line with this goal, the teacher selection policy was changed in 2002 from a lottery system to a selection method which operates via competitive centralized testing. This might have raised teacher effectiveness in public primary and secondary institutions if the test scores of teacher candidates are a reliable indicator of teacher effectiveness. While under a perfectly-operating lottery system, selected teachers are more or less randomly chosen from the pool of applicants, under a testing system, only the best teachers (according to their test scores) would be chosen out of the applicant pool. In addition, as

[9] http://bit.ly/iVZojN; http://bit.ly/j5tOLv

will be discussed later, the lottery system itself was manipulated through personal, family and political connections not based on merit.

But what determines teacher effectiveness and are scores on a teacher selection or teacher certification exam representative of teacher quality? The following section summarizes previous empirical studies focusing on these issues in teacher effectiveness and its causes.

## II. Review of the Literature

Learning outcomes are affected by many factors, including: students' ability, potential, enthusiasm and behavior; school management, resources and atmosphere; curriculum and content; and teacher ability, preparation, attitudes and practices. Schools and classrooms are elaborate and dynamic mediums and identifying the education production function and underlying technology through which these various inputs affect student outcomes continues to be a major challenge of educational research.

The existing literature is subject to a wide array of challenges, ranging from research design and methodology issues to data availability. Usually researchers are forced to use measures which are only partial indicators of learning outcomes and in many cases it is not possible to apply the appropriate methodologies required for reliable inference. Therefore the results, interpretations and policy implications of many studies are regularly questioned.

Keeping this caveat in mind, some general conclusions can be drawn from the body of research on the determinants of learning. First, out-of-school factors such as ability, motivation, parental characteristics, neighborhood and socioeconomic status are the strongest predictors of learning and it is not easy to change these factors through policy intervention in the short run. Second, among the factors which are open to policy influence, teacher quality is one of the most

important school input affecting learning. Santiago (2002), Schacter and Thum (2004) and Eide, Goldhaber and Brewer (2004) present extensive and detailed reviews of this line of research.

### A. Variation in teacher effectiveness

Empirical investigations analyzing the impact of teachers on learning usually estimate individual teacher effects by making use of student-teacher matched panel data sets with teacher fixed effects and then construct a teacher effectiveness distribution based on estimations of individual teacher effects. Studies employing this methodology suggest that teachers differ substantially in terms of effectiveness. Recent studies conclude that one standard deviation increase in teacher effectiveness is associated with a 0.1-0.15 standard deviation increase in the mathematics test scores of primary and secondary school students (Hanushek & Rivkin, 2010).

Empirical evidence also highlights that teachers are essential in influencing student learning: Rivkin et al. (2005) analyze a unique matched panel data from the UTD Texas Schools Project which allows them to identify teacher effectiveness based on student performance. They conclude that the contribution of a ten student reduction in class size is less than that of a standard deviation increase in teacher quality.

In another study, Rockoff (2004) analyzes a 10-year panel data of test scores and teacher assignments to understand how much teachers affect learning. The panel structure allows him to focus on differences in the performance of the same student with different teachers and to decompose the variation in teacher quality from variation in students' characteristics. His analysis suggests that variation in teacher quality explains 23 percent of the variation in the test scores that are potentially open to policy influence.

In addition to these findings, researchers in this literature have also tried to decompose total teacher effects into subcomponents related to various measured teacher characteristics such as teacher experience, teacher education, teacher certification etc. However these studies are in consensus that the available, measured teacher characteristics are only mildly associated with estimated individual teacher effects (Aaronson, Barrow, & Sander, 2007; Hanushek, 1992; Rivkin, et al., 2005; Rockoff, 2004).

**B. What explains variation in teacher effectiveness?**

These findings are in line with the meta-analyses conducted on school resources and teacher characteristics: Hanushek covered a significant number of studies from the US in three reviews. He compiled 147 separately estimated educational production functions from 33 publications (Hanushek, 1986). Later he updated this survey twice. In his 1989 study he compiled 187 estimations from 38 articles (Hanushek, 1989) and in 1997 he covered a set of publications available through 1994. This set included 90 publications and 377 separate estimates (Hanushek, 1997). The selection criteria to be included in these surveys were to be published in a book or refereed journal, relating some objective measure of student output to family and school characteristics, and providing information about the statistical significance of the estimated relationships.

Hanushek draws three main conclusions from these meta-analyses: First, the estimates obtained from educational production functions do not look promising for teacher education. These studies fail to establish a strong and consistent relationship between teacher education and higher student achievement. Second, the majority of the estimated coefficients for teacher experience point in the correct direction and 30 percent of the estimated coefficients exceed the conventional statistical significance level of 5 percent. However, the results for teacher experience are hardly

overwhelming; the relationship between teacher experience and student achievement is strong only relative to other school inputs[10]. Hanushek (1986, 1989, 1997) claims that the positive association between teacher experience and student achievement may be due to possible selection effects. He stresses that this finding may be a result of experienced teachers being allowed to select schools and classroom with higher achieving students. Third, as Table 3 shows, among the entire array of teacher characteristics considered, higher teacher test scores are most consistently associated with stronger learning outcomes.

**Table 3: Percentage Distribution of Estimated Effect of Teacher Characteristics on Student Performance**

| | 1986 | | 1989 | | 1997 | |
|---|---|---|---|---|---|---|
| | Statistically significant & positive | Positive | Statistically significant & positive | Positive | Statistically significant & positive | Positive |
| Teacher education | 6 | 30 | 7 | 35 | 9 | 42 |
| Teacher experience | 30 | 60 | 29 | 60 | 29 | 59 |
| Teacher test score | 28 | 78 | 26 | 58 | 37 | 64 |

Source: Author's calculations from the studies of Hanushek (1986, 1989, 1997)

Note, however, that these meta-analyses cover only studies based on US data and the evidence from other developed countries is scarce. There is no meta-analysis available for developed countries other than for the US. However, the study by Hanushek and Luque (2003) gives some insight on this front. They analyze TIMSS data for 18 developed and developing countries[11] and suggest that the findings are very similar to those yielded by the meta-analyses that only include studies from the US.

[10] Hanushek also summarizes estimated coefficients for student teacher ratio, per pupil spending, facilities and administrative inputs.

[11] Canada, Cyprus, Czech Republic, Greece, Hong Kong, Ireland, Japan, Latvia, Netherlands, New Zealand, Norway, Portugal, Thailand, Scotland, United States and Slovenia

As for developing countries, the first comprehensive meta-analysis dates back to 1987[12]. Fuller (1987) reviewed 60 studies investigating student achievement in developing countries. Later Fuller and Clarke (1994) expanded Fuller's 1987 study by surveying an additional 47 studies published between 1987 and 1993. These meta-analyses included studies that used at least some measure of student's social class as a control variable. A year later, Hanushek (1995) conducted a larger survey with the same criteria for the selection of studies based on his previous research (Harbison & Hanushek, 1992). Lastly, more recently, Glewwe et al. (2011) conducted a meta-analysis on developing countries and extracted estimates from studies published between 1990 and 2010. They filtered a very large pool of studies according to their methodological approaches and ended up with 79 studies which use at least simple OLS with at least one family background, school expenditure, teacher and one additional school variable as controls. A total of 43 of these 79 studies had a more complicated identification strategy, such as randomized controlled trials, difference-in-differences, regression discontinuity and matching designs.

These meta-analyses, which cover the last three decades, consistently show that teacher test scores are a stronger indicator of teacher effectiveness than teacher education and teacher experience and this distinction appears to be more pronounced in developing countries than in developed countries (see Table 4). Therefore, especially in developing countries, teacher test scores may provide valuable input for policy makers in designing teacher selection and hiring mechanisms.

[12] Relatively smaller surveys appeared earlier (Heyneman & Loxley, 1983; Schiefelbein & Simmons, 1981; Simmons & Alexander, 1978).

**Table 4: Percentage Distribution of Estimated Effects of Teacher Characteristics on Student Performance in Developing Countries (statistically significant and positive)**

| | | | | Glewwe et al. (2011) | |
|---|---|---|---|---|---|
| | Fuller (1987) | Fuller and Clarke (1994) | Hanushek (1995) | inc. OLS | exl. OLS |
| Teacher education | 46 | 54 | 56 | 33 | 15 |
| Teacher experience | 43 | 40 | 35 | 27 | 18 |
| Teacher test score | 100 | 100 | - | 55 | 65 |

Source: Authors calculations from the studies of Fuller (1987), Fuller and Clarke (1994), Hanushek (1995) and Glewwe et al.(2011)

However, it should be noted that the methodology and findings of these meta-analyses have been disputed. Hedges et al. (1994) conclude that there is a systematic positive relation between resource inputs and school outcomes after analyzing the same set of studies surveyed by Hanushek. They claim that vote counting, the methodology which Hanushek employed, is problematic. Similarly, Dewey et al. (2000) claim that the inclusion of parental income in educational production function estimates leads to misspecification and this avoids the detection of a consistent relationship between resources and outcomes. Lastly, the weighting of the studies surveyed was also an issue: Krueger (2002) notes that given that Hanushek equally weights each estimate his selection rule automatically extracts more estimates from publications which conducts subsample analyses by grade, race, gender etc. The shortcomings of these meta-analyses should be kept in mind.

## III. Teacher selection regimes in Turkey

### A. Overview of the teacher labor market in Turkey

The demand for school teachers in Turkey arises predominantly from the public sector. As of 2009, the OECD reports that the number of classroom teachers and academic staff in Turkey's

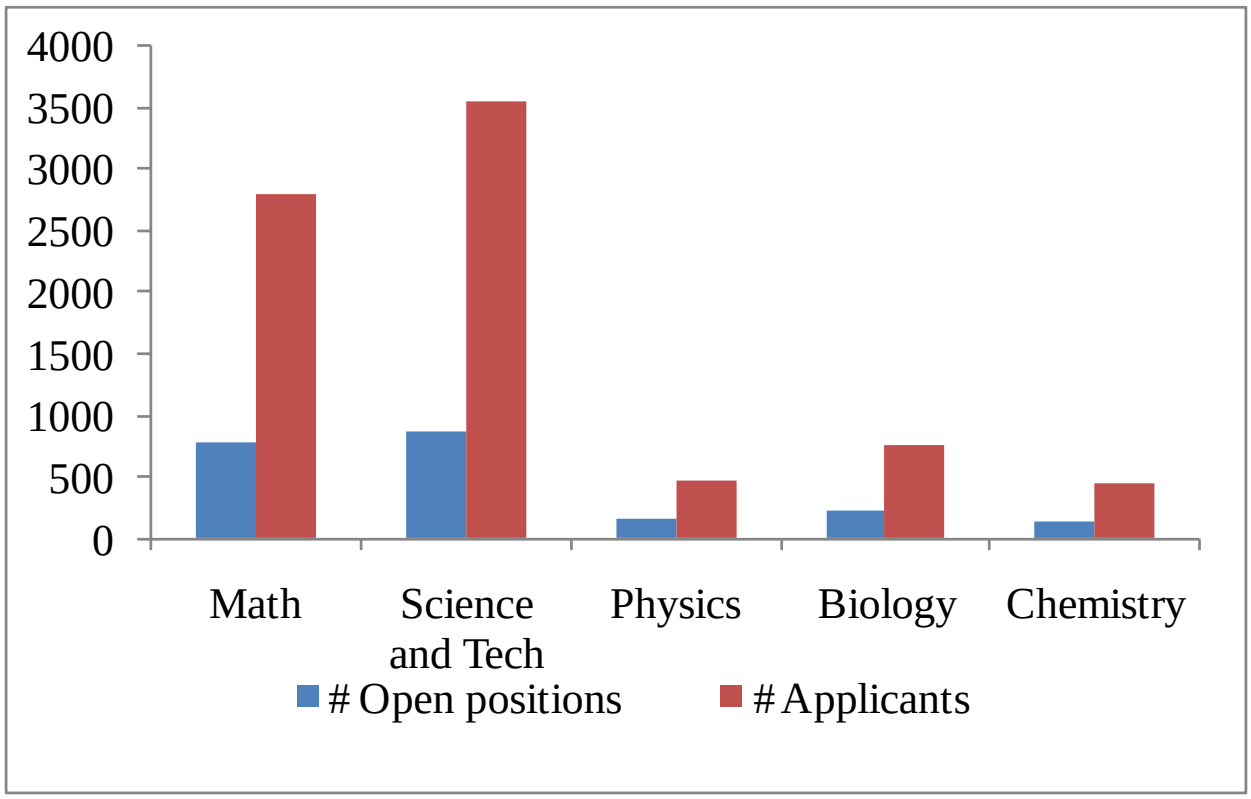
public sector was 722,338 whereas it was 57,539 in the private sector.[13] The governance of public education provision in the country is very highly centralized and this is reflected in the assignment of teachers to schools (Fretwell & Wheeler, 2001). Teachers are assigned to public schools from headquarters; thus schools do not have any autonomy in hiring teachers. However, the centralized nature is not only evident in human resource management. Almost every aspect of public education provision is tightly monitored and managed from headquarters in the capital, Ankara. For example, teachers do not have any role in curriculum design and schools do not have their own budgets to manage.

In general, Turkey has a concurrent model of initial teacher training. Teacher candidates for primary schools have to obtain a four-year degree from education faculties. However, for secondary schools there are two paths. In addition to teacher candidates emerging from education faculties, graduates of science and literature faculties are also allowed to register for teaching certificate programs and may qualify as teacher candidates after successful completion of this certificate program (EACEA, 2011b).

Another lingering characteristic of the teacher labor market in Turkey is an excess supply of teachers. In 2010 approximately 327,000 teachers were looking for a teaching position in the public sector and the number of applicants was three to four times higher than the number of available teaching slots, as Figure 22 shows. That same year, MONE demanded 782 mathematics teachers and received 2798 applications. For science, these figures were 861 and 3546[14], respectively. The gap is evident in every subject; excess supply is not specific to any subset of fields.

[13] http://stats.oecd.org
[14] http://personel.meb.gov.tr/ana_sayfa.asp

**Figure 22: The number of open positions and applicants by subject**




Source: Author's own calculations from http://personel.meb.gov.tr/ana_sayfa.asp

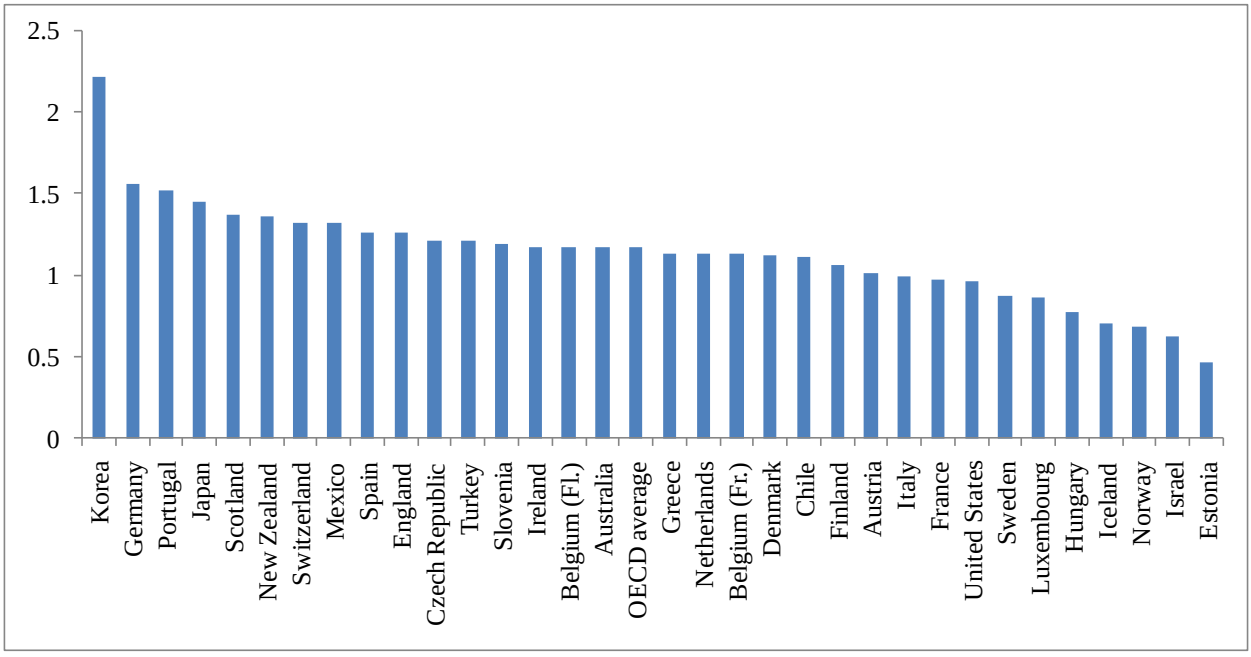
The army of inactive teachers represents a significant population given that the number of employed teachers in the public sector is 680,000. While MONE predicts that the desired level of employed teachers in the public education system is 717,000[15] the gap between supply of and demand for teachers has widened cumulatively over time.

It should be noted also total enrollment in education faculties in Turkey has increased steadily over time: The annual enrollment increased from 33 thousand in 2007 to 45 thousand in 2008 and to 54 thousand in 2009 whereas MONE expands the teaching force by approximately 30 thousand each year.

[15] http://icden.meb.gov.tr/digeryaziler/MEB_ic_denetim_faaliyet_raporu_2009.pdf

A possible explanation for the teacher surplus would be the presence of very attractive teacher salaries. However, teacher salaries in Turkey are not attractive at all. In the public sector the starting annual salary of a teacher is around $14,000 and ratio of teacher salary after 15 years of experience to GDP per capita is only slightly above OECD average, as Figure 23 shows.

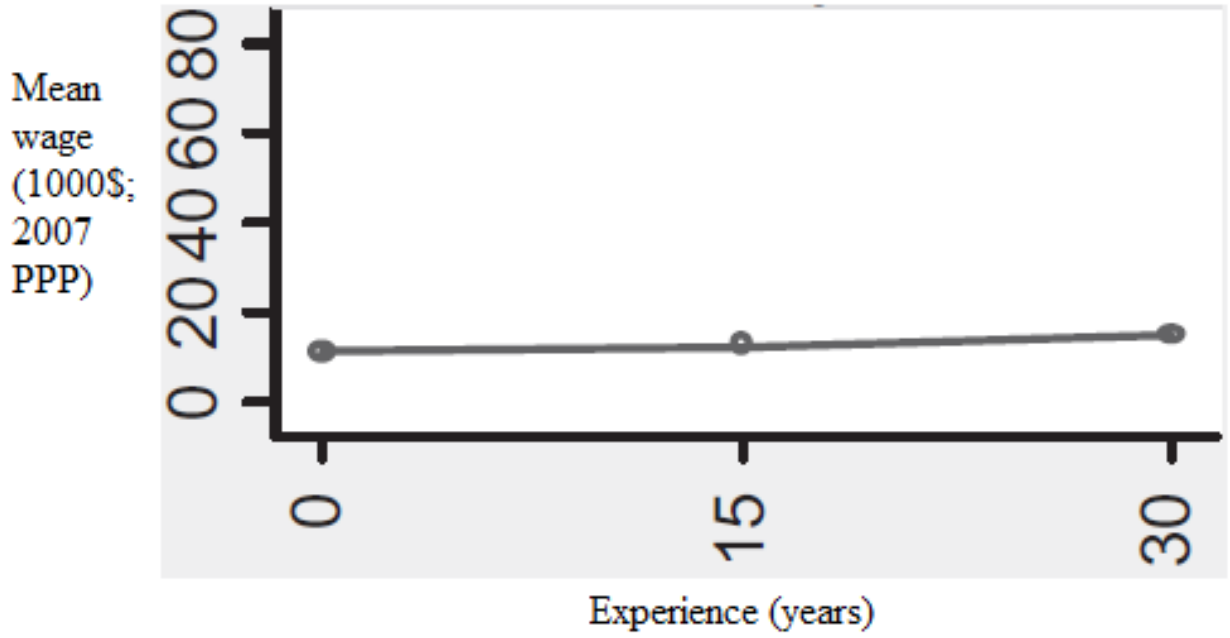
**Figure 23: Ratio of salary after 15 years of experience to GDP per capita**




Source: OECD (2009)

Furthermore, Dolton and Marcenaro Gutierrez (2011) present a cross-country analysis of teacher pay and performance by taking the relative earnings distribution in each country into account. Their analysis confirms that teacher salaries are not especially attractive in Turkey relative to other professions, and the salary-experience profile is flat, as Figure 24 depicts. Salaries do not improve much with experience. The salary of a teacher with 15 years of experience is around $16,000 (OECD, 2009). Therefore starting salaries and/or expectations of higher future salaries in the teaching profession cannot explain the excess supply in the teacher labor market in the country.

**Figure 24: Average teacher wage-experience profile in Turkey**




Source: Dolton & Marcenaro Gutierrez (2011)

Although pay may not be an issue, another important feature of Turkey's teacher labor market may lie behind the excess supply of teachers. All public servants are protected by law and unions and job separation is a very unlikely event. Therefore, the teaching profession offers substantial job security and given the presence of very high chronic unemployment rates, individuals value job security heavily.

One study (Caner & Okten, 2010) analyzes the college major choice decision in a risk and return framework using university entrance exam data for Turkey and shows that individuals choosing to study in education faculties are very sensitive to risk when it comes to career choice. A study focusing on a very large sample of entering students in education faculties (Aksu, Demir, Daloglu, Yildirim, & Kiraz, 2010) and another investigating teachers employed by the public sector (TED, 2009) also demonstrate that job security is one of the main motivators of attending education faculties as well as working as a teacher in the public sector.

## B. The legal framework for teacher selection in Turkey

There are three main legal regimes that regulate the hiring of public school teachers in Turkey. First, teachers working in the public sector are subject to Law No. 657. This law defines the rights as well as legal obligations of public servants since 1965. Second, *the regulation of the tests concerning the assignments of public servant candidates* states the testing procedures for public servant posts since 2002. Third, the MONE's *regulation of teacher assignment and replacement* explains how the testing procedures and test results apply to the teacher selection process. The current version of this regulation was legislated in 2010 and it has changed many times in the past according to the needs of the MONE.

Under the teacher selection regime prior to 2002, any eligible teacher candidate was able to apply to any available position announced by the MONE. The available teaching posts were distributed to applicants by lottery. This system was a cause of concern for the MONE as well as the State Planning Organization (SPO) (SPO, 1989). One of the main problems with the pre-2002 system was a constant imbalance of the teacher population across regions. According to the Research and Development Department of the MONE, one preliminary report of the 1993 National Education Assembly stressed that more than 10 percent of teachers employed by MONE in urban areas did not teach a single class. Another problem documented in MONE's records was that political pressures and interventions damaged the fairness and equality principles in the teacher labor market and caused unrest among teachers (EARGED, 1995). Indeed, it was well-known publicly that to have connections in provincial offices as well as in the capital was essential to win the lottery and get hired. Thus nepotism was a general worry concerning the selection process.

The new legal framework under *the regulation of the tests concerning the assignments of public servant candidates* changed the teacher selection regime fundamentally in 2002. At this date, the MONE abandoned recruiting teachers based on lottery and started to use teacher test scores. Following the legislation, the Center for Measurement, Selection and Placement (ÖSYM) launched a central examination process which is known as the Public Servant Selection Examination (KPSS).

This exam has two sessions. In the first session, teacher candidates have to answer 120 multiple choice questions about Turkish, Mathematics, History, Citizenship, General Culture and Geography in 180 minutes. In the second session, teacher candidates have to answer 120 multiple choice questions about educational psychology, educational programs and teaching and educational guidance in 180 minutes. Then applicants are assigned to provinces centrally by the MONE solely based on their test scores in the central examination and their ranked list of preferred provinces (see Table 5 for a hypothetical example of how this works). Once a teacher is placed to a province the governor has the authority to assign the teacher to a school in the province. ÖSYM conducts the exam annually and if a teacher candidate fails then s/he has to wait for the next appointment cycle.

**Table 5: A hypothetical presentation of teacher selection after 2002**

| | Ranking in the exam | Ordered list of provinces | Assignment result |
|---|---|---|---|
| Applicant 1 | 2 | B, C, A, D | B |
| Applicant 2 | 1 | C, B, D, A | C |
| Applicant 3 | 4 | A, B, C, D | D |
| Applicant 4 | 5 | D, C, B, A | Not assigned |
| Applicant 5 | 3 | B, A, C, D | A |

Under this teacher selection regime, it is not possible to game the hiring process and it is also not possible to leverage nepotism in order to get a teaching position. Thus it is reasonable to claim that the allocation of teaching positions based on test scores addresses the lack of merit and qualification as factors in the allocation of teachers under the previous regime. However one question remains to be answered: Does the new system ensure that the qualified teachers are employed?

## IV. Data and descriptive information

In order to answer the question of how teacher effectiveness has changed in Turkey and its consequences, the TIMSS 1999[16] and TIMSS 2007[17] data sets are employed. These data sets have some important qualities which render them very suitable to investigate this issue.

The TIMSS target populations in 1999 and 2007 included all students enrolled in the eighth grade and these projects assess a representative set of 8th graders. Therefore the samples in 1999 and 2007 form two comparable groups and more importantly the representativeness allows one to have a stronger basis to make policy implications. For this purpose, TIMSS utilizes a two-stage cluster sampling technique. According to this technique, the first step was to draw schools with probability proportional to size. This means that schools with larger student populations have a greater probability of being selected in the sample. Then classrooms were drawn randomly with equal probabilities.

The TIMSS project conducts four questionnaires, i.e. student, school, and mathematics and science teacher questionnaires. The student and teacher questionnaires contain extensive information about demographic and socioeconomic characteristics of students and teachers. In

[16] http://timss.bc.edu/timss1999.html
[17] http://timss.bc.edu/timss2007/index.html

addition, the school questionnaire contains information on school location, resources and governance. However, more importantly, it is possible to link teachers to students in the same classroom. Thus teacher characteristics may be matched with students' TIMSS achievement, which is a standardized measure.

The information collected via these questionnaires in 1999 and 2007 is comparable to a certain extent. The questionnaires in 1999 and 2007 do not overlap extensively; however most of the essential information is available in both data sets.

The policy change that is the subject of the evaluation in this study falls in the middle of 1999 and 2007, the dates that Turkey participated in TIMSS. Thus in the TIMSS 2007 data set there is a reasonable number of students and teachers who were subject to the policy change which was launched in 2002.

Lastly, teacher experience is reported in years such as 1, 2, 3 etc. but not in year categories such as 0-4, 5-8 etc. This distinction is crucial for this analysis because the data on teacher experience in TIMSS allows defining the treatment and control groups with respect to the inception date of the new policy.

In the TIMSS 1999 sample there are 206 schools with 7841 students. On average these students are 14.2 years old and 42 percent of them are female. Eight percent of them do not speak Turkish at home and 41 percent have more than 25 books at home. Only 29 percent of these students' parents have education that is higher than the secondary level and 37 percent are subject to low levels of instructional resources in their school. Lastly, 82 percent of them like mathematics/science and 26 percent are in school with low attendance status.

In the TIMSS 2007 sample there are 146 schools with 4498 students. On average these students are 14 years old and 46 percent of them are female. Eleven percent of them do not speak Turkish at home and 37 percent have more than 25 books at home. Only 31 percent of these students' parents have education that is higher than the secondary level and 26 percent are subject to low levels of instructional resources at the school. Lastly, 83 percent of them like mathematics/science and 25 percent are in schools with low attendance status (see Table 6).

**Table 6: Student characteristics**

| | Student characteristics | | | | | |
|---|---|---|---|---|---|---|
| | 1999 | | | 2007 | | |
| | TEXP>=5 | TEXP<=4 | Tot. | TEXP>=5 | TEXP<=4 | Tot. |
| Average age of students | 14.19 | 14.28 | 14.20 | 14.02 | 14.09 | 14.04 |
| % of female students | 0.43 | 0.37 | 0.42 | 0.47 | 0.45 | 0.47 |
| % of students who does not speak Turkish at home | 0.07 | 0.16 | 0.08 | 0.06 | 0.21 | 0.11 |
| % of students with more than 25 books at home | 0.44 | 0.32 | 0.42 | 0.42 | 0.23 | 0.37 |
| % of students with parental education is higher than secondary | 0.31 | 0.20 | 0.29 | 0.37 | 0.17 | 0.31 |
| % of students who likes mathematics/science | 0.81 | 0.84 | 0.82 | 0.83 | 0.83 | 0.83 |
| % of students who has low levels of resources for math | 0.37 | 0.40 | 0.38 | 0.25 | 0.27 | 0.26 |
| % of students with low attendance status | 0.29 | 0.14 | 0.27 | 0.24 | 0.28 | 0.25 |

In each school, one mathematics and one science teacher are in the sample. In 1999, 35 percent of this population is female with an average age of 36. They have 12 years of experience, 48 percent of them have a subject education degree and 44 percent of them serve in rural locations. In 2007, 51 percent of this population is female with an average age of 34. They have 9 years of experience, 62 percent of them have a subject education degree and 50 percent of them serve in rural locations (see Table 7).

**Table 7: Teacher characteristics**

| | Teacher characteristics | | | | | |
|---|---|---|---|---|---|---|
| | 1999 | | | 2007 | | |
| | TEXP>=5 | TEXP<=4 | Tot. | TEXP>=5 | TEXP<=4 | Tot. |

| | | | | | | |
|---|---|---|---|---|---|---|
| Average age of teachers | 38.91 | 26.98 | 36.44 | 38.40 | 27.09 | 33.73 |
| Percent of female teachers | 0.37 | 0.31 | 0.35 | 0.46 | 0.57 | 0.51 |
| Average experience of teachers | 14.54 | 2.52 | 12.05 | 14.14 | 2.24 | 9.23 |
| Percent of teachers with subject education degree | 0.49 | 0.43 | 0.48 | 0.55 | 0.73 | 0.62 |
| Percent of teachers in rural locations | 0.42 | 0.52 | 0.44 | 0.29 | 0.78 | 0.50 |

## V. Identification Strategy

For the empirical analysis the treatment group is defined as the students whose teachers have four or less years of experience in the TIMSS 2007. Although the teachers are not explicitly identified as teachers selected using the test-based regime (such information is not available in TIMSS), it is implied that they indeed are by the timing of the first central examination and the timing of the TIMMS data collection. The first central examination in Turkey was conducted in July 2002; ÖSYM announced the test scores in August 2002[18] and the MONE distributed the teaching posts based on announced test scores in September, October and November 2002[19]. On the other hand, the TIMSS 2007 application in Turkey was conducted in April, May and June 2007 (Olson, Martin, Mullis, & Arora, 2008). Thus a teacher who was hired with the first central examination would have been assigned to a post as early as September 2002 and the same teacher would have answered the TIMSS teacher questionnaire as late as June 2007. According to this hypothetical example this teacher could not have five years of experience at the time of TIMSS application. Therefore the treatment group is assumed to be as defined above: students whose teachers had four or less years of experience.

However, this is an imperfect measure of teacher selection via the central examination: First, teacher turnover leads to measurement error; because it is possible to quit and return to teaching, which may be an issue especially for female teachers who may stop teaching and take a yearlong

[18] http://www.osym.gov.tr/belge/1-6128/2002-sinavlari.html
[19] http://personel.meb.gov.tr/sayfa_goster.asp?ID=207

maternal leave[20]. Second, ÖSYM conducted another central examination which is known as the Central Elimination Examination for Institutions (DMS) in 2001[21]. DMS was different from KPSS and it is not clear how many teaching posts were distributed based on DMS scores as well as whether DMS scores were the sole determinant of the teacher assignments. This issue may lead to measurement error.

Keeping these shortcomings in mind, this study basically compares the difference of average student achievement between treatment and control groups in 1999 and 2007. Thus the study aims to compare two different estimates of teacher effectiveness. For that purpose, it focuses on across subject variation in 1999 and 2007 in a difference-in-differences framework in order to obtain unbiased estimates.

The econometric analysis estimates a classical education production function, which can be described as follows:

$$A_{ik} = \alpha + \beta X_{ik} + \delta S_k + \varepsilon_i + \theta_k \qquad (1.1)$$

In equation 1.1 the learning outcome, A, of student *i* in school *k* is established by a vector of her individual attributes (*X*) and by a vector of school and school-related inputs (*S*). $\varepsilon_i$ reflects the contribution of all unobserved student characteristics and $\theta_k$, all remaining unobserved school-level factors.

However, as described in the previous section, for each student there are data on teacher attributes by subject in both TIMSS 1999 and 2007. This feature allows the elaboration of the education production function in 1.1 one step further:

[20] According to Law No. 657 teachers are allowed to have an 8-week paid maternal leave and a 12-month unpaid maternal leave.
[21] http://www.osym.gov.tr/belge/1-12485/2001-sinavlari.html

$$A_{ijk} = \alpha + \beta X_{ik} + \gamma T_{jk} + \delta S_k + \varepsilon_{ij} + \vartheta_{jk} + \theta_k \quad (1.2)$$

Equation 1.2 defines the subject achievement function where *j* signifies the subject. $A_{ijk}$ is, simply, achievement level of student *i*, in the subject *j* in the school *k*. The vector *T* denotes the characteristics of the teacher of subject *j* and the error term is a combination of three levels, i.e. student, subject and school-level error terms. The difference-in-differences setup can be easily expressed in this subject level achievement function as follows:

$$A_{ijk} = \alpha + \rho TIMSS_i + \tau(TIMSS_i * TREAT_{ijk}) + \beta X_{ik} + \gamma T_{jk} + \delta S_k + \varepsilon_{ij} + \vartheta_{jk} + \theta_k \quad (1.3)$$

In equation 1.3, the *TIMSS* dummy variable denotes the TIMSS wave in which the student participated and *TREAT* is a dummy denoting whether the student's teacher had four or less years of experience or not. The $\tau$ coefficient is the one of interest as it is the difference in differences estimator. If the change of the teacher selection regime in 2002 had an impact on teacher effectiveness $\tau$ should be different from zero. However, an important caveat is that for the unbiased estimation of $\tau$ treatment status should not be correlated with unobserved time variant factors.

It should be noted that it is possible to estimate two subject achievement functions with TIMSS data, i.e. mathematics and science achievement functions. However, these estimations only allow for between student comparisons. On the other hand, the differenced version of these achievement functions permits within-student estimation and the differenced version can be written as:

$$A_{ijk} - A_{ilk} = \tau(TIMSS_i * TREAT_{ijk} - TIMSS_i * TREAT_{ilk}) + \gamma(T_{jk} - T_{lk}) + (\varepsilon_{ij} - \varepsilon_{il}) + (\vartheta_{jk} - \vartheta_{lk}) \quad (1.4)$$

In equation 1.4, student and school characteristics do not exhibit any variation across subjects *j* and *l*. Therefore, the vectors of student and school characteristics are no longer present in the differenced achievement function. However, the unbiased estimation of $\tau$ requires certain assumptions. First, student traits may be subject variant. For example, some students may be more willing to show effort in subject *j*. As long as these unobserved traits are uncorrelated with treatment status this issue will not lead to any bias in the estimates. Thus the assumption of $E(TIMSS_i*TREAT_{ijk} - TIMSS_i*TREAT_{ilk})(\varepsilon_{ijt} - \varepsilon_{ilt})=0$ should hold. Second, certain unobserved aspects of teacher attributes may be correlated with certain teaching techniques or attitudes. Thus, the assumption of $E(TIMSS_i*TREAT_{ijk} - TIMSS_i*TREAT_{ilk})(\vartheta_{ijt} - \vartheta_{ilt})=0$ should hold as well. In this case, the main challenge is the student-teacher sorting. School administrators may systematically match student and teachers based on certain unobserved student and/or teacher attributes.

Making use of within-student variation (across subject variation) at the cross-section is not a novel idea. In his well-known study, Dee (2007) focuses on within student comparisons in order to investigate the impact of teacher's gender on student achievement, Aslam and Kingdon (2007) analyze the connection between student learning and teachers' classroom practices with the same methodology and similarly Van Klaveren (2011) examines whether the proportion of time that teachers lecture in front of the class influences the cognitive performance of students by exploiting across subject variation. In this study, the steps of these researchers are followed and

the impact of the treatment is estimated by exploiting the across-subject variation within a difference-in-differences setup.

For the estimations, the dependent variable, i.e. test scores in TIMSS 1999 and 2007, is standardized with mean 0 and standard deviation 1 by TIMSS wave and subject and student dummies are included to the estimations in order to estimate the differenced version given in equation 1.4.

## VI. Findings

Table 8 presents the estimated values for the coefficients of interest under various specifications. Estimations in column labeled 1 reflect the model without any control variables. Then, teacher's gender (column 2), teacher's age (column 3), teacher's education (column 4), instructional time (column 5), class size (column 6) and level of instructional resources for subject (column 7) were added to the estimations step by step for robustness purposes, that is, in order to check whether the coefficient of interest is sensitive to the inclusion of additional control variables.

The results in Table 8 consistently show that estimated impact of the treatment status in 2007 is statistically different from zero and positive. Furthermore, the estimated impact magnitude, the direction of the impact as well as the statistical significance are not sensitive to the inclusion of additional control variables. Thus students with teachers who had four years or less of experience in 2007 had higher test scores than their counterparts in 1999, even after controlling for student and school characteristics with student dummy variables and for teacher and class characteristics with teacher's gender, age, education, instructional time, class size and level of instructional resources per subject. These estimations were repeated with more general specifications that included teacher's experience, squared term of teacher's experience, squared term for class size

and squared term for instructional time. The findings did not show any quantitative nor qualitative change. All in all, the findings highlight that there is an achievement difference of 0.2 standard deviations in favor of students whose teachers have four years or less experience in 2007.

### A. Sub-group analysis: Female teachers

Table 9 presents the estimations for the sub-group of students whose teachers are female. In general, estimated impacts of the treatment on students whose teachers are female and have four years or less of experience in 2007 are statistically different from zero and positive. In comparison to Table 8, the estimates imply that the impact sizes are much larger and they are more sensitive to the inclusion of additional control variables. However, the inclusion of additional control variables does not have an effect on the direction of the impact or the statistical significance. Without any controls, the estimated impact size is 0.45 standard deviations. After the inclusion of instructional time, class size and level of instructional resources for subject the estimated impact size climbs to 0.64 standard deviations.

### B. Sub-group analysis: Male teachers

Table 10 presents the estimations for the sub-group of students whose teachers are male. The estimates are statistically different from zero and positive. However, compared to Table 9, the impact sizes are much smaller and they are not sensitive to the inclusion of additional control variables. The various estimates show achievement differences of 0.08-0.13 standard deviations in favor of students whose teachers are male and have four years or less experience in 2007. Thus the impact of the teacher testing reforms appear to be stronger for female teachers than for male teachers, although the effects on the latter are not insignificant.

### C. Sub-group: Students with scores below the mean

The sub-group analysis was also conducted for students with scores lower than the mean. The aim of this analysis is to detect any heterogeneous effect which may be associated with the treatment status. Table 11 presents the estimations for this sub-group. The estimated impacts are positive and statistically different from zero but only with a 10 percent significance level. The estimates are not sensitive to the inclusion of additional control variables. In comparison with the estimated coefficients in Table 8, the impact sizes are slightly smaller. Large standard errors do not allow concluding that the estimates in Table 11 and Table 8 are statistically different from each other.

As an important note, this sub-group analysis was repeated with various other classifications: For example, students were separated by number of books at home and highest parental education. The findings of these different classifications were not different from the findings presented in Table 11, neither quantitatively nor qualitatively.

## VII. Robustness

The results at hand are in accordance with the main hypothesis of this study. Mathematics and science teachers with four or less years of experience in 2007 appear to be 0.2 standard deviations more effective than their counterparts in 1999. The methodology, i.e. focusing on across subject variation within a difference-in-difference framework, allows controlling for student and school level confounding factors and time invariant factors. However, this does not eliminate other potential sources of bias. Thus, for example if principals are more likely to match low-achieving students with more experienced teachers and if this tendency is much more intensified in 2007 then the findings above may be biased upwards. Another serious issue may be another policy change which overlaps with the timing of the change in teacher selection regime.

If this policy change has a positive effect on teacher quality overall, again, findings of this study may be biased upwards.

### A. Student-teacher sorting

The TIMSS 1999 and 2007 school questionnaires collected data on whether principals sort students to classes by their mathematics and science ability. In 1999, according to principals, 24 schools sorted students by their ability in mathematics as well as in science whereas 159 schools did not sort students in either subject. Six schools sorted students to classes by their mathematics ability but did not sort them by their science ability and one school sorted students by their science ability but did not sort them by their mathematics ability. In 2007, 38 schools sorted students by their ability in mathematics as well as in science whereas 103 schools did not sort students in either subject. Three schools sorted students to classes by their mathematics ability but did not sort them by their science ability and two school sorted students by their science ability but did not sort them by their mathematics ability. Van Klaveren (2011) defines strong sorting as a situation where students are assigned to classes based on their science and mathematics skills and weak sorting as a situation where students are assigned to classes based either on their mathematics skills or on their science skills. Thus there are 24 schools with strong sorting in TIMSS 1999 Turkey data and there are 38 schools with strong sorting in TIMSS 2007 Turkey data.

It should be noted that students have to be grouped by their ability in order to match them with teachers which possess certain characteristics that are potentially beneficial for student outcomes. Therefore, sorting students by ability is a prerequisite for student-teacher sorting. Thus this section, by focusing on schools with strong sorting, discusses whether student-teacher sorting cause any bias in the estimations presented in Tables 8-11.

Table 13 presents the estimations for the sub-group of schools with strong sorting. Estimated impact of the treatment status in 2007 is statistically different from zero and positive in all specifications. The direction of the impact as well as its statistical significance is not sensitive to the inclusion of additional control variables; however the impact size ranges between 0.3 and 0.16 standard deviations. Point estimates gradually drop to 0.16 from 0.30 standard deviations with the inclusion of each control variable. However none of them are statistically different from the estimates in Table 8. Thus this analysis fails to provide any evidence in favor of an upward bias which may be caused by student-teacher sorting.

**B. A Time-variant factor**

The pre-service teacher training programs in Turkey were restructured in line with the Basic Education Programme and the expansion of compulsory years of schooling to eight years in 1997. As a part of this restructuring, departments and programs of education faculties were reformed and programs such as science education and mathematics education for primary education were established under education faculties. Coordination between education and science and letters faculties was intensified and the share of in-class training was increased (T. C. Yükseköğretim Kurulu, 2007).

These changes were launched in the 1997-1998 academic year and incoming and current students of all pre-service teacher training programs were subject to these changes. Thus the restructuring affected the cohort of post-1998 graduates of education faculties and if these changes had an impact on teacher quality in Turkey then this may cause a bias in the estimation.

In order to address this issue another treatment variable was constructed. It is assumed that the graduating classes of 1999, 2000 and 2001 have 7, 6 and 5 years of experience in 2007,

respectively. Teachers with 5 to 7 years of experience were not subject to the new teacher selection policy and at least a significant portion of this population should have been subject to the reform of pre-service teacher training programs.

Table 12 presents the estimations which also include an interaction variable of TIMSS 2007 wave and students whose teachers have 5 to 7 years of experience. The coefficients on this interaction variable are statistically insignificant and the point estimates are negative in all specification. The estimated impact of the treatment status in 2007 (TIMSS wave 2007 * Teacher experience <= 4) is still statistically different from zero and positive in all specifications. The direction of the impact as well as the statistical significance are not sensitive to the inclusion of "TIMSS wave 2007 * Teacher experience >=5 & <=7"; however estimates are less precise. Thus this analysis fails to provide any evidence in favor of an upward bias which may be caused by the reform of pre-service teacher training programs which partially overlaps with the change of teacher selection regime.

## VIII. Discussion

The research in this dissertation suggests that the 2002 change of teacher selection regime in Turkey was associated with a 0.2 standard deviation increase in students' TIMSS achievement. Is it possible to interpret this finding in a causal way? This depends on the validity of assumptions underlying the methodology utilized in this analysis. Focusing on across-subject variation within a difference-in-differences framework allows controlling for confounding factors at the student and school level and time-invariant unobserved variables. However, student-teacher sorting and time-variant factors remain to be tackled to draw more reliable causal inferences. On the other hand, within the limitations of TIMSS 1999 and 2007 data sets no evidence has been found which supports the case of bias due to student-teacher sorting or other

time-variant factors. Therefore the change of teacher selection regime stands out as the most plausible explanation for increased teacher effectiveness between 1999 and 2007.

Sub-group analyses also draw attention to some other important aspects of the policy change in 2002. Female teachers hired after the introduction of centralized testing are much more effective than their counterparts. Apparently, with the introduction of the new teacher selection regime, the teaching profession attracted more qualified female candidates when compared to male candidates. This may be explained by the fact that the wages of men and women are at parity in the public sector whereas there is a large gender wage-gap in the private sector in favor of men (Tansel, 2005). Additionally, females with university degrees are two times more likely to be unemployed when compared to males. As of 2011, females with university degree had an unemployment rate of 15.2 percent whereas the same rate for males was 7.2 percent. Therefore the centralized testing procedure offers an important opportunity to females because centralized testing leads to employment in a public sector with high job security. The change in the gender composition of teachers between 1999 and 2007 is also in line with this inference. The share of female teachers soared from 35 percent in 1999 to 51 percent in 2007.

The sub-group analysis of students with scores lower than the mean is also in accordance with the general claim of this study. As mentioned in Section 3, teacher candidates are assigned to teaching positions based on their centralized test score and their preferred ranked list of provinces. Thus, top performers in the centralized test are likely to end up in schools where school resources are abundant; students predominantly speak Turkish at home and have high family wealth endowments. On the other hand, teacher candidates who have lower scores are likely to end up in schools with fewer resources, students whose mother tongue is not Turkish and have parents with low socioeconomic status. That is why the majority of students with scores

lower than the mean do not appear to match with the top performing teachers. Therefore their teachers' effectiveness will be low in comparison to teachers' whose students' scores are above the mean. This is in line with the findings presented in Table 11.

One more issue remains to be answered: TIMSS as well as PISA studies show that the increase in test scores is happening at the lower end of the student achievement distribution. If students with higher socioeconomic status and greater school resources are getting top performing teacher then how can one explain the increasing test scores at the lower end of the achievement distribution? Indeed, most of the opening teaching positions were in places where school resources and parental socioeconomic background was low. Although these students --which had lower school and family resources--, did not get the best teachers, the teachers they did receive were still much more effective than their counterparts in 1999. That is why the lower end of the achievement distribution improved in TIMSS and PISA studies. To provide more detail on this issue, in 2007 teachers with four or less years of experience were more likely to have more students who do not speak Turkish at home. Their students had fewer books and their students' parental education was lower. Similarly these students were subject to less educational resources and their attendance status was worse when compared to their counterparts in 1999.

Table 14 presents estimation results that do not include student dummies in order to provide some insight about the extent of between-student selection. As expected, the point estimate of treatment status in 2007 is negative in all of the specifications. In five of seven specifications the estimated impact is statistically different than zero. Lastly, with the inclusion of additional control variables, the coefficient of interest approaches zero and its precision becomes weaker. This finding clearly demonstrates that the student population faced by teachers with four years of

experience or less in 2007 is not similar to the student population faced by teachers with four years or less experience in 1999.

## IX. Conclusion

In Turkey, a teacher hiring system based on lottery was replaced with a teacher selection model (KPSS) which operates through centralized testing. This study evaluated the impact of this new teacher selection policy on mathematics and science test scores of 8$^{th}$ graders. The findings show that a 0.2 standard deviation increase in test scores can be attributed to the policy change and the estimated impact is much higher for students with female teachers.

The findings provide a reasonable explanation for the rising trend in student achievement in Turkey reported by TIMSS and PISA. First, since the analyzed period precedes the curriculum reform in Turkey, the findings cannot be attributed to the curriculum reform. Second, TIMSS data do not provide any evidence in favor of the reform of pre-service teacher training programs of 1997 whereas all of the findings are consistent with a possible impact of the introduction of the KPSS on teacher effectiveness.

Lastly, the results provide evidence in favor of the presence of a differential assignment of teachers into schools and classrooms. It may be claimed that the MONE attempts to ensure a more balanced distribution of teacher assignment across resource rich and poor regions. As mentioned earlier, the MONE as well as SPO were concerned about the imbalance of the teaching force across regions.

The interpretation of these findings in terms of policy implication should take into account the fact that the study does still have a number of limitations. These shortcomings are discussed in

the last chapter of the dissertation, which also provides a discussion of policy implications and makes suggestions for future research.

# X. Tables

## A. Estimation Results

### Table 8: Main results

| | -1 | -2 | -3 | -4 | -5 | -6 | -7 |
|---|---|---|---|---|---|---|---|
| Teacher experience <= 4 | -0.22** | -0.22** | -0.19* | -0.19* | -0.18* | -0.19* | -0.19* |
| | [0.10] | [0.10] | [0.10] | [0.10] | [0.10] | [0.10] | [0.10] |
| TIMSS wave 2007 * Teacher experience <= 4 | **0.21**** | **0.21**** | **0.21**** | **0.21**** | **0.20**** | **0.21**** | **0.21**** |
| | [0.10] | [0.10] | [0.10] | [0.10] | [0.10] | [0.10] | [0.10] |
| Teacher's sex = Female | | -0.01 | -0.01 | -0.01 | -0.02 | -0.02 | -0.02 |
| | | [0.02] | [0.02] | [0.02] | [0.02] | [0.02] | [0.02] |
| Teacher's age = 25-29 | | | 0.02 | 0.01 | 0.02 | 0.01 | 0.01 |
| | | | [0.02] | [0.02] | [0.02] | [0.02] | [0.02] |
| Teacher's age = 30-39 | | | 0.04 | 0.03 | 0.04 | 0.03 | 0.02 |
| | | | [0.03] | [0.03] | [0.03] | [0.03] | [0.03] |
| Teacher's age = 40-49 | | | 0.09*** | 0.09*** | 0.09*** | 0.09*** | 0.08** |
| | | | [0.03] | [0.03] | [0.03] | [0.03] | [0.03] |
| Teacher's age = 50-59 | | | 0.04 | 0.04 | 0.05 | 0.04 | 0.03 |
| | | | [0.04] | [0.04] | [0.04] | [0.04] | [0.04] |
| Teacher with education faculty degree | | | | 0.01 | 0.01 | 0.01 | 0.02 |
| | | | | [0.02] | [0.02] | [0.02] | [0.02] |
| Weekly teaching time in minutes | | | | | 0 | 0 | 0 |
| | | | | | [0.00] | [0.00] | [0.00] |
| Class size | | | | | | 0 | 0 |
| | | | | | | [0.00] | [0.00] |
| Instructional resources = Medium | | | | | | | 0.05 |
| | | | | | | | [0.03] |
| Instructional resources = High | | | | | | | 0 |
| | | | | | | | [0.05] |
| Observations | 15,912 | 15,912 | 15,912 | 15,912 | 15,912 | 15,912 | 15,912 |
| Adjusted R-squared | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 |

Robust standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Standard errors clustered at the class level

Base category for teacher's age = under 25

Base category for instructional resources = low

**Table 9: Sub-group analysis, female teachers**

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Teacher experience <= 4 | -0.46*** | -0.50*** | -0.52*** | -0.54*** | -0.63*** | -0.65*** |
| | [0.00] | [0.03] | [0.03] | [0.04] | [0.05] | [0.05] |
| TIMSS wave 2007 * Teacher experience <= 4 | **0.45*** ** | **0.50*** ** | **0.51*** ** | **0.54*** ** | **0.63*** ** | **0.64*** ** |
| | [0.05] | [0.04] | [0.05] | [0.05] | [0.06] | [0.06] |
| Teacher's age = 25-29 | | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 |
| | | [0.04] | [0.04] | [0.03] | [0.03] | [0.03] |
| Teacher's age = 30-39 | | -0.02 | -0.04 | -0.06 | -0.08 | -0.10* |
| | | [0.06] | [0.05] | [0.05] | [0.05] | [0.05] |
| Teacher's age = 40-49 | | 0.11* | 0.11* | 0.10* | 0.09* | 0.10* |
| | | [0.06] | [0.06] | [0.06] | [0.05] | [0.05] |
| Teacher's age = 50-59 | | 0.19*** | 0.19*** | 0.18*** | 0.16*** | 0.17*** |
| | | [0.06] | [0.06] | [0.06] | [0.06] | [0.05] |
| Teacher with education faculty degree | | | 0.04 | 0.04 | 0.04 | 0.05* |
| | | | [0.03] | [0.03] | [0.03] | [0.03] |
| Weekly teaching time in minutes | | | | -0.00 | -0.00 | -0.00 |
| | | | | [0.00] | [0.00] | [0.00] |
| Class size | | | | | 0.01*** | 0.01*** |
| | | | | | [0.00] | [0.00] |
| Instructional resources = Medium | | | | | | 0.11* |
| | | | | | | [0.06] |
| Observations | 7,071 | 7,071 | 7,071 | 7,071 | 7,071 | 7,071 |
| Adjusted R-squared | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 |

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1
Standard errors clustered at the class level
Base category for teacher's age = under 25
Base category for instructional resources = low

**Table 10: Sub-group analysis, male teachers**

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Teacher experience <= 4 | -0.16 | -0.06* | -0.08*** | -0.07*** | -0.07*** | -0.08*** |
| | [.] | [0.03] | [0.02] | [0.03] | [0.03] | [0.03] |
| TIMSS wave 2007 * Teacher experience <= 4 | **0.10*** ** | **0.08** ** | **0.12*** ** | **0.13*** ** | **0.12*** ** | **0.12*** ** |
| | [0.02] | [0.03] | [0.04] | [0.04] | [0.04] | [0.04] |
| Teacher's age = 25-29 | | -0.00 | -0.01 | 0.01 | -0.02 | -0.03 |
| | | [0.04] | [0.04] | [0.05] | [0.06] | [0.07] |
| Teacher's age = 30-39 | | 0.10** | 0.06 | 0.10 | 0.06 | 0.06 |
| | | [0.05] | [0.05] | [0.07] | [0.08] | [0.08] |
| Teacher's age = 40-49 | | 0.11*** | 0.12*** | 0.15*** | 0.13** | 0.13** |
| | | [0.04] | [0.04] | [0.06] | [0.06] | [0.06] |
| Teacher's age = 50-59 | | 0.07 | 0.08** | 0.11* | 0.08 | 0.08 |
| | | [0.05] | [0.04] | [0.06] | [0.07] | [0.07] |
| Teacher with education faculty degree | | | 0.07*** | 0.07*** | 0.07*** | 0.07*** |
| | | | [0.02] | [0.02] | [0.02] | [0.02] |
| Weekly teaching time in minutes | | | | 0.00 | 0.00 | 0.00 |
| | | | | [0.00] | [0.00] | [0.00] |
| Class size | | | | | 0.01 | 0.01 |
| | | | | | [0.00] | [0.00] |
| Instructional resources = Medium | | | | | | 0.02 |
| | | | | | | [0.05] |
| Instructional resources = High | | | | | | -0.01 |
| | | | | | | [0.06] |
| Observations | 8,841 | 8,841 | 8,841 | 8,841 | 8,841 | 8,841 |
| Adjusted R-squared | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 |

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1
Standard errors clustered at the class level
Base category for teacher's age = under 25
Base category for instructional resources = low

**Table 11: Sub-group analysis: underperforming students**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Teacher experience <= 4 | -0.16** | -0.16** | -0.17** | -0.17** | -0.17** | -0.18** | -0.18** |
| | [0.08] | [0.08] | [0.08] | [0.08] | [0.08] | [0.09] | [0.09] |
| TIMSS wave 2007 * Teacher experience <= 4 | **0.15*** | **0.14*** | **0.14*** | **0.14*** | **0.14*** | **0.15*** | **0.15*** |
| | [0.08] | [0.08] | [0.08] | [0.08] | [0.08] | [0.09] | [0.09] |
| Teacher's sex = Female | | -0.01 | 0.00 | -0.00 | -0.00 | -0.00 | -0.00 |
| | | [0.02] | [0.02] | [0.02] | [0.02] | [0.02] | [0.02] |
| Teacher's age = 25-29 | | | -0.01 | -0.01 | -0.01 | -0.01 | -0.02 |
| | | | [0.02] | [0.02] | [0.02] | [0.02] | [0.02] |
| Teacher's age = 30-39 | | | -0.03 | -0.04 | -0.03 | -0.04 | -0.04 |
| | | | [0.03] | [0.03] | [0.04] | [0.04] | [0.04] |
| Teacher's age = 40-49 | | | -0.01 | -0.01 | -0.01 | -0.02 | -0.02 |
| | | | [0.03] | [0.03] | [0.03] | [0.03] | [0.03] |
| Teacher's age = 50-59 | | | -0.04 | -0.04 | -0.04 | -0.05 | -0.05 |
| | | | [0.04] | [0.04] | [0.04] | [0.04] | [0.04] |
| Teacher with education faculty degree | | | | 0.01 | 0.01 | 0.01 | 0.02 |
| | | | | [0.02] | [0.02] | [0.02] | [0.02] |
| Weekly teaching time in minutes | | | | | 0.00 | 0.00 | 0.00 |
| | | | | | [0.00] | [0.00] | [0.00] |
| Class size | | | | | | 0.00** | 0.00** |
| | | | | | | [0.00] | [0.00] |
| Instructional resources = Medium | | | | | | | 0.05* |
| | | | | | | | [0.03] |
| Instructional resources = High | | | | | | | 0.37*** |
| | | | | | | | [0.04] |
| Observations | 8,235 | 8,235 | 8,235 | 8,235 | 8,235 | 8,235 | 8,235 |
| Adjusted R-squared | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 |

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1
Standard errors clustered at the class level
Base category for teacher's age = under 25
Base category for instructional resources = low

**Table 12: Time variant factors: Change in pre-service teacher training programs**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Teacher experience <= 4 | -0.22** | -0.22** | -0.18* | -0.18* | -0.18* | -0.18* | -0.18* |
| | [0.10] | [0.10] | [0.10] | [0.10] | [0.10] | [0.10] | [0.10] |
| TIMSS wave 2007 * Teacher experience <= 4 | **0.20*** | **0.20*** | **0.19*** | **0.19*** | **0.19*** | **0.19*** | **0.19*** |
| | [0.10] | [0.10] | [0.10] | [0.10] | [0.10] | [0.10] | [0.10] |
| Teacher experience >=5 & <=7 | 0.00 | -0.00 | 0.04 | 0.03 | 0.03 | 0.04 | 0.04 |
| | [0.06] | [0.06] | [0.06] | [0.06] | [0.06] | [0.07] | [0.07] |
| TIMSS wave 2007 * Teacher experience >=5 & <=7 | **-0.04** | **-0.04** | **-0.05** | **-0.05** | **-0.05** | **-0.06** | **-0.05** |
| | [0.07] | [0.07] | [0.07] | [0.07] | [0.07] | [0.07] | [0.07] |
| Teacher's sex = Female | | -0.01 | -0.01 | -0.01 | -0.01 | -0.02 | -0.02 |
| | | [0.02] | [0.02] | [0.02] | [0.02] | [0.02] | [0.02] |
| Teacher's age = 25-29 | | | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 |
| | | | [0.02] | [0.02] | [0.02] | [0.03] | [0.03] |
| Teacher's age = 30-39 | | | 0.03 | 0.03 | 0.03 | 0.03 | 0.02 |
| | | | [0.03] | [0.03] | [0.04] | [0.04] | [0.04] |
| Teacher's age = 40-49 | | | 0.08** | 0.08** | 0.08** | 0.08** | 0.08** |
| | | | [0.04] | [0.04] | [0.04] | [0.04] | [0.04] |
| Teacher's age = 50-59 | | | 0.04 | 0.03 | 0.04 | 0.04 | 0.03 |
| | | | [0.04] | [0.04] | [0.04] | [0.04] | [0.04] |
| Teacher with education faculty degree | | | | 0.01 | 0.01 | 0.01 | 0.02 |
| | | | | [0.02] | [0.02] | [0.02] | [0.02] |
| Weekly teaching time in minutes | | | | | 0.00 | 0.00 | 0.00 |
| | | | | | [0.00] | [0.00] | [0.00] |
| Class size | | | | | | 0.00 | 0.00 |
| | | | | | | [0.00] | [0.00] |
| Instructional resources = Medium | | | | | | | 0.05 |
| | | | | | | | [0.03] |
| Instructional resources = High | | | | | | | 0.00 |
| | | | | | | | [0.05] |
| Observations | 15,912 | 15,912 | 15,912 | 15,912 | 15,912 | 15,912 | 15,912 |
| Adjusted R-squared | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 |

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1
Standard errors clustered at the class level
Base category for teacher's age = under 25
Base category for instructional resources = low

**Table 13: Student-teacher sorting: Schools with ability sorting**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Teacher experience <= 4 | -0.28*** | -0.27*** | -0.18** | -0.17** | -0.10 | -0.13* | -0.11** |
| | [0.08] | [0.08] | [0.07] | [0.07] | [0.07] | [0.07] | [0.05] |
| TIMSS wave 2007 * Teacher experience <= 4 | **0.30*** ** | **0.29*** ** | **0.28*** ** | **0.27*** ** | **0.21*** ** | **0.22*** ** | **0.16*** ** |
| | [0.09] | [0.09] | [0.07] | [0.07] | [0.07] | [0.07] | [0.06] |
| Teacher's sex = Female | | -0.01 | -0.05** | -0.05** | -0.07*** | -0.06*** | -0.08*** |
| | | [0.02] | [0.02] | [0.02] | [0.02] | [0.02] | [0.02] |
| Teacher's age = 25-29 | | | 0.08* | 0.08* | 0.13*** | 0.13*** | 0.09*** |
| | | | [0.05] | [0.05] | [0.04] | [0.04] | [0.03] |
| Teacher's age = 30-39 | | | 0.14** | 0.15*** | 0.28*** | 0.24*** | 0.21*** |
| | | | [0.06] | [0.05] | [0.05] | [0.05] | [0.04] |
| Teacher's age = 40-49 | | | 0.16*** | 0.16*** | 0.26*** | 0.24*** | 0.23*** |
| | | | [0.06] | [0.05] | [0.05] | [0.04] | [0.03] |
| Teacher's age = 50-59 | | | 0.22*** | 0.21*** | 0.30*** | 0.27*** | 0.22*** |
| | | | [0.06] | [0.05] | [0.05] | [0.05] | [0.05] |
| Teacher with education faculty degree | | | | -0.03 | -0.03 | -0.02 | -0.02 |
| | | | | [0.03] | [0.02] | [0.02] | [0.02] |
| Weekly teaching time in minutes | | | | | 0.00*** | 0.00*** | 0.00*** |
| | | | | | [0.00] | [0.00] | [0.00] |
| Class size | | | | | | -0.02 | -0.05*** |
| | | | | | | [0.01] | [0.01] |
| Instructional resources = Medium | | | | | | | 0.09** |
| | | | | | | | [0.04] |
| Instructional resources = High | | | | | | | 0.51*** |
| | | | | | | | [0.07] |
| Observations | 2,944 | 2,944 | 2,944 | 2,944 | 2,944 | 2,944 | 2,944 |
| Adjusted R-squared | 0.87 | 0.87 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 |

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1
Standard errors clustered at the class level
Base category for teacher's age = under 25
Base category for instructional resources = low

**Table 14: Estimations without student fixed effect**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| TIMSS wave 2007 | 0.04 | 0.04 | 0.11 | 0.11 | 0.17** | 0.16* | 0.09 |
| | [0.07] | [0.07] | [0.07] | [0.07] | [0.08] | [0.09] | [0.09] |
| Teacher experience <= 4 | -0.38*** | -0.38*** | -0.21** | -0.21* | -0.17 | -0.17 | -0.19* |
| | [0.09] | [0.09] | [0.11] | [0.11] | [0.11] | [0.11] | [0.11] |
| TIMSS wave 2007 * Teacher experience <= 4 | **-0.11** | **-0.11** | **-0.16** | **-0.17** | **-0.19*** | **-0.19*** | **-0.16** |
| | [0.11] | [0.11] | [0.11] | [0.11] | [0.11] | [0.11] | [0.11] |
| Teacher's sex = Female | | -0.01 | -0.03 | -0.03 | -0.03 | -0.03 | 0.01 |
| | | [0.06] | [0.06] | [0.06] | [0.06] | [0.06] | [0.05] |
| Teacher's age = 25-29 | | | 0.15** | 0.15** | 0.16** | 0.16** | 0.15** |
| | | | [0.07] | [0.07] | [0.07] | [0.07] | [0.07] |
| Teacher's age = 30-39 | | | 0.13 | 0.13 | 0.17 | 0.17 | 0.13 |
| | | | [0.11] | [0.11] | [0.11] | [0.11] | [0.10] |
| Teacher's age = 40-49 | | | 0.40*** | 0.40*** | 0.42*** | 0.43*** | 0.41*** |
| | | | [0.11] | [0.11] | [0.11] | [0.11] | [0.10] |
| Teacher's age = 50-59 | | | 0.20 | 0.20 | 0.23 | 0.23 | 0.13 |
| | | | [0.14] | [0.14] | [0.14] | [0.14] | [0.13] |
| Teacher with education faculty degree | | | | -0.01 | -0.01 | -0.01 | -0.00 |
| | | | | [0.06] | [0.06] | [0.06] | [0.05] |
| Weekly teaching time in minutes | | | | | 0.00** | 0.00** | 0.00* |
| | | | | | [0.00] | [0.00] | [0.00] |
| Class size | | | | | | -0.00 | -0.00 |
| | | | | | | [0.00] | [0.00] |
| Instructional resources = Medium | | | | | | | 0.18*** |
| | | | | | | | [0.06] |
| Instructional resources = High | | | | | | | 0.78*** |
| | | | | | | | [0.15] |
| Observations | 15,912 | 15,912 | 15,912 | 15,912 | 15,912 | 15,912 | 15,912 |
| Adjusted R-squared | 0.04 | 0.04 | 0.06 | 0.06 | 0.06 | 0.06 | 0.09 |

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1
Standard errors clustered at the class level
Base category for teacher's age = under 25
Base category for instructional resources = low

# CHAPTER 4. EDUCATIONAL ATTAINMENT AND TIMING OF MARRIAGE AND FERTILITY: EVIDENCE FROM TURKEY

## I. Introduction

This study contributes to the literature on the relationship between educational attainment and timing of marriage and fertility. More specifically, it investigates whether the relationship between these two variables implies causality from educational attainment to timing of marriage and fertility.

The connection between investments in public education and increases in educational attainment and the question of whether an increase in educational attainment has an impact on fertility and marriage patterns have been thoroughly investigated by economists. Early studies describe the negative association between increased education and fertility as one of most clear-cut correlations in the social science literature (Cochrane, 1979) and quite a few empirical studies highlight a robust and negative relationship between female education and fertility. Schultz (1997) provides a detailed survey and an extensive list of studies on the association between female education and fertility, focusing on low income and developing countries.

Of course, the observed negative correlation between female education and fertility cannot be interpreted as a causal relationship since the reverse causality, that lower fertility allows households to invest more in education, is also possible. Indeed, this point has been made in the literature (Bledsoe, Casterline, Johnson-Kuhn, & Haaga, 1999). However, most of the cumulated research rarely discusses identification concerns and is generally only based on descriptive analyses. But the reality is that household and community characteristics are important factors that may affect simultaneously both educational attainment and fertility patterns in developing

countries and within those countries, by region. Moreover, fertility itself may have a direct causal impact on schooling decisions. Therefore, utilizing quasi-experimental methods that attempt to address identification issues are important in answering this type of research questions.

This study uses a quasi-experimental technique that seeks to adjust for biases due to the endogeneity of educational attainment to assess the impact of a policy change that drastically altered the education system in Turkey: the Compulsory Education Law enacted in 1997. This Law required that all the children enrolled in grade 4 or lower must stay in school until the completion of the eighth grade. Extending compulsory years of schooling from five to eight years necessitated a dramatic increase in teacher capacity. In urban areas, school availability was not the major problem; however lack of sufficient classroom capacity and inadequate number of teachers were main challenges constraining school attendance. Similarly, in rural areas the deterioration of educational quality in village schools became a serious issue and almost all of the rural schools were suffering from significant teacher turnover.

In line with the needs of the policy change, the MONE increased the stock of primary education classrooms by 80 thousand and the number of primary education teachers increased by more than 100 thousand between 1996-1997 and 2002-2003 school years. These figures correspond to a 41 percent rise in the number of classrooms and a 36 percent rise in the number of teachers. Total enrollment in primary education soared by 1 million students in the same time period. As a result, net enrollment rates in primary education increased from 85.63% in 1997 to 96.3% in 2003. It should be also noted that during the six years prior to 1997 enrollment rates as well as number of teachers were stagnating.

This study uses two repeated cross sections of women born between 1974 and 1990 from the 2003 and 2008 Turkey Demographic and Health Surveys. The research links female education to the timing of marriage and fertility utilizing historical region-level data on number of teachers between 1986 and 2001. The exposure of a woman to the Compulsory Education Law was determined both by the number of teachers in her region of birth and by her year of birth when Compulsory Education Law was initiated. After controlling for region of birth, year of birth, age effects and household characteristics, the interaction between dummy variables indicating the age of the individual in 1997, intensity of the Compulsory Education Law in her region of birth and DHS wave are plausibly exogenous variables and are used as instruments in the timing of marriage and fertility equations.

The estimates supplied below indicate that the Compulsory Education Law led to a 34 percentage point increase in the probability of completing eight years of schooling and an additional 1.5 years of schooling. These results are robust to different specifications.

Under the assumption that exposure to the Compulsory Education Law is a valid instrument for educational attainment, two-stage least squares estimations (TSLS) are conducted in order to estimate the impact of female education on timing of marriage and fertility. The results presented below indicate that TSLS estimates are statistically insignificant whereas the OLS estimates are negative and statistically significant. This suggests that OLS estimates may be biased. However the OLS estimates are still within the 95% confidence interval of the TSLS estimates.

The remainder of this study is organized as follows. Section 2 outlines relevant studies utilizing quasi-experimental methods. Section 3 provides background information on marriage and fertility in Turkey as well as on the Compulsory Education Law. Section 4 gives detailed

information on the data utilized and provides an overview of the identification strategy. In Section 5, the estimated impact of the Compulsory Education Law on education is presented. Section 6 is devoted to reduced form estimations and the two stage least square estimations attempting to establish a causal link between educational attainment and timing of first marriage and first birth. Section 7 discusses the findings and Section 8 presents the conclusions.

## II. Relevant studies utilizing quasi-experimental methods

There are several channels through which female education and fertility may be connected. The opportunity cost of child-bearing and rearing may be related to female education. For women with more years of schooling this cost may be higher than those with less years of schooling, which acts to reduce fertility (Becker, 1991). Child health and mortality may also be associated with mother's years of schooling. If more years of schooling lead to improvements in child health and mortality then preferred family size may be reached with fewer births (Schultz, 1994). Another channel between female education and fertility may be established via knowledge and use of family planning methods. Thus, female education may cause a change in reproduction technology and this may have an impact on fertility (Rosenzweig & Schultz, 1985). Lastly, women's status and bargaining power within the household may be related to years of schooling and this may affect fertility decisions (Eswaran, 2002).

The number of studies investigating causal links between female education and fertility is indeed very limited. There are only three studies for developed countries (Black, Devereux, & Salvanes, 2008; McCrary & Royer, 2006; Monstad, Propper, & Salvanes, 2008) and five studies for developing/low income countries (Breierova & Duflo, 2004; Gulesci & Meyersson, 2012; Kırdar, Dayıoğlu, & Koç, 2009; Kırdar, Dayıoğlu Tayfur, & Koç, 2011; Osili & Long, 2008).

For developed countries, the available empirical evidence comes solely from the US and Norway. McCrary and Royer (2006) use age-at-school entry policies to identify the effect of mother's schooling on the probability of motherhood and age at birth in Texas and California between 1989–2002. Their regression discontinuity approach highlights clearly that school entry policies have large effects on schooling: one-fourth of young Texan mothers and one-seventh of young California mothers born after the school entry date have a year less education than they otherwise would. Then they combine school entry laws with the mother's exact date of birth to form an instrument for schooling and their two-stage least squares (TSLS) analysis shows that these individuals are equally likely to become mothers and their age at birth are statistically not different.

Black, Devereux and Salvanes (2008) investigate the relationship between female education and the probability of teenage motherhood. They make use of changes in compulsory schooling laws in the US and Norway and they find evidence that increasing mandatory education reduces the probability of teenage motherhood and the size of the effect is similar in the US and Norway. However they only estimate reduced form equations. Thus their findings establish a link between changes in compulsory schooling laws and teenage motherhood but not years of schooling and teenage motherhood.

Monstad, Propper and Salvanes (2008) extends Black, Devereux and Salvanes (2008)'s study by solely focusing on Norway but also investigating the causal effect of education on the timing of the fertility of women born between 1947 and 1958 in Norway within an two-stage least squares framework. The source of exogenous variation in mothers' education is the change in compulsory years of schooling from seven to nine which was implemented over a 12-year period from 1960 to 1972 in different municipalities at different times. Their results indicate that an

additional year of schooling leads to reduction in the probability of giving birth when women are between 15 and 20 years old.

For developing countries, the empirical evidence comes from three different countries, i.e. Indonesia, Nigeria and Turkey. Breierova and Duflo (2004) study the impact of primary school construction programs in Indonesia between 1973–1974 and 1978–1979 on years of schooling and fertility. In this time period, over 60 thousand new schools were constructed and the allocation of these new schools varied considerably across the country's 281 districts. They use the product of year of birth and number of new schools built by district as an instrument for schooling to estimate the effects of mother's and father's education in fertility functions. They find that average years of schooling of parents have a negative impact on number of children born before age 15; however estimated standard errors are too large to draw the same conclusion for number of children born before age 25 and number of children ever born.

Osili and Long (2008) capitalize on a nationwide program in Nigeria that provided tuition-free primary education and which increased the number of primary school classrooms at varying rates across the 19 states of Nigeria in 1976 to investigate the connection between female education and fertility. The conception of their identification strategy is identical to Breierova and Duflo (2004)'s identification strategy. They utilize the product of year of birth and per capita amount of federal funds given to each state for classroom construction as an instrument for mother's schooling and estimate the number of births before age 25 in the 1999 Nigerian Demographic Health Survey. Two-stage least squares estimates of the effect of mother's schooling on the number of births before age 25 are negative and statistically significant.

For Turkey, three are three studies which examine the association between female education and timing of fertility and marriage mainly exploiting the variation in years of schooling triggered by the Compulsory Education Law which raised compulsory years of schooling from five to eight in 1997. Kırdar, Dayıoğlu and Koç (2009; 2011) investigated the impact of the Compulsory Schooling Law on the probabilities of getting married at 16 and giving birth at 17 in two consecutive studies. They primarily utilized duration analysis and compared cohorts which were born before and after 1986 in the cross sections of Turkey Demographic and Health Surveys (TDHS) of 2003 and 2008. Their analysis with TDHS 2003 shows that women born after 1986 were 34 percent less likely to get married at age 16 and also 44 percent less likely to give birth at age 17 (Kırdar, et al., 2009). Their analysis with TDHS 2008 shows that women born after 1986 were 44 percent less likely to get married at age 16 and 34 percent less likely to give birth at age 17 (Kırdar, et al., 2011).

Gulesci and Meyersson (2012) analyze the ever-married female subsample of TDHS 2008 to examine the same research questions with a regression discontinuity approach claiming that those who were born after September 1986 were under treatment and those who were born before September 1986 constitute the control group. The first stage estimation clearly highlights a significant difference between treatment and control groups. The treatment group had approximately one more year of schooling when compared to the control group. However, reduced form estimations and regression discontinuity-instrumental variable estimations do not provide any evidence indicating a difference in age at first marriage and age at first birth. Based on RD and RD-IV estimations they also present findings showing that women in treatment group were more likely to marry after age 16 and give birth after 17; however it is not clear whether it is appropriate to study these outcome variables with the ever-married female subsample. In

discussing their results on age at first marriage and age at first birth, Gulesci and Meyersson (2012) suggest that schooling may increase a woman's opportunities in the marriage market, which might lead to finding a husband earlier.

An important caveat concerning the examinations by Kırdar, Dayıoğlu and Koç (2009; 2011) and Gulesci and Meyersson (2012) is that these researchers do not exploit any measure of treatment intensity in their analyses and their results depend solely on variation over time. In essence, they compare cohorts in terms of timing of marriage and fertility before and after the initiation of the Compulsory Education Law. This study, on the other hand, makes use of a treatment intensity measure and capitalizes not only on variation in time but as well as variation within cohorts.

# III. Background information

## A. Population change in developing countries

All countries are subject to demographic transition and this transition can be categorized depending on the mortality and fertility rates of the human populations and the stages of their development. In pre-industrial stage mortality and fertility rates are high and approximately in balance. It is postulated that all human populations had this balance until late $18^{th}$ century. Because mortality and fertility rates were roughly in balance population growth was very slow during this stage. In connection with the initiation of industrialization this stage is usually followed by reduction in mortality rates. This decline in mortality rates is mostly associated with advancement in nutrition, food supply and sanitation which leads to higher life expectancy. It has been also put forward that the increase in female literacy rate and public health education programs established in late $19^{th}$ and early $20^{th}$ centuries were other driving sources behind the reduction of mortality rates during this period. In northwestern Europe mortality rates started to

decline in late 18th century and south and east Europe followed the same path in the next 100 years. Given that fertility rates do not exhibit a similar decline, population growth in this stage is typically high. However, after this stage fertility rates start to drop as well. This decline in the fertility rates are typically in relation with ascending wages, expansion of family planning methods, urbanization, fall in subsistence agriculture, rising status and education of women and higher parental investment in children. In developed countries in northern Europe fertility rates started to descend during late 19th century. However, it may be claimed that most of the developing countries are still in this stage. It should be noted that although fertility rates start to drop during this stage it is still higher than mortality rates. Thus population growth slows down; but remains positive. In the last stage of demographic transition fertility and mortality rates level off and most of the developed countries are assumed to be experiencing this stage since late 20th century. Therefore population growth stops in human populations experiencing the last stage of demographic transition. Additionally, in some of the developed countries such as Germany, Italy and Japan fertility rates are currently lower than mortality rates and this leads to shrinking of these populations (Caldwell, Caldwell, Caldwell, McDonald, & Schindlmayr, 2006). The fertility and mortality rates as well as the developmental stage of Turkey indicate that Turkey is still in the third stage of demographic transition, i.e. fertility rate is dropping; however fertility rate is still higher than mortality rate.

Obviously it is very challenging to identify the causal mechanisms which may be used to explain the variation in fertility and mortality rates between human populations and time periods. Not surprisingly, there is no consensus on the causes of demographic transition in the literature. Regarding the literature by demographers, Kirk (1996) notes that reduction in mortality is usually considered as the raison d'être for the reduction in fertility and claims that reduced

mortality leads to a healthier population which, in turn, leads to improvements in living condition which is typically regarded as a major determinant of fertility decline. However Kirk (1996) also underlines that findings of studies investigating causality from mortality decline to fertility decline is mixed.

In the economics literature reduced fertility is usually explained as a function of income, prices and preferences/tastes (Becker, 1991; T. P. Schultz, 1997). This approach received sustained criticism from other fields and it has been claimed that while economists' approach are not unsuccessful in explaining the demographic transition (Kirk, 1996) it is not compatible with evidence regarding fertility trends in pre-industrial human populations (Cleland & Wilson, 1987). Supported by extensive anthropological field research, Caldwell (1976) presented an attempt to unite economic, cultural and institutional theories for fertility decline. Although Caldwell (1976) was also claiming that pre-industrial societies were rational decision makers he argued that rational behavior operates within the framework of established social ends and these ends differed between human populations. In this respect Caldwell(1976) claims that industrialization/modernization and westernization are distinct processes and westernization is the primary force which leads to reduced fertility rates via the transmission of concepts of secularization and nuclear family, i.e. changes in social ends. The proposition of Leasthaege (1983) is even more culture-oriented than that of Caldwell's. He suggest that variation in fertility behavior is primarily connected to cultural differences, more specifically differences in secularism, materialism, religious beliefs and individuation. In its essence, Leasthaege (1983) establishes a theory of higher order needs (individualism and self-fulfillment) and claims that decrease in church attendance and secularization are highly connected with the rise of higher

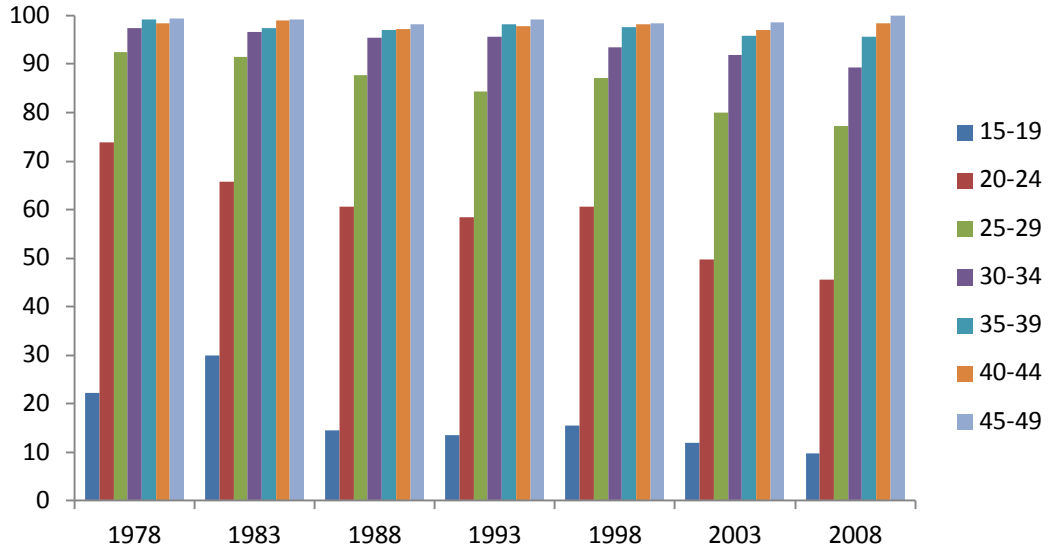
order needs which, in turn, leads to fertility decline. On the other hand, it is not clear how the ideas of Cladwell and Leasthaege can be tested with empirical data.

### B. Marriage and fertility in Turkey

The evidence provided by the studies briefly summarized above is mixed regarding the relationship between female education and fertility/marriage in various countries. Thus it is crucial to depict the contextual setting concerning fertility and marriage in Turkey before moving forward.

In Turkey, according to the TDHS 2008, almost all of the women get married at least once by the age of 49. The share of never-married women aged 45-49 is 0.1 percent and divorce is a very rare event: 1.7 percent of women aged 15-49 are divorced and 1.6 percent are not divorced but living separately. Thus for the vast majority of women marriage happens only one time during their lives. It is also worth mentioning that during the last three decades age at first marriage exhibits a positive trend. In 1978, 22 percent of women aged 15-19 were ever-married and this figure dropped to 10 percent in 2008. In 1978, 74 percent of women aged 20-24 were ever-married and this figured dropped to 46 percent in 2008 (Figure 25) (Hacettepe University Institute of Population Studies, 2009).

**Figure 25: Percentage distribution of ever-married women by age groups, 1978-2008**

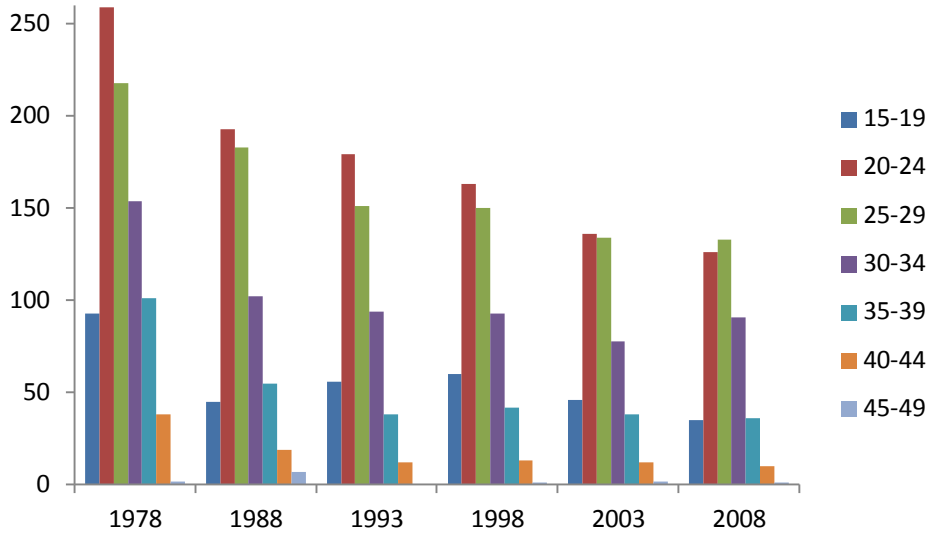



Similarly, median age at first marriage also presents a positive trend. According to the TDHS 2008, median age at first marriage increased from 19.8 years for women aged 45-49 to 22.6 years for women aged 25-29. Median age at first marriage is approximately 2 years greater in urban areas and it is also positively correlated with level of education. Median age at first marriage for women with at least a high school degree is 5-6 years higher than for women with no primary education degree (Hacettepe University Institute of Population Studies, 2009).

Timing of first birth is tightly connected to timing of marriage. First birth occurs about 1.6 years after marriage on average. The total fertility rate is around 2 children per women in urban areas and 2.68 children in rural areas. This rate also differs by level of education: Women without primary education degree have a total fertility rate of 2.65 whereas women with at least high school degree have a total fertility rate of 1.53. The trend of age-specific fertility rates are downward sloping for the last three decades. There were 93 births per thousand women aged 15-19 in 1978 and this figure decreased to 35 in 2008. Similar trends are true for other age groups (Figure 26) (Hacettepe University Institute of Population Studies, 2009). Lastly, births to

unmarried women are very rare events. According to TDHS 2008 there are almost no births to unmarried women.

**Figure 26: Age specific fertility rates (per 1000 women, 1978-2008)**




## C. Compulsory Education Law

Public discussions on raising schooling in Turkey to eight years of compulsory education date back to 1946. In that year, the Third National Education Convention recommended an increase in compulsory years of schooling from five to eight; however, this recommendation did not attract much attention until 1961. Then, that year, Primary Education Law numbered 222 established the ages of 7-14 as compulsory education period and increased compulsory years of schooling to eight. However, the Primary Education Law also segmented these eight years into two components: The first five years constituted the primary education and the following three years formed the lower secondary education (Arı, 2002) and contradicting the clear provisions of the Primary Education Law, only five years of primary education were implemented as compulsory (Başaran, 1994).

In the following years, moving to the eight years of compulsory schooling were discussed by the Tenth through Fifteenth National Education Conventions and two pilot studies in were conducted in 1971 and 1981 in 22 provinces and 28 schools. After the first pilot study, in 1973, the Basic Law of National Education numbered 1739 was passed. This law established eight years of compulsory schooling as an ideal to achieve. Then, after the second pilot study was concluded, the second and seventh articles of the Basic Law of National Education were amended in 1983 as follows: "Primary education covers children aged between 6 and 14. Primary education is compulsory for all female and male citizens and free in public schools". However, an additional amendment (Law numbered 2917) followed this one in the same year: "Until middles schools (schools serving grades 6 to 8) are accessible nationwide only the first five years of primary education are compulsory".

Until 1997, middle schools remained out of the coverage of compulsory education. However, at last, Law number 4306, passed in August 1997, amended one more time the Basic Law of Education. This amendment defined primary education institutions as schools serving grades 1 to 8 and grants a unified degree of primary education. Thus this amendment abolished middle schools and legally and effectively increased compulsory years of schooling from five to eight starting from the 1997-1998 school year.

This breakthrough was supported by substantial new funding which financed additional infrastructure and human resources so as to replace the system consisting of five-year primary schools and three-year middle schools with one consisting of eight-year primary schools. Total annual expenditures, including all investment and recurrent costs and loans that directly support primary education were estimated at more than USD 3 billion annually (Dulger, 2004). The OECD reports that resources devoted to this expansion exceeded USD 11 billion in total (OECD,

2010b). These resources were targeted mainly to disadvantaged areas as the government saw the program as an instrument to decrease inequalities in school access.

# IV. Data and methodology

## A. Data

The data used in this study comes from the Turkey Demographic Health Surveys (TDHS) of 2003 and 2008. The study focuses on women who were between 18 to 29 years old in 2003 and 2008. Among those individuals those who were between 18-22 are defined as the young cohort whereas those who were between 23-29 are defined as the old cohort. In total, there were 10335 women in these age categories; however, this number declines to 9933 after excluding women with missing marital status or age at marriage information.

For the TDHS 2003, mean years of schooling for the young and old cohorts are very close to each other. Both cohorts have on average of 7.5 years of schooling, with 44 percent of women completing eight years of schooling and with the young cohort slightly more likely to complete eight years of schooling. Close to 9 percent of the young cohort had their first marriage at age 16 or earlier and for the old cohort the equivalent figure is 13 percent. Similarly 6 percent of the young cohort gave their first birth at age 17 or earlier whereas 10 percent of old cohort gave their first birth at age 17 or earlier.

In the TDHS 2008, the mean years of schooling of young cohort was 1.1 years higher than that of the old cohort and 72 percent of the young cohort completed eight years of schooling whereas only 45 percent of the old cohort completed eight years of schooling. About 7 percent of women in the young cohort had their first marriage at age 16 or earlier while for the old cohort the

equivalent figure was 10 percent. Similarly, 5 percent of the young cohort gave their first birth at age 17 or earlier whereas 8 percent of the old cohort gave their first birth at age 17 or earlier.

Using information on the region of birth, the TDHS data is matched with administrative data on the number of teachers serving in grades 1-8 in each region and the number of children aged 6-13 in each region. The source of administrative data is the MONE's statistical yearbooks. These administrative data are available at the regional level and data collection was conducted for the school years between 1986-1987 and 2001-2002. The data on number of children aged 6-13 in each region are constructed based on calculations from the 1985, 1990 and 2000 Censuses. By compiling these data it became possible to compare the number of teachers per 1000 children for each woman in their region of birth when they were at the modal age of fifth grade, i.e. 10 years of age. In TDHS 2003, the mean number of teachers per 1000 children for young cohort was 27 and the equivalent for the old cohort was 25. In the TDHS 2003, the mean number of teachers per 1000 children for the young cohort was 29 and the equivalent for the old cohort was 26.

**Table 15: Descriptive Statistics**

| | 2003 | | | 2008 | | |
|---|---|---|---|---|---|---|
| | 18-22 | 23-29 | Total | 18-22 | 23-29 | Total |
| Mean years of schooling | 7.56 | 7.48 | 7.52 | 8.73 | 7.63 | 8.11 |
| At least eight years of schooling (%) | 0.47 | 0.42 | 0.44 | 0.72 | 0.45 | 0.57 |
| First marriage at 16 years of age (%) | 0.09 | 0.13 | 0.11 | 0.07 | 0.10 | 0.09 |
| First birth at 17 years of age (%) | 0.06 | 0.10 | 0.09 | 0.05 | 0.08 | 0.07 |
| Teachers per children aged 6-13 in region of birth when individual was 10 years old | 0.027 | 0.025 | 0.026 | 0.029 | 0.026 | 0.027 |
| Number of observations | 2413 | 2850 | 5263 | 2577 | 2093 | 4670 |

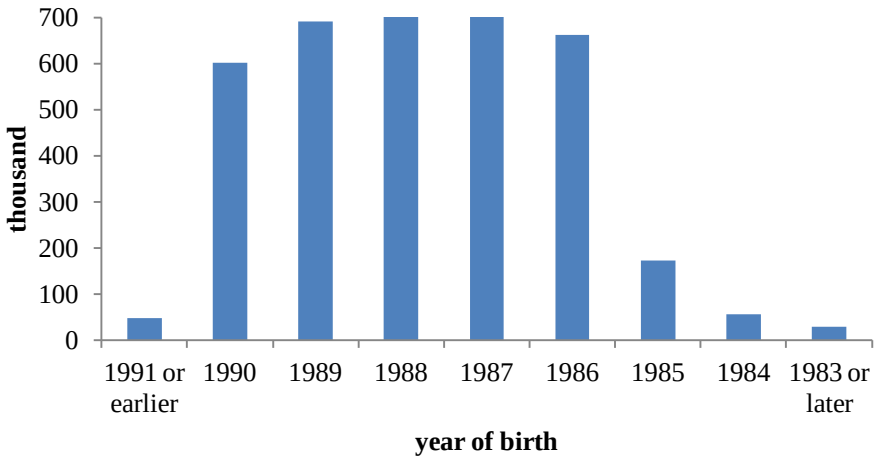
This descriptive presentation highlights several important points: First, the young cohort in 2008 has a higher level of education and is far more likely to complete eight years of schooling than the young cohort in 2003. On the other hand, the young cohort in 2008 does not appear to be much different than the young cohort in 2003 in terms getting married at 16 and giving birth at

17. Lastly, the young cohort in 2008 benefited from a higher number of teachers per child when compared to the young cohort in 2003. However, descriptive statistics only allow for a basic comparison across cohorts. The following subsection gives a formal exposition of the identification strategy used in this dissertation.

## B. Identification strategy

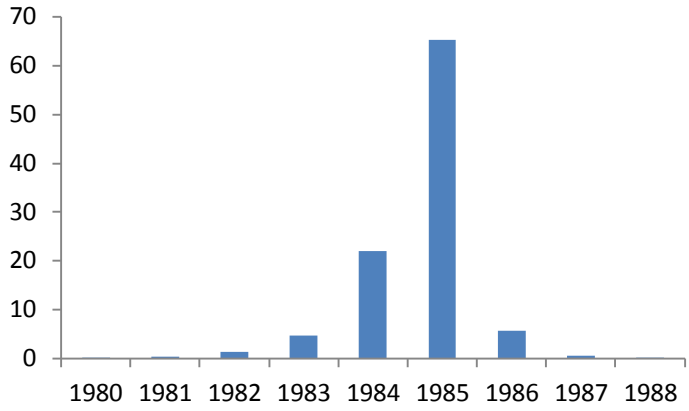
The identification strategy depends on the assumption that the year of birth of women captures variation in time. Cohorts born earlier than 1987 were not subject to the Compulsory Education Law whereas cohorts born in 1987 and afterwards were subject to the Compulsory Education Law. Once again, it should be underlined that the Compulsory Educational Law increased compulsory years of schooling from five to eight and was in force starting in the1997-1998 school year. Thus, those who completed grade four in the 1996-1997 school year were the earliest cohort which was subject to the Compulsory Education Law. Administrative data of the student population by year of birth and grade is not available; however data on the student population at public primary schools by year of birth provides the picture presented in Figure 27. Based on this figure, it is inferred that those born in 1987 constitute the major population across fourth grade in public primary schools.

**Figure 27: Number of students in public primary schools (grades 1-5, 1996-1997 school year)**




The TIMSS 1999 data, which was collected from a nationally representative sample of eighth grade students during the 1998-1999 school year also exhibits a similar pattern. According to this source, 65 percent of eight graders in the 1998-1999 school year was born in 1985 and 22 percent was born in 1984. Thus it may be claimed that the majority of students at grade 6 in 1996-1997 school year was born in 1985. Then it may be also claimed that the majority of students at grade 4 in the 1996-1997 school year was born in 1987 (Figure 28). Therefore, administrative as well as survey data suggest that the 1987 cohort is the first cohort which was subjected to the Compulsory Education Law.

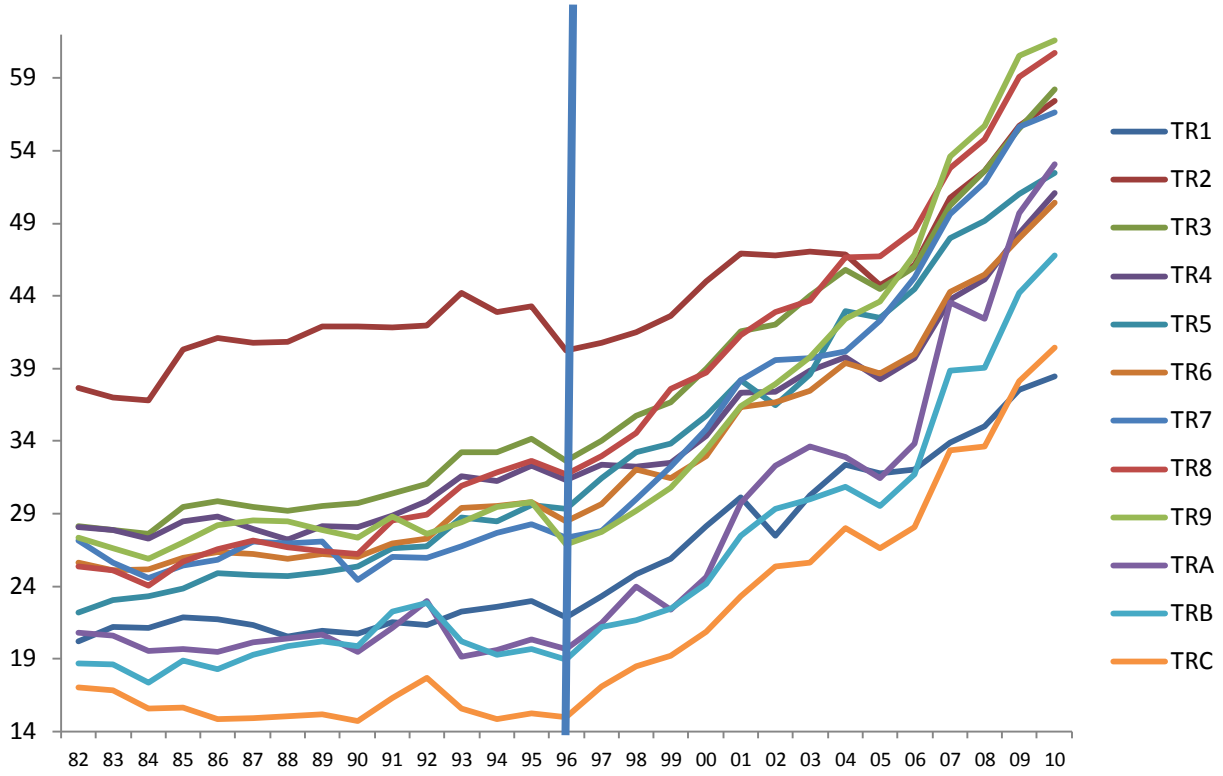
**Figure 28: Percentage distribution of student population by year of birth (1998-1999 school year, grade 8, TIMSS 1999)**




However, solely focusing on variation across cohorts may lead to deceptive conclusions because of unobserved events occurring simultaneously with the Compulsory Education Law. Therefore, it is also assumed that region of birth captures within year of birth variation in the intensity of the implementation of the Compulsory Education Law. For that purpose, the number of teachers per children aged 6-13 in the region of birth when women were 10 years old are used as an indicator of treatment intensity. The treatment intensity variable is constructed in this way because the 1987 cohort was 10 years old at the beginning of the 1997-1998 school year.

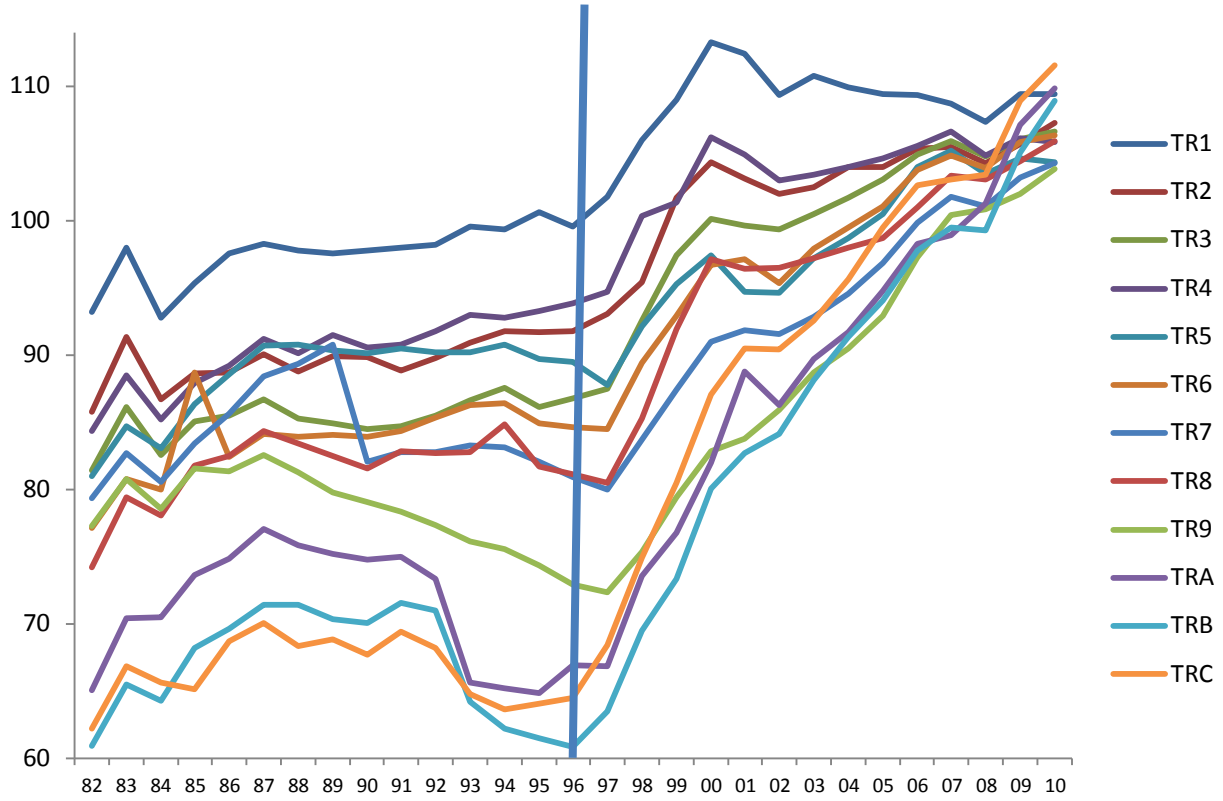
Between 1982 and 1996, the number of teachers per 1000 children aged 6-13 in each region remained relatively stable; however it started to soar in the 1997-1998 school year. On the other hand, the extent of this increase varied across regions. The number of teachers per 1000 children aged 6-13 ascended by more than 50 percent in South-eastern and North-eastern Anatolia and more than 40 percent in Central-eastern Anatolia between 1997 and 2001 whereas the increase was more modest in West and East Marmara, equal to less than 20 percent as Figure 29 shows.

**Figure 29: Number of teachers per 1000 children aged 6-13 (1982-2010)**




Similarly, between 1982 and 1996 the gross enrollment rate between first and eighth grades remained stagnant. However, in tandem with the initiation of the Compulsory Education Law and the expansion of the number of teachers, gross enrollment rates also started to rise and this increase exhibited considerable regional variation as well. As Figure 30 depicts, gross enrollment rates ascended dramatically in South-eastern, North-eastern and Central-eastern Anatolia whereas the increase was much moderate in regions where the gross enrollment was already close to 90 or above 90 percent such as West, East Marmara and Western Anatolia.

**Figure 30: Gross enrollment rate (%, grades 1-8)**




The discussion so far indicates that women's exposure to the Compulsory Education Law is determined jointly by their year of birth and region of birth. In order to make use of the variation across regions and cohorts in a regression framework, a difference-in-difference-in-difference strategy can be utilized. More specifically, the schooling decision is conceptualized as being a function of the year of birth, region of birth and teachers per children aged 6-13 when the individual was 10 years old at a given time. That is:

$$S_{ijk} = F(\beta_k, \alpha_j, TPC_{jk}) \qquad (1)$$

where, in Equation 1, $S_{ijk}$ stands for years of schooling/completing eight years of schooling (the educational outcomes examined) of woman *i* born in region *j* in year *k*, $\alpha_j$ is region of birth, $\beta_k$ is

year of birth and $TPC_{jk}$ denotes the number of teachers per children aged 6-13 at region of birth when women was 10 years old.

Given that a specific cohort was under treatment with varying degrees of treatment intensity, the difference-in-difference strategy utilized by Breierova and Duflo (2004) and Osili and Long (2008) can be applied in this setting with the cross section of TDHS 2008 and the first stage linear estimation equation can be expressed as follows:

$$S_{ijk} = c + \sum_{j=1}^{11} \alpha_j + \sum_{k=1}^{16} \beta_k + Y_i + TPC_{jk}\mu + (Y_i * TPC_{jk})\delta + X_i\vartheta + \varepsilon_{ijk} \quad (2)$$

In Equation 2, $c$ is a constant, $\alpha_j$ is a region of birth fixed effect, $\beta_k$ is a year of birth fixed effect, $Y_i$ is a dummy indicating whether the women belongs to the young cohort (those who were born in 1987 or later), $TPC_{jk}$ denotes the number of teachers per child aged 6-13 at region of birth when women were 10 years old, and $X_i$ reflects a vector of individual-level control variables. Under the assumption that the impact of Compulsory Education Law was exogenous, then $\delta$ will provide the unbiased estimate indicating the impact of $TPC_{jk}$ on $S_{ijk}$ for the treated population.

However, in this study a difference-in-difference-in-difference strategy is preferred by combining cross sections of TDHS 2003 and 2008. This is not an arbitrary decision. First, given that the aim of the study is to examine the connection between education and the timing of first marriage and birth, it is important to compare treatment and control groups that are in the same age groups because timing of marriage and birth will be sensitive to age. Employing a difference-in-difference strategy with one cross section based just on TDHS 2008 will not allow controlling for age fixed effects. On the other hand, within a difference-in-difference-in-

difference framework it would be possible to control for year of birth as well as age fixed effects. Second, a substantial portion of the young cohort observed in TDHS 2008 is still in school. Thus, employing a difference-in-difference approach with only the cross section of data provided by TDHS 2008 will lead to underestimation of $\delta$ in the first stage estimation. Obviously, this choice comes with an additional assumption: The young cohorts in 2003 and 2008 are assumed to share the same trend in years of schooling and marriage/fertility patterns in the absence of the Compulsory Education Law.

More specifically, the difference-in-difference-in-difference strategy can be explained in its essence as follows: The difference in the number of teachers per child between the young cohort and the old cohort in 2008 can be compared to the difference in number of teachers per child between the young cohort and the old cohort in 2003 and the difference-in-difference between 2008 and 2003 can be related to the difference in educational attainment. This suggests running the following regression:

$$S_{ijkl} = c + \sum_{j=1}^{11} \alpha_j + \sum_{k=1}^{16} \beta_k + \sum_{m=1}^{11} \gamma_m + d_l + Y_i + TPC_{jk}\mu + (Y_i * TPC_{jk})\delta + (Y_i * TPC_{jk} * d_l)\theta + X_i\vartheta + \varepsilon_{ijkl} \quad (3)$$

In Equation 3, $S_{ijkl}$ stands for years of schooling/completing eight years of schooling of woman $i$ born in region $j$ in year $k$ at DHS wave $l$, $\gamma_m$ is an age fixed effect, $d_l$ is the dummy for the TDHS wave and $X_i$ reflects a vector of individual-level control variables. In this equation, $\theta$ will provide an unbiased estimate indicating the impact of $TPC_{jk}$ on $S_{ijk}$ for the young population observed in TDHS 2008 under the assumptions mentioned above.

Estimates of Equation 3 are of primary interest because they give an evaluation of the effect of the Compulsory Education Law on women's years of schooling. However Equation 3 also constitutes the first stage of a two-stage least-squares (TSLS) estimation of the impact of additional years of schooling on the probability of getting married at age 16 or earlier and giving birth at age 17 or earlier.

In this difference-in-difference-in-difference setting, the ordinary least-squares (OLS) estimates, which relate first marriage at 16 or first birth at age 17 to education can be stated as follows:

$$M_{ijkl} = c + \sum_{j=1}^{11} \alpha_j + \sum_{k=1}^{16} \beta_k + \sum_{m=1}^{11} \gamma_m + d_l + Y_i + TPC_{jk}\mu + \left(Y_i * TPC_{jk}\right)\pi + S_{ijkl}\rho + X_i\tau + \varphi_{ijkl} \quad (4)$$

where $M_{ijkl}$ stands for a dummy variable which is equal to 1 if a woman was married at age 16 or earlier (gave birth at age 17 or earlier) and 0 otherwise. However, this straightforward OLS approach may lead to biased estimates of $\rho$ if there is a correlation between $S_{ijkl}$ and $\varphi_{ijkl}$. But if the assumptions that (1) the probability of having a first marriage at age 16 or earlier (giving first birth at age 17 or earlier) is not systematically correlated with the intensity of the implementation of the Compulsory Education Law and (2) the Compulsory Education Law had no direct effect on the probability of having first marriage at age 16 or earlier (giving first birth at age 17 or earlier), then the variable equal to the product of belonging to the young cohort, intensity of the Compulsory Education Law in her region of birth and DHS wave can be used to instrument for the years of schooling variable in Equation 4. For that purpose, the predicted values of years of schooling may be obtained from Equation 3 and these predicted values then replace the actual years of schooling variable in Equation 4. This suggests running the following TSLS estimation:

$$M_{ijkl} = c + \sum_{j=1}^{11} \alpha_j + \sum_{k=1}^{16} \beta_k + \sum_{m=1}^{11} \gamma_m + d_l + Y_i + (Y_i * TPC_{jk})\pi + \widehat{S_{ijkl}}\rho + X_i\tau + \varphi_{ijkl} \quad (5)$$

Equation 5 constitutes the second stage of the two-stage least-squares (TSLS) estimation and the value of $\rho$ obtained via the estimation of Equation 5 will provide an unbiased estimate of the impact of $S_{ijkl}$ on $M_{ijkl}$.

# V. First stage analysis

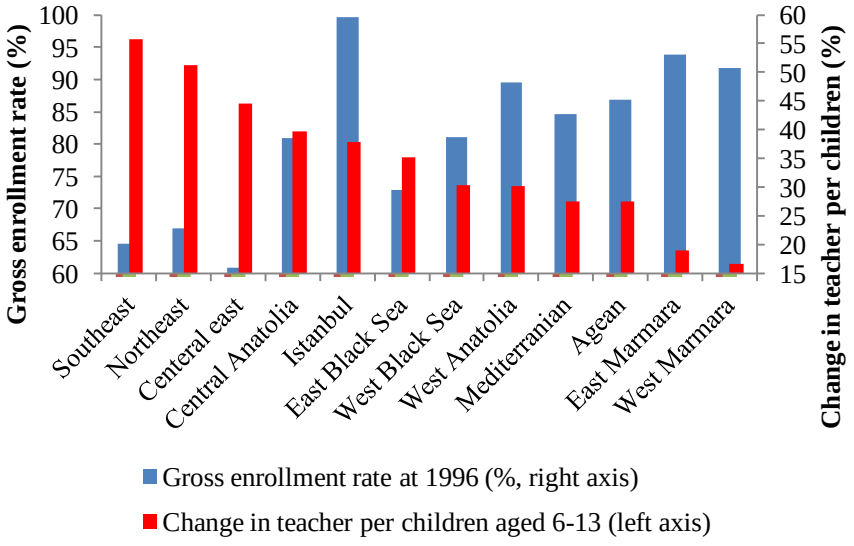
## A. Construction of treatment/control groups

In this analysis, there are 12 cohorts in each DHS wave aged between 18 and 29. In the TDHS 2003, year of birth varies between 1974 and 1985 and in TDHS 2008 year of birth varies between 1979 and 1990. Conceptually, those who were born in 1987 or later are subject to Compulsory Education Law whereas those born before 1987 are not subject to the Compulsory Education Law. Thus, those who were 21 or younger in TDHS 2008 should constitute the treated young cohort and those who were 21 or younger in TDHS 2003 should constitute the untreated young cohort. In order to check the validity of this assumption, the unrestricted version of Equation 3 is proposed as follows:

$$S_{ijkl} = c + \sum_{j=1}^{11} \alpha_j + \sum_{k=1}^{16} \beta_k + \sum_{m=1}^{11} \gamma_m + d_l + \sum_{k=1}^{12} \delta_m * (\gamma_m * TPC_{jk}) + \sum_{k=1}^{12} \theta_m * (\gamma_m * TPC_{jk} * d_l) + X_i\vartheta + \varepsilon_{ijkl} \quad (6)$$

In Equation 6, the dummy variable for the old/young cohort is replaced with 12 dummies for each age. Thus the assumption defining those who were younger than 21 as the young cohort has been relaxed. Equation 6 has been estimated with one important control variable: As mentioned earlier, the MONE aimed to increase equality of access to education. Therefore regions with low levels of gross enrollment rates received systematically more teachers: As Figure 31 graphically depicts the correlation coefficient between the gross enrollment rate in 1996 and the percentage change in teachers per children between 1996 and 2001 in twelve regions is -0.76.

**Figure 31: Gross enrollment and teachers per child**



For this reason, interactions between the age dummies and the gross enrollment rate at 1996 in the region of birth are included in Equation 6 as controls. Lastly, the dependent variable analyzed includes years of schooling as well as completing eight years of schooling, i.e. completing primary education.

The following graphs depict point estimates and 95 percent confidence interval for $\theta_m$ obtained in these regressions. The standard errors of the regression coefficients are clustered at the region of birth and year of birth.

**Figure 32: Dependent variable: Completing eight years of schooling**

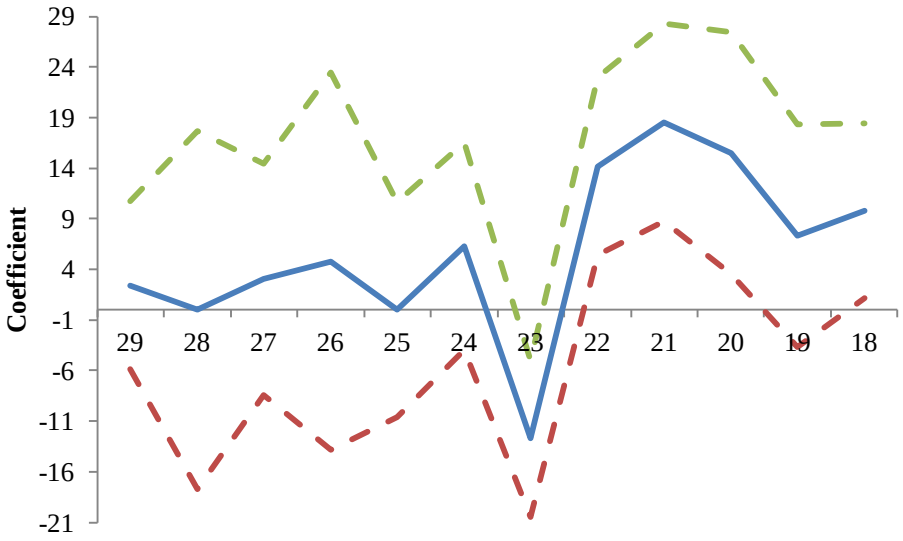
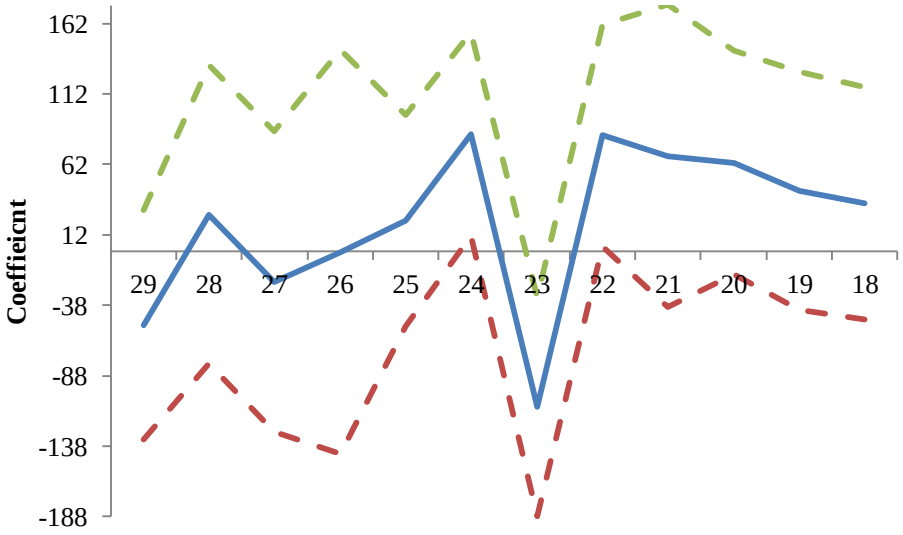


**Figure 33: Dependent variable: Years of schooling**




Figures 32 and 33 highlight important findings. For both dependent variables examined, point estimates for those who were younger than 21 are positive. Additionally, the precision of these estimates are much accurate when the dependent variable is completing eight years of schooling.

However, it is appears that point estimates for those who were 22 are also positive as well as statistically significant at conventional levels. This may be primarily due to late enrollment. Children are supposed to start first grade at age 6. However, because of various reasons, they may register in first grade at age 7 or, although rarely, later. At the beginning of the 1996-1997 school year, 8.3 percent of students between grades 1 and 5 were out of modal age for these grades. Therefore, it is likely that a significant, though unknown, portion of those born in 1986 were in grade 4 at the beginning of the 1996-1997 school year and thus they may have been subject to the Compulsory Education Law. Parallel to these arguments, Kırdar, Dayıoğlu and Koç (2009; 2011) compute median school starting age as 7 from TDHS 1998 and consider those born in 1986 under treatment status. Based on these findings, it was decided to report estimation

results including those aged 22 as part of the treatment group and excluding those aged 22 from the estimation sample.

Lastly, the jump at age 24 and the fall at age 23 may be related with small sample sizes. In the TDHS 2008 there were approximately 400 observations for each age category.

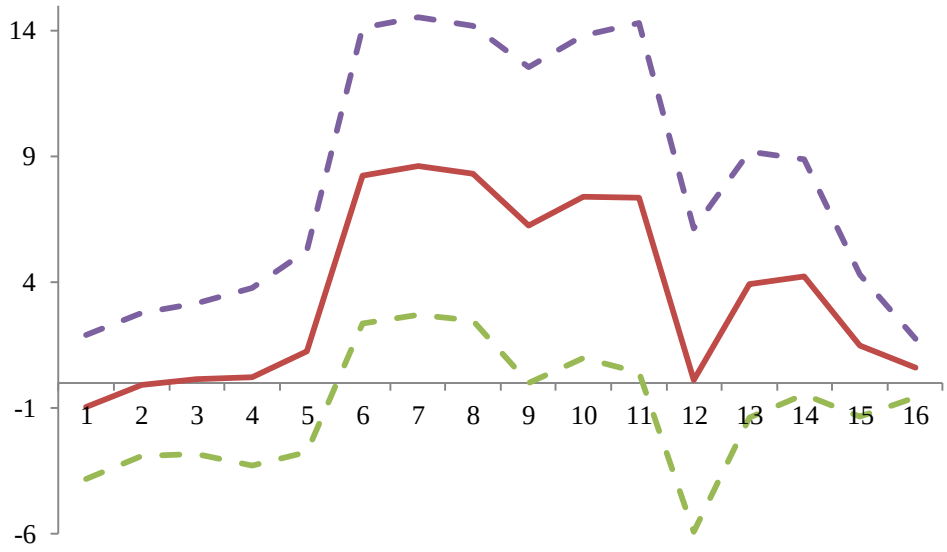
Joint significant tests of equality of coefficients to zero justify employing a restricted model: In both models, the null hypothesis of $\theta_{18} = \theta_{19} = \theta_{20} = \theta_{21} = \theta_{22} = 0$ is rejected and $\theta_{25} = \theta_{26} = \theta_{27} = \theta_{28} = \theta_{29} = 0$ could not be rejected. Additionally, $\theta_{23} = \theta_{24} = 0$ is rejected; however $\theta_{23} + \theta_{24} = 0$ could not be rejected. Therefore it is assumed that the coefficients of the interactions between control group age dummies and treatment intensity are zero and the control group is constituted by those who were between 23 and 29. Additionally, the null hypothesis of $\theta_{18} = \theta_{19} = \theta_{20} = \theta_{21} = \theta_{22}$ could not be rejected for each model and thus it is also assumed that the coefficients of the interactions between treatment group age dummies and treatment intensity are the same and the treatment group is constituted by those who were between 18 and 22. These restrictions are important for practical reasons: First, the large number of coefficients that must be estimated are reduced. This leads to a decrease in the degree of multicollinearity among independent variables and to an increase in the efficiency of the estimates. Assuming that the restrictions are true, Equation 6 simplifies to Equation 3 and this equation forms the first stage estimation equation.

### B. Impact of Compulsory Education on different levels of education

The nature of the policy intervention, i.e. increasing compulsory years of schooling from five to eight years, indicates that the impact of the intervention may vary depending on the level of education. Conceptually, the intervention should lead to an increase in the probability of

completing 6, 7 and 8 years of schooling; however it should not have an impact on completing less than 6 years and more than 8 years of schooling. In order to check whether the impact of the intervention varies by level of education, the restricted model has been estimated for $S_{ijklm}$, a dummy variable that is equal to one if the woman *i* born in region *j* in year *k* at DHS wave *l* completed *m* years of schooling or less where *m* ranges between 1 and 16. Figure 34 depicts point estimates of $\theta_m$ for these 16 estimations with 95 percent confidence intervals.

**Figure 34: The impact of intervention at different levels of education**




The findings in Figure 34 show the expected results: the point estimate is smaller and could not predict completing 1 to 5 years schooling; but then the point estimate jumps when the person completes 6 years of schooling and remains high until completing 8 years of schooling. The point estimates for completing 9 to 11 years of schooling are smaller and less precise than those for completing 6 to 8 years of schooling; however they are positive and statistically significant highlighting that the Compulsory Education Law may have an impact reaching beyond completing 8 years of schooling and on high school graduation, i.e. completing 11 years

schooling. Lastly, the instrument could not predict completing 12 to 16 years of schooling as well. These findings verify that the impact of the Compulsory Education Law varies between levels of education and it is much more effective in increasing years of schooling between 6 to 11 years schooling.

### C. First stage estimation results

The first stage estimation was conducted for the two dependent variables: completing eight years of schooling and years of schooling, and the regressions are repeated by excluding those aged 22 from the estimation sample in order to check whether the outcomes are sensitive to the inclusion of this age group in the analysis. Additionally, independent variables were added to the estimation equation in a stepwise manner in order to detect any issues concerning the robustness of the results to the inclusion of independent variables.

Lastly, the same set of analyses was conducted with the ever-married female subsample. The total female sample, including both ever-married and never-married females, does not allow utilizing additional controls because the data set does not contain individual-level pre-treatment control variables for the total female sample whereas the ever-married female sample contains information on mother tongue, type of place of childhood and parental education, which may be considered as pre-treatment variables. By focusing on ever-married female subsample it is aimed to check whether outcomes are sensitive to controlling for these individual-level variables.

The estimated first stage regressions with the total female sample are as follows:

Model 1 $$S_{ijkl} = c + \sum_{j=1}^{11} \alpha_j + \sum_{k=1}^{16} \beta_k + \sum_{m=1}^{11} \gamma_m + d_l + Y_i + (Y_i * TPC_{jk} * d_l)\theta + \varepsilon_{ijkl} \quad (7)$$

Model 2

$$S_{ijkl} = c + \sum_{j=1}^{11} \alpha_j + \sum_{k=1}^{16} \beta_k + \sum_{m=1}^{11} \gamma_m + d_l + Y_i + (Y_i * TPC_{jk} * d_l)\theta + \sum_{k=1}^{16} (\beta_k * GER_{j,96})\vartheta_k + \varepsilon_{ijkl} \quad (8)$$

Model 3

$$S_{ijkl} = c + \sum_{j=1}^{11} \alpha_j + \sum_{k=1}^{16} \beta_k + \sum_{m=1}^{11} \gamma_m + d_l + Y_i + (Y_i * TPC_{jk} * d_l)\theta + \sum_{k=1}^{16} (\beta_k * GER_{j,96})\vartheta_k + TPC_{jk}\mu + \varepsilon_{ijkl} \quad (9)$$

Model 4

$$S_{ijkl} = c + \sum_{j=1}^{11} \alpha_j + \sum_{k=1}^{16} \beta_k + \sum_{m=1}^{11} \gamma_m + d_l + Y_i + (Y_i * TPC_{jk} * d_l)\theta + \sum_{k=1}^{16} (\beta_k * GER_{j,96})\vartheta_k + TPC_{jk}\mu + (Y_i * TPC_{jk})\delta + \varepsilon_{ijkl} \quad (10)$$

In these models $\beta_k * GER_{j,96}$ stands for year of birth and gross enrollment rate at region of birth in 1996 interactions. The coefficient of interest is $\theta$ which will provide the unbiased estimate indicating the impact of $TPC_{jk}$ on $S_{ijkl}$ for the young population observed in the TDHS 2008. Each model contains region of birth, year of birth and age fixed effects and standard errors are clustered at the region of birth and year of birth. Table 16 presents the point estimates and standard errors for $\theta$.

Table 16 highlights the results of the first stage estimation. The point estimates of the coefficient of interest are statistically significant under all of the specifications. In most of the estimations, point estimates are statistically significant at the 1 percent level. The point estimate is not sensitive to the inclusion of control variables when the dependent variable is completing eight years of schooling, but the inclusion of $\beta_k * GER_{j,96}$ leads to a sizeable increase in the coefficient

of interest when the dependent variable is years of schooling. However the inclusion of $TPC_{jk}\mu$ and $Y_i * TPC_{jk}$ does not cause any meaningful change in the point estimates or standard errors. Lastly, excluding those aged 22 from the estimation sample slightly increases point estimates whereas standard errors remain more or less stable. This is not surprising because a rough analysis of administrative data already hints that only a small portion of the 1986 cohort was in the treatment group in TDHS 2008.

**Table 16: Summary of first stage estimations, total female sample**

| | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| Dependent variable: Completing eight years of schooling | | | | |
| $\theta$ | 10.84*** | 13.37*** | 12.72*** | 11.85*** |
| | [1.90] | [2.58] | [2.63] | [2.91] |
| age 22 excluded | | | | |
| $\theta$ | 12.08*** | 14.88*** | 13.94*** | 11.94*** |
| | [2.09] | [2.39] | [2.45] | [2.78] |
| Dependent variable: Years of schooling | | | | |
| $\theta$ | 30.85* | 61.31*** | 60.68*** | 52.15** |
| | [17.13] | [20.14] | [20.70] | [22.49] |
| age 22 excluded | | | | |
| $\theta$ | 33.87* | 67.99*** | 66.69*** | 49.80** |
| | [17.88] | [19.54] | [20.35] | [22.59] |

1% = ***; 5% = **; 10% = *

Multiplication of $\theta$ by the mean value of *TPC* for the young population in the TDHS 2008 provides an estimate of the change in years of schooling and the change in probability of completing eight years of schooling due to the Compulsory Education Law. Thus, based on the point estimates obtained in Model 4, it is estimated that the Compulsory Education Law led to a

34 percentage point increase in the probability of completing eight years of schooling and to an additional 1.5 years of schooling.[22]

Lastly, Table 17 presents the F-ratios associated with the test for weak instruments. Staiger and Stock (1997) propose an F-ratio of 10 as a conservative threshold for the assessment of weakness of instruments and Cameron and Trivedi (2005) suggest an F-ratio of 5 as a less restrictive rule of thumb. In all specifications, the F-ratios exceed the less restrictive rule of thumb of Cameron and Trivedi (2005). On the other hand, for the more restrictive F-ratio test, when the dependent variable is completing eight years of schooling an F-ratio of 10 is also exceeded for all of the estimations; however when the dependent variable is years of schooling most of the estimates remain under the threshold of 10. This finding is not surprising given that the impact of the Compulsory Education Law was more directly oriented to completing eight years of schooling and not on changing years of schooling (Figure 34). Lastly, excluding those aged 22 from the estimation sample is associated with an increase in F-ratios.

**Table 17: F-ratios associated with the test for weak instruments**

| | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| Dependent variable: Completing eight years of schooling | | | | |
| $\theta$ | 32.55 | 26.85 | 23.39 | 16.58 |
| $\theta$ – age 22 excluded | 33.41 | 38.76 | 32.37 | 18.45 |
| Dependent variable: Years of schooling | | | | |
| $\theta$ | 3.24 | 9.27 | 8.59 | 5.38 |
| $\theta$ – age 22 excluded | 3.59 | 12.11 | 10.74 | 4.86 |

These estimations do not include any individual-level control variables; however, as noted earlier, it is possible to introduce individual-level control variables by focusing on the ever-married women subsamples of the TDHS 2003 and TDHS 2008. These surveys contain a module which collects more detailed information from ever-married women. This allows constructing

[22] The mean value of *TPC* for the young population in TDHS 2008 is 0.0288606. Thus, 0.0288606 X 11.85 = 0.34199811 and 0.0288606 X 11.85 = 1.50508029.

pre-treatment individual-level control variables for this sub-sample of women. Thus it becomes possible to further investigate the sensitivity of the coefficients of interest to the inclusion of additional control variables. For this examination four models are estimated:

Model 5

$$S_{ijkl} = c + \sum_{j=1}^{11} \alpha_j + \sum_{k=1}^{16} \beta_k + \sum_{m=1}^{11} \gamma_m + d_l + Y_i + (Y_i * TPC_{jk} * d_l)\theta + \sum_{k=1}^{16} (\beta_k * GER_{j,96})\vartheta_k + TPC_{jk}\mu + (Y_i * TPC_{jk})\delta + \varepsilon_{ijkl} \quad (11)$$

Model 6

$$S_{ijkl} = c + \sum_{j=1}^{11} \alpha_j + \sum_{k=1}^{16} \beta_k + \sum_{m=1}^{11} \gamma_m + d_l + Y_i + (Y_i * TPC_{jk} * d_l)\theta + \sum_{k=1}^{16} (\beta_k * GER_{j,96})\vartheta_k + TPC_{jk}\mu + (Y_i * TPC_{jk})\delta + ME_i\omega + FE_i\varphi + \varepsilon_{ijkl} \quad (12)$$

Model 7

$$S_{ijkl} = c + \sum_{j=1}^{11} \alpha_j + \sum_{k=1}^{16} \beta_k + \sum_{m=1}^{11} \gamma_m + d_l + Y_i + (Y_i * TPC_{jk} * d_l)\theta + \sum_{k=1}^{16} (\beta_k * GER_{j,96})\vartheta_k + TPC_{jk}\mu + (Y_i * TPC_{jk})\delta + ME_i\omega + FE_i\varphi + MT_i\sigma + \varepsilon_{ijkl} \quad (13)$$

Model 8

$$S_{ijkl} = c + \sum_{j=1}^{11} \alpha_j + \sum_{k=1}^{16} \beta_k + \sum_{m=1}^{11} \gamma_m + d_l + Y_i + (Y_i * TPC_{jk} * d_l)\theta + \sum_{k=1}^{16} (\beta_k * GER_{j,96})\vartheta_k + TPC_{jk}\mu + (Y_i * TPC_{jk})\delta + ME_i\omega + FE_i\varphi + MT_i\sigma + CP_i + \varepsilon_{ijkl} \quad (14)$$

Model 5 presents just a re-estimation of Model 4 with the sub-sample of ever-married women. In Model 6 *ME* and *FE* stand for mother's and father's education. In Model 7 *MT* stands for mother's tongue and in Model 8 *CP* stands for childhood place of residence. Standard errors are clustered at the region of birth and year of birth. Table 18 presents the point estimates and standard errors for $\theta$.

**Table 18: Summary of first stage estimations, ever-married female subsample**

| | Model 5 | Model 6 | Model 7 | Model 8 |
|---|---|---|---|---|
| Dependent variable: Completing eight years of schooling | | | | |
| $\theta$ | 23.72*** | 21.89*** | 22.94*** | 22.86*** |
| | [5.91] | [5.04] | [5.10] | [5.19] |
| age 22 excluded | | | | |
| $\theta$ | 28.27*** | 27.53*** | 28.53*** | 30.16*** |
| | [6.65] | [5.44] | [5.45] | [5.30] |
| Dependent variable: Years of schooling | | | | |
| $\theta$ | 80.79** | 67.28*** | 84.14*** | 82.91*** |
| | [33.77] | [25.14] | [23.95] | [24.59] |
| age 22 excluded | | | | |
| $\theta$ | 86.16* | 87.38*** | 104.36*** | 114.30*** |
| | [44.35] | [31.82] | [30.20] | [29.23] |

1% = ***; 5% = **; 10% = *

The findings presented in Table 18 suggest that the coefficient of interest is robust to inclusion of pre-treatment individual-level control variables when the dependent variable is completing eight years of schooling. The coefficient is more sensitive to the inclusion of pre-treatment individual-level control variables when the dependent variable is years of schooling. However, the changes cannot be considered to be dramatic: in all specifications, the coefficient remains positive and statistically significant at conventional levels.

## VI. Reduced form, ordinary least squares (OLS) and two-stage least square (TSLS) estimations

In the previous section, the first stage relationship between teachers per children and educational attainment was examined. This section focuses on the impact of teachers per children and educational attainment on the probabilities of getting married at age 16 or earlier and giving birth at age 17 or earlier. These specific outcome variables are studied in this section because of several reasons. First, legal marriage age in Turkey is 17. Thus this legal regulation offers a natural boundary. Second, first birth occurs about 1.05 years after first marriage on average for the analyzed sample of ever-married women. Therefore threshold level for age at first marriage has been chosen as 16 years of age. Third, and most importantly, exactly these outcome variables had been previously investigated by Kırdar, Dayıoğlu and Koç (2009; 2011) and Gulesci and Meyersson (2012). Thus, using these outcome variables enable a comparison between the findings of this study and those of earlier studies.

The reduced form, OLS and TSLS estimation equations are specified as follows:

Reduced form

$$M_{ijkl} = c + \sum_{j=1}^{11} \alpha_j + \sum_{k=1}^{16} \beta_k + \sum_{m=1}^{11} \gamma_m + d_l + Y_i + (Y_i * TPC_{jk} * d_l)\theta + \sum_{k=1}^{16} (\beta_k * GER_{j,96})\vartheta_k + TPC_{jk}\mu + (Y_i * TPC_{jk})\delta + \varepsilon_{ijkl} \quad (15)$$

OLS

$$M_{ijkl} = c + \sum_{j=1}^{11} \alpha_j + \sum_{k=1}^{16} \beta_k + \sum_{m=1}^{11} \gamma_m + d_l + Y_i + S_{ijkl}\theta + \sum_{k=1}^{16} (\beta_k * GER_{j,96})\vartheta_k + TPC_{jk}\mu + (Y_i * TPC_{jk})\delta + \varepsilon_{ijkl} \quad (16)$$

$$M_{ijkl} = c + \sum_{j=1}^{11} \alpha_j + \sum_{k=1}^{16} \beta_k + \sum_{m=1}^{11} \gamma_m + d_l + Y_i + \widehat{S_{ijkl}}\theta$$

TSLS *(17)*

$$+ \sum_{k=1}^{16} (\beta_k * GER_{j,96})\vartheta_k + TPC_{jk}\mu + (Y_i * TPC_{jk})\delta + \varepsilon_{ijkl}$$

In Equations 15, 16 and 17 $M_{ijkl}$ stands for a dummy variable which is equal to 1 if a woman was married at age 16 or earlier (gave birth at age 17 or earlier) and 0 otherwise. In Equation 15, the estimate of $\theta$ indicates whether the instrument is able to predict the probability of getting married at age 16 or earlier (gave birth at age 17 or earlier). Equation 16 presents an OLS estimation ignoring the possible endogeneity of the educational attainment variable. Equation 17 presents a TSLS estimation in which $S_{ijkl}$-hat is predicted from the respective first stage estimation. Thus it reflects an attempt to solve the endogeneity issue by instrumenting $S_{ijkl}$ with the exogenous change in $TPC_{jk}$ reflected by $Y_i * TPC_{jk} * d_l$.

Table 19 presents the point estimates and standard errors for $\theta$.

**Table 19: Point estimates and standard errors of $\theta$ under different specifications**

| | First marriage at 16 or earlier | First birth at 17 or earlier |
|---|---|---|
| Reduced form | 0.36 | 0.10 |
| | [1.22] | [1.16] |
| Reduced form - excluding age 22 | 0.42 | 0.04 |
| | [1.30] | [1.25] |
| Independent variable: Completing eight years of schooling | | |
| OLS | -0.13*** | -0.10*** |
| | [0.01] | [0.01] |
| OLS - excluding age 22 | -0.13*** | -0.10*** |
| | [0.01] | [0.01] |
| Independent variable: Years of schooling | | |
| OLS | -0.02*** | -0.01*** |
| | [0.00] | [0.00] |
| OLS - excluding age 22 | -0.02*** | -0.01*** |
| | [0.00] | [0.00] |

| | | |
|---|---|---|
| Independent variable: instrumented completing eight years of schooling | | |
| TSLS | 0.03 | 0.01 |
| | [0.10] | [0.10] |
| TSLS - excluding age 22 | 0.03 | 0.00 |
| | [0.11] | [0.10] |
| Independent variable: instrumented years of schooling | | |
| TSLS | 0.01 | 0.00 |
| | [0.02] | [0.02] |
| TSLS - excluding age 22 | 0.01 | 0.00 |
| | [0.03] | [0.02] |

1% = ***; 5% = **; 10% = *

The point estimates of the coefficient of interest reported in Table 19 are positive in reduced form estimations; however standard errors are too large to make any inferences. It should be also mentioned that the 95 percent confidence interval does not rule out a mild negative impact of teachers per children on probabilities of getting married at age 16 or earlier and giving birth at age 17 or earlier. The confidence interval for getting married at age 16 is bounded by -2.06 and 2.77 and for giving birth at age 17 by -2.20 and 2.39. Based on these figures it is inferred that the impact of the Compulsory Education Law on getting married at age 16 and giving birth at age 17 ranges between -6 percent and 8 percent and on giving birth at age 17 or earlier between -6 percent and 7 percent.[23]

OLS estimates of the impact of years of schooling and completing eight years of schooling on getting married at age 16 or earlier and giving birth at age 17 or earlier are statistically significant and negative. However, the estimated impact sizes are modest. An additional year of schooling is associated with a one percentage point decline in the probability of giving birth at age 17 or earlier and a two percentage points decline in the probability of getting married at age 16 or earlier. The impact of completing eight years of schooling is associated with a ten

[23]0.0288606 X -2.06 = -0.059452836 and 0.0288606 X 2.77 = 0.079943862 and 0.0288606 X -2.2 = -0.06349332 and 0.0288606 X 2.39 = 0.068976834.

percentage point decline in the probability of giving birth at age 17 or earlier and thirteen percentage points decline in the probability of getting married at age 16 or earlier. However these estimates may be biased because the OLS estimation assumes that there is no correlation between the error term and educational attainment variable.

Finally, TSLS estimates are positive and statistically insignificant. However standard errors are relatively large. Thus, the OLS estimates are within the 95% confidence interval of the TSLS estimates. It is not therefore possible to conclude whether OLS estimates are biased or not. On the other hand, it is clear that the TSLS and OLS estimates are not in line and the TSLS estimates do not provide any evidence in favor of a causal connection from years of schooling and completing eight years of schooling to getting married at age 16 or earlier and giving birth at age 17 or earlier.

## VII. Conclusions

This study has shown evidence that the introduction of the Compulsory Education law of 1997 in Turkey sharply increased the probability of completing eight years of schooling and increased the years of schooling of the groups in the population more affected by the policy relative to groups not affected by the policy change. At the mean, it is estimated that Compulsory Education Law led to a 34 percentage point increase in the probability of completing eight years of schooling and an additional 1.5 years of schooling. These results are robust to different specifications.

The research also examined the issue of how the Compulsory Education law affected marriage and fertility. Compulsory schooling laws may affect timing of marriage and giving birth because increases in current and expected human capital may raise the opportunity cost of marriage and

child-bearing, thus having a negative impact on marriage and fertility decisions. This study focused on estimating how the higher schooling associated with the implementation of the compulsory schooling law in Turkey affected the rate of women getting married at age 16 or earlier and giving birth at age 17 or earlier.

The results of this study do not provide any evidence showing that increased educational attainment has a causal effect on the probability of getting married and giving birth at an early stage of life. Under the assumption that exposure to the Compulsory Education Law is a valid instrument for educational attainment, TSLS estimations were conducted in order to estimate the impact of female education on timing of marriage and fertility. TSLS estimates are statistically insignificant whereas OLS estimates are negative and statistically significant. This suggests that OLS estimates may be biased. However OLS estimates are within the 95% confidence interval of TSLS estimates.

These results are partially in line with the findings of Gulesci and Meyersson (2012). However it is a challenging task to assess the contrast between the findings of Kırdar, Dayıoğlu and Koç (2009; 2011) and this study. First of all, although this study and Kırdar, Dayıoğlu and Koç's studies utilize the same data sources, the samples analyzed are different. The Kırdar, Dayıoğlu and Koç's studies examine women aged between 10 and 30 whereas in this study the analyzed sample consists of women aged between 18 and 29. Second, the methodologies of studies are different. Kırdar, Dayıoğlu and Koç primarily use duration analysis with the cross sections of the TDHS 2003 and 2008. This study pools TDHS 2003 and 2008 and analyzes it within a difference-in-difference-in-difference framework. Lastly and most importantly, Kırdar, Daıoğlu and Koç (2009; 2011) as well as Gulesci and Meyersson (2012) solely capitalize on variation in

time whereas this study takes advantage of a measure of treatment intensity in addition to variation in time.

There are certain drawbacks of relying only on variation in time as an identification strategy. There may be other events simultaneously occurring as the Compulsory Education Law was implemented, changes which may affect educational attainment and/or the timing of marriage and fertility: First, until 2002 the minimum legal age of marriage for women was 15 and women were also allowed to get married at age 14 under certain conditions such as pregnancy. This minimum legal age of marriage for women was raised to 17 when the new Civil Code was put in force in 2002. Kırdar, Dayıoğlu and Koç (2011) attempt to address this issue by creating a control variable distinguishing cohorts which were subjected to new Civil Code; however Gulesci and Meyersson (2012) do not provide a discussion on the possible impact of the new Civil Code on the timing of marriage and giving birth.

An important topic for future research would be to collect more data on other events which may have affected the timing of marriage and fertility. Previous studies only partially attempt to address these problems. Taking advantage of a measure of treatment intensity this study develops a more conservative and strict identification approach. It is suggested that this methodological difference may be an important factor which may lead to contrasting findings present in previous studies and this study.

# VIII. Tables

## A. Estimation results

### Table 20: Unrestricted estimations

| | Dependent variable | | | |
|---|---|---|---|---|
| | Completing eight years of schooling | | Years of schooling | |
| VARIABLES | Coefficient | Standard error | Coefficient | Standard error |
| Age == 18 X TPC X TDHS == 2008 | 9.77** | [4.38] | 34.63 | [41.85] |
| Age == 19 X TPC X TDHS == 2008 | 7.31 | [5.58] | 43.25 | [42.90] |
| Age == 20 X TPC X TDHS == 2008 | 15.48** | [6.07] | 63.32 | [40.36] |
| Age == 21 X TPC X TDHS == 2008 | 18.53*** | [4.97] | 67.95 | [54.35] |
| Age == 22 X TPC X TDHS == 2008 | 14.19*** | [4.46] | 82.48** | [39.89] |
| Age == 23 X TPC X TDHS == 2008 | -12.74*** | [3.92] | -110.01*** | [39.45] |
| Age == 24 X TPC X TDHS == 2008 | 6.29 | [5.20] | 83.46** | [36.71] |
| Age == 25 X TPC X TDHS == 2008 | -0.01 | [5.39] | 22.11 | [37.86] |
| Age == 26 X TPC X TDHS == 2008 | 4.80 | [9.45] | -0.14 | [72.72] |
| Age == 27 X TPC X TDHS == 2008 | 3.02 | [5.82] | -21.25 | [54.01] |
| Age == 28 X TPC X TDHS == 2008 | -0.01 | [8.97] | 26.46 | [53.63] |
| Age == 29 X TPC X TDHS == 2008 | 2.43 | [4.19] | -51.82 | [41.19] |
| Year of birth == 1974 X GER at 1996 | 0.11 | [0.29] | 0.66 | [2.79] |
| Year of birth == 1975 X GER at 1996 | -0.23 | [0.44] | -0.09 | [3.06] |
| Year of birth == 1976 X GER at 1996 | 0.29 | [0.28] | 5.51 | [3.40] |
| Year of birth == 1977 X GER at 1996 | 0.65* | [0.34] | 5.49* | [2.80] |
| Year of birth == 1978 X GER at 1996 | 0.48* | [0.27] | 4.72* | [2.74] |
| Year of birth == 1979 X GER at 1996 | 0.27 | [0.26] | 3.40 | [2.44] |
| Year of birth == 1980 X GER at 1996 | 0.23 | [0.26] | 2.16 | [2.39] |
| Year of birth == 1981 X GER at 1996 | 0.40 | [0.25] | 2.87 | [2.43] |
| Year of birth == 1982 X GER at 1996 | 0.38 | [0.27] | 3.75 | [2.55] |
| Year of birth == 1983 X GER at 1996 | 0.30 | [0.28] | 3.54 | [2.61] |
| Year of birth == 1984 X GER at 1996 | 0.35 | [0.28] | 2.27 | [2.48] |
| Year of birth == 1985 X GER at 1996 | 0.14 | [0.26] | 1.91 | [2.50] |
| Year of birth == 1986 X GER at 1996 | 0.24 | [0.35] | 1.98 | [3.23] |
| Year of birth == 1987 X GER at 1996 | -0.07 | [0.36] | 0.77 | [3.72] |
| Year of birth == 1988 X GER at 1996 | 0.15 | [0.30] | 1.09 | [2.96] |
| Year of birth == 1989 X GER at 1996 | 0.04 | [0.35] | -1.07 | [3.06] |
| Age == 18 X TPC | 9.86* | [5.18] | 22.54 | [40.69] |
| Age == 19 X TPC | 4.92 | [5.37] | -7.94 | [42.62] |
| Age == 20 X TPC | 7.30 | [6.39] | 18.25 | [45.85] |
| Age == 21 X TPC | 2.91 | [5.55] | -3.23 | [43.32] |
| Age == 22 X TPC | -4.22 | [5.09] | -68.75 | [42.26] |
| Age == 23 X TPC | 16.01*** | [5.20] | 79.15* | [43.06] |
| Age == 24 X TPC | -1.75 | [5.79] | -72.15 | [46.41] |
| Age == 25 X TPC | 4.05 | [5.61] | -22.23 | [44.98] |
| Age == 26 X TPC | -2.62 | [9.06] | -63.55 | [66.81] |
| Age == 27 X TPC | -1.70 | [6.24] | -39.82 | [60.21] |
| Age == 28 X TPC | 9.60 | [9.12] | 28.99 | [65.25] |
| Age == 29 X TPC | -3.82 | [6.72] | -15.73 | [54.86] |
| Age == 18 | 0.39** | [0.19] | 8.89*** | [1.62] |
| Age == 19 | 0.63** | [0.32] | 10.66*** | [2.89] |
| Age == 20 | 0.16 | [0.28] | 7.12*** | [2.60] |
| Age == 21 | 0.36 | [0.31] | 8.02*** | [2.87] |
| Age == 22 | 0.37 | [0.33] | 8.48*** | [3.17] |
| Age == 23 | 0.57** | [0.22] | 11.28*** | [2.03] |

| | | | | |
|---|---|---|---|---|
| Age == 24 | 0.65* | [0.34] | 10.62*** | [2.99] |
| Age == 25 | 0.25 | [0.29] | 7.88*** | [2.75] |
| Age == 26 | 0.32 | [0.38] | 9.05*** | [3.42] |
| Age == 27 | 0.24 | [0.37] | 8.52** | [3.31] |
| Age == 28 | 0.66** | [0.28] | 11.25*** | [2.29] |
| Age == 29 | 0.65* | [0.35] | 10.30*** | [3.30] |
| Year of birth == 1974 | -0.09 | [0.25] | -2.01 | [2.52] |
| Year of birth == 1975 | -0.16 | [0.31] | -3.55 | [2.72] |
| Year of birth == 1976 | 0.17 | [0.27] | -2.74 | [2.53] |
| Year of birth == 1977 | -0.15 | [0.30] | -2.73 | [2.69] |
| Year of birth == 1978 | -0.05 | [0.14] | -1.43 | [1.51] |
| Year of birth == 1979 | -0.18 | [0.23] | -2.00 | [1.95] |
| Year of birth == 1980 | -0.43** | [0.21] | -5.16** | [2.27] |
| Year of birth == 1981 | 0.04 | [0.22] | 0.04 | [2.18] |
| Year of birth == 1982 | -0.03 | [0.19] | -0.95 | [1.88] |
| Year of birth == 1983 | 0.11 | [0.13] | -0.97 | [1.20] |
| Year of birth == 1984 | -0.34* | [0.20] | -3.04* | [1.80] |
| Year of birth == 1985 | -0.06 | [0.18] | -2.08 | [2.04] |
| Region of birth == TR2 | -0.32*** | [0.10] | -1.52* | [0.80] |
| Region of birth == TR3 | -0.21*** | [0.06] | -1.16** | [0.49] |
| Region of birth == TR4 | -0.24*** | [0.04] | -1.48*** | [0.37] |
| Region of birth == TR5 | -0.03 | [0.04] | 0.29 | [0.36] |
| Region of birth == TR6 | -0.21*** | [0.05] | -1.47*** | [0.43] |
| Region of birth == TR7 | -0.19*** | [0.05] | -1.26** | [0.51] |
| Region of birth == TR8 | -0.21*** | [0.05] | -1.27** | [0.53] |
| Region of birth == TR9 | -0.20*** | [0.07] | -1.44** | [0.68] |
| Region of birth == TRA | -0.29*** | [0.08] | -2.91*** | [0.78] |
| Region of birth == TRB | -0.41*** | [0.09] | -4.44*** | [0.92] |
| Region of birth == TRC | -0.38*** | [0.09] | -4.37*** | [0.84] |
| Observations | 10,183 | | 10,182 | |
| Adjusted R-squared | 0.58 | | 0.80 | |

Robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

## Table 21: First stage estimation, completing eight years of schooling

| | Dependent variable: Completing eight years of schooling | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
| VARIABLES | Coefficient | Standard error | Coefficient | Standard error | Coefficient | Standard error | Coefficient | Standard error |
| Young X TPC X TDHS == 2008 | 10.84*** | [1.90] | 13.37*** | [2.58] | 12.72*** | [2.63] | 11.85*** | [2.91] |
| Year of birth == 1974 X GER at 1996 | | | -0.20 | [0.28] | -0.18 | [0.27] | -0.17 | [0.27] |
| Year of birth == 1975 X GER at 1996 | | | -0.17 | [0.34] | -0.16 | [0.33] | -0.15 | [0.33] |
| Year of birth == 1976 X GER at 1996 | | | 0.02 | [0.29] | 0.02 | [0.29] | 0.03 | [0.29] |
| Year of birth == 1977 X GER at 1996 | | | 0.36 | [0.33] | 0.38 | [0.33] | 0.39 | [0.32] |
| Year of birth == 1978 X GER at 1996 | | | 0.38 | [0.26] | 0.41 | [0.26] | 0.42 | [0.26] |
| Year of birth == 1979 X GER at 1996 | | | 0.05 | [0.27] | 0.08 | [0.27] | 0.09 | [0.27] |
| Year of birth == 1980 X GER at 1996 | | | 0.41 | [0.27] | 0.43 | [0.28] | 0.44 | [0.28] |
| Year of birth == 1981 X GER at 1996 | | | 0.15 | [0.27] | 0.20 | [0.27] | 0.19 | [0.28] |
| Year of birth == 1982 X GER at 1996 | | | 0.23 | [0.27] | 0.30 | [0.27] | 0.29 | [0.27] |
| Year of birth == 1983 X GER at 1996 | | | 0.31 | [0.27] | 0.28 | [0.27] | 0.27 | [0.27] |
| Year of birth == 1984 X GER at 1996 | | | 0.32 | [0.26] | 0.28 | [0.26] | 0.28 | [0.26] |
| Year of birth == 1985 X GER at 1996 | | | 0.18 | [0.26] | 0.14 | [0.26] | 0.13 | [0.26] |
| Year of birth == 1986 X GER at 1996 | | | -0.08 | [0.34] | -0.09 | [0.35] | -0.09 | [0.35] |
| Year of birth == 1987 X GER at 1996 | | | -0.00 | [0.31] | 0.00 | [0.31] | 0.00 | [0.31] |
| Year of birth == 1988 X GER at 1996 | | | 0.25 | [0.29] | 0.26 | [0.29] | 0.26 | [0.29] |
| Year of birth == 1989 X GER at 1996 | | | -0.19 | [0.30] | -0.19 | [0.29] | -0.19 | [0.29] |
| TPC | | | | | 6.69 | [4.71] | 6.02 | [4.98] |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Young X TPC | | | | | | | 1.29 | [2.03] |
| Age == 18 | 0.70*** | [0.07] | 0.59*** | [0.11] | 0.43** | [0.16] | 0.43*** | [0.17] |
| Age == 19 | 0.74*** | [0.07] | 0.79** | [0.31] | 0.63* | [0.32] | 0.64** | [0.32] |
| Age == 20 | 0.66*** | [0.06] | 0.35 | [0.27] | 0.19 | [0.29] | 0.20 | [0.30] |
| Age == 21 | 0.63*** | [0.06] | 0.54* | [0.29] | 0.39 | [0.31] | 0.40 | [0.31] |
| Age == 22 | 0.57*** | [0.06] | 0.54* | [0.31] | 0.41 | [0.33] | 0.42 | [0.33] |
| Age == 23 | 0.69*** | [0.08] | 0.59*** | [0.12] | 0.42** | [0.16] | 0.46** | [0.18] |
| Age == 24 | 0.75*** | [0.07] | 0.80** | [0.31] | 0.64** | [0.32] | 0.68** | [0.33] |
| Age == 25 | 0.66*** | [0.07] | 0.35 | [0.27] | 0.19 | [0.30] | 0.23 | [0.31] |
| Age == 26 | 0.57*** | [0.08] | 0.48 | [0.29] | 0.33 | [0.31] | 0.37 | [0.32] |
| Age == 27 | 0.59*** | [0.07] | 0.56* | [0.31] | 0.43 | [0.33] | 0.47 | [0.34] |
| Age == 28 | 0.63*** | [0.09] | 0.52*** | [0.13] | 0.36** | [0.17] | 0.40** | [0.18] |
| Age == 29 | 0.75*** | [0.08] | 0.80** | [0.31] | 0.64** | [0.32] | 0.69** | [0.33] |
| Year of birth == 1974 | -0.17** | [0.09] | -0.09 | [0.21] | -0.08 | [0.20] | -0.11 | [0.21] |
| Year of birth == 1975 | -0.06 | [0.09] | 0.17 | [0.24] | 0.18 | [0.24] | 0.15 | [0.24] |
| Year of birth == 1976 | 0.05 | [0.07] | 0.04 | [0.24] | 0.03 | [0.25] | -0.01 | [0.25] |
| Year of birth == 1977 | 0.08 | [0.08] | -0.14 | [0.25] | -0.15 | [0.25] | -0.18 | [0.26] |
| Year of birth == 1978 | 0.06 | [0.07] | 0.03 | [0.16] | 0.02 | [0.16] | -0.01 | [0.17] |
| Year of birth == 1979 | -0.06 | [0.08] | -0.18 | [0.20] | -0.19 | [0.19] | -0.22 | [0.19] |
| Year of birth == 1980 | 0.07 | [0.08] | -0.18 | [0.20] | -0.17 | [0.20] | -0.21 | [0.20] |
| Year of birth == 1981 | 0.09 | [0.06] | -0.03 | [0.23] | -0.09 | [0.24] | -0.10 | [0.25] |
| Year of birth == 1982 | 0.12* | [0.06] | -0.00 | [0.20] | -0.06 | [0.20] | -0.07 | [0.20] |
| Year of birth == 1983 | 0.08 | [0.07] | 0.11 | [0.18] | 0.14 | [0.18] | 0.13 | [0.18] |
| Year of birth == 1984 | -0.00 | [0.07] | -0.34* | [0.19] | -0.31 | [0.19] | -0.32* | [0.19] |
| Year of birth == 1985 | 0.04 | [0.07] | -0.03 | [0.18] | 0.02 | [0.18] | -0.00 | [0.18] |
| Region of birth == TR2 | -0.25*** | [0.04] | -0.25*** | [0.04] | -0.38*** | [0.09] | -0.37*** | [0.09] |
| Region of birth == TR3 | -0.20*** | [0.02] | -0.19*** | [0.04] | -0.25*** | [0.05] | -0.25*** | [0.06] |
| Region of birth == TR4 | -0.22*** | [0.02] | -0.22*** | [0.03] | -0.27*** | [0.05] | -0.27*** | [0.05] |
| Region of birth == TR5 | -0.03 | [0.03] | -0.02 | [0.03] | -0.05 | [0.04] | -0.05 | [0.04] |
| Region of birth == TR6 | -0.22*** | [0.02] | -0.21*** | [0.04] | -0.24*** | [0.05] | -0.24*** | [0.05] |
| Region of birth == TR7 | -0.21*** | [0.03] | -0.19*** | [0.05] | -0.22*** | [0.05] | -0.22*** | [0.05] |
| Region of birth == TR8 | -0.23*** | [0.03] | -0.20*** | [0.05] | -0.25*** | [0.05] | -0.25*** | [0.05] |
| Region of birth == TR9 | -0.25*** | [0.03] | -0.21*** | [0.07] | -0.25*** | [0.07] | -0.25*** | [0.07] |
| Region of birth == TRA | -0.38*** | [0.03] | -0.33*** | [0.08] | -0.32*** | [0.08] | -0.32*** | [0.08] |
| Region of birth == TRB | -0.51*** | [0.02] | -0.45*** | [0.09] | -0.43*** | [0.09] | -0.43*** | [0.09] |
| Region of birth == TRC | -0.49*** | [0.02] | -0.43*** | [0.08] | -0.39*** | [0.09] | -0.39*** | [0.09] |
| Observations | 10,183 | | 10,183 | | 10,183 | | 10,183 | |
| Adjusted R-squared | 0.58 | | 0.58 | | 0.58 | | 0.58 | |

Robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

## Table 22: First stage estimation, completing eight years of schooling excluding age 22

| | Dependent variable: Completing eight years of schooling | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
| VARIABLES | Coefficient | Standard error | Coefficient | Standard error | Coefficient | Standard error | Coefficient | Standard error |
| Young X TPC X TDHS == 2008 | 12.08*** | [2.09] | 14.88*** | [2.39] | 13.94*** | [2.45] | 11.94*** | [2.78] |
| Year of birth == 1974 X GER at 1996 | | | -0.16 | [0.26] | -0.13 | [0.25] | -0.11 | [0.25] |
| Year of birth == 1975 X GER at 1996 | | | -0.13 | [0.33] | -0.11 | [0.32] | -0.09 | [0.32] |
| Year of birth == 1976 X GER at 1996 | | | 0.06 | [0.27] | 0.06 | [0.27] | 0.08 | [0.27] |
| Year of birth == 1977 X GER at 1996 | | | 0.39 | [0.31] | 0.43 | [0.31] | 0.45 | [0.31] |
| Year of birth == 1978 X GER at 1996 | | | 0.42* | [0.25] | 0.47* | [0.25] | 0.48** | [0.24] |
| Year of birth == 1979 X GER at 1996 | | | 0.09 | [0.25] | 0.13 | [0.25] | 0.15 | [0.24] |
| Year of birth == 1980 X GER at 1996 | | | 0.45* | [0.25] | 0.48* | [0.25] | 0.50* | [0.26] |
| Year of birth == 1981 X GER at 1996 | | | 0.14 | [0.25] | 0.20 | [0.24] | 0.21 | [0.24] |
| Year of birth == 1982 X GER at 1996 | | | 0.27 | [0.25] | 0.36 | [0.25] | 0.33 | [0.25] |
| Year of birth == 1983 X GER at 1996 | | | 0.34 | [0.25] | 0.30 | [0.25] | 0.28 | [0.25] |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Year of birth == 1984 X GER at 1996 | | | 0.36 | [0.24] | 0.31 | [0.25] | 0.29 | [0.25] |
| Year of birth == 1985 X GER at 1996 | | | 0.23 | [0.24] | 0.16 | [0.24] | 0.14 | [0.23] |
| Year of birth == 1987 X GER at 1996 | | | -0.01 | [0.29] | -0.00 | [0.29] | -0.00 | [0.29] |
| Year of birth == 1988 X GER at 1996 | | | 0.25 | [0.26] | 0.26 | [0.26] | 0.26 | [0.26] |
| Year of birth == 1989 X GER at 1996 | | | -0.19 | [0.28] | -0.19 | [0.28] | -0.19 | [0.28] |
| TPC | | | | | 9.11* | [4.86] | 7.59 | [5.16] |
| Young X TPC | | | | | | | 2.80 | [2.13] |
| Age == 18 | 0.65*** | [0.07] | 0.53*** | [0.10] | 0.30** | [0.15] | 0.32** | [0.15] |
| Age == 19 | 0.69*** | [0.07] | 0.73** | [0.29] | 0.52* | [0.30] | 0.53* | [0.30] |
| Age == 20 | 0.61*** | [0.07] | 0.30 | [0.24] | 0.08 | [0.27] | 0.10 | [0.27] |
| Age == 21 | 0.59*** | [0.07] | 0.49* | [0.26] | 0.29 | [0.28] | 0.30 | [0.28] |
| Age == 23 | 0.64*** | [0.08] | 0.52*** | [0.11] | 0.30** | [0.15] | 0.39** | [0.17] |
| Age == 24 | 0.70*** | [0.08] | 0.74** | [0.29] | 0.53* | [0.30] | 0.62* | [0.31] |
| Age == 25 | 0.61*** | [0.07] | 0.30 | [0.25] | 0.08 | [0.27] | 0.17 | [0.28] |
| Age == 26 | 0.53*** | [0.08] | 0.43 | [0.26] | 0.23 | [0.29] | 0.32 | [0.30] |
| Age == 27 | 0.63*** | [0.03] | 0.55** | [0.25] | 0.36 | [0.27] | 0.37 | [0.26] |
| Age == 28 | 0.58*** | [0.09] | 0.46*** | [0.12] | 0.23 | [0.15] | 0.33* | [0.17] |
| Age == 29 | 0.70*** | [0.09] | 0.74** | [0.30] | 0.53* | [0.30] | 0.62* | [0.32] |
| Year of birth == 1974 | -0.14 | [0.09] | -0.08 | [0.21] | -0.07 | [0.19] | -0.14 | [0.20] |
| Year of birth == 1975 | -0.02 | [0.10] | 0.18 | [0.24] | 0.20 | [0.23] | 0.12 | [0.24] |
| Year of birth == 1977 | 0.12 | [0.08] | -0.13 | [0.24] | -0.15 | [0.24] | -0.22 | [0.24] |
| Year of birth == 1978 | 0.10 | [0.07] | 0.03 | [0.15] | 0.02 | [0.15] | -0.05 | [0.16] |
| Year of birth == 1979 | -0.03 | [0.08] | -0.17 | [0.20] | -0.19 | [0.19] | -0.26 | [0.19] |
| Year of birth == 1980 | 0.11 | [0.09] | -0.17 | [0.19] | -0.15 | [0.19] | -0.23 | [0.19] |
| Year of birth == 1981 | 0.04 | [0.04] | -0.03 | [0.15] | -0.09 | [0.15] | -0.07 | [0.15] |
| Year of birth == 1982 | 0.15** | [0.07] | -0.00 | [0.19] | -0.08 | [0.19] | -0.11 | [0.19] |
| Year of birth == 1983 | 0.12* | [0.07] | 0.12 | [0.17] | 0.16 | [0.16] | 0.12 | [0.16] |
| Year of birth == 1984 | 0.03 | [0.07] | -0.33* | [0.20] | -0.28 | [0.19] | -0.33* | [0.19] |
| Year of birth == 1985 | 0.08 | [0.08] | -0.01 | [0.17] | 0.05 | [0.16] | 0.01 | [0.17] |
| Region of birth == TR2 | -0.24*** | [0.04] | -0.23*** | [0.04] | -0.41*** | [0.10] | -0.39*** | [0.10] |
| Region of birth == TR3 | -0.19*** | [0.02] | -0.17*** | [0.03] | -0.26*** | [0.06] | -0.25*** | [0.06] |
| Region of birth == TR4 | -0.20*** | [0.02] | -0.20*** | [0.03] | -0.27*** | [0.05] | -0.26*** | [0.05] |
| Region of birth == TR5 | -0.01 | [0.03] | -0.00 | [0.03] | -0.05 | [0.04] | -0.04 | [0.04] |
| Region of birth == TR6 | -0.21*** | [0.02] | -0.19*** | [0.04] | -0.24*** | [0.04] | -0.24*** | [0.05] |
| Region of birth == TR7 | -0.22*** | [0.03] | -0.18*** | [0.05] | -0.23*** | [0.05] | -0.22*** | [0.05] |
| Region of birth == TR8 | -0.21*** | [0.03] | -0.18*** | [0.04] | -0.25*** | [0.05] | -0.24*** | [0.05] |
| Region of birth == TR9 | -0.24*** | [0.03] | -0.19*** | [0.06] | -0.24*** | [0.07] | -0.24*** | [0.07] |
| Region of birth == TRA | -0.38*** | [0.03] | -0.31*** | [0.07] | -0.29*** | [0.07] | -0.30*** | [0.07] |
| Region of birth == TRB | -0.50*** | [0.02] | -0.42*** | [0.08] | -0.40*** | [0.08] | -0.41*** | [0.08] |
| Region of birth == TRC | -0.48*** | [0.02] | -0.41*** | [0.08] | -0.35*** | [0.08] | -0.35*** | [0.08] |
| Observations | 9,243 | | 9,243 | | 9,243 | | 9,243 | |
| Adjusted R-squared | 0.58 | | 0.58 | | 0.58 | | 0.58 | |

Robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

## Table 23: First stage estimation, years of schooling

| | Dependent variable: Years of schooling | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
| VARIABLES | Coefficient | Standard error | Coefficient | Standard error | Coefficient | Standard error | Coefficient | Standard error |
| Young X TPC X TDHS == 2008 | 30.85* | [17.13] | 61.31*** | [20.14] | 60.68*** | [20.70] | 52.15** | [22.49] |
| Year of birth == 1974 X GER at 1996 | | | 0.39 | [2.69] | 0.41 | [2.68] | 0.50 | [2.69] |
| Year of birth == 1975 X GER at 1996 | | | 0.86 | [2.66] | 0.88 | [2.65] | 0.98 | [2.65] |
| Year of birth == 1976 X GER at 1996 | | | 4.37 | [2.86] | 4.37 | [2.86] | 4.50 | [2.86] |
| Year of birth == 1977 X GER at 1996 | | | 3.79 | [2.83] | 3.81 | [2.83] | 3.92 | [2.81] |
| Year of birth == 1978 X GER at 1996 | | | 4.34* | [2.56] | 4.38* | [2.55] | 4.45* | [2.54] |
| Year of birth == 1979 X GER at 1996 | | | 1.93 | [2.48] | 1.97 | [2.48] | 2.04 | [2.47] |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Year of birth == 1980 X GER at 1996 | | | 4.42* | [2.61] | 4.44* | [2.61] | 4.55* | [2.64] |
| Year of birth == 1981 X GER at 1996 | | | 1.58 | [2.54] | 1.63 | [2.54] | 1.51 | [2.57] |
| Year of birth == 1982 X GER at 1996 | | | 3.20 | [2.50] | 3.26 | [2.50] | 3.17 | [2.51] |
| Year of birth == 1983 X GER at 1996 | | | 4.12 | [2.52] | 4.09 | [2.53] | 4.01 | [2.52] |
| Year of birth == 1984 X GER at 1996 | | | 2.49 | [2.43] | 2.45 | [2.43] | 2.39 | [2.43] |
| Year of birth == 1985 X GER at 1996 | | | 1.97 | [2.38] | 1.93 | [2.40] | 1.84 | [2.39] |
| Year of birth == 1986 X GER at 1996 | | | 0.49 | [3.27] | 0.48 | [3.27] | 0.49 | [3.28] |
| Year of birth == 1987 X GER at 1996 | | | 1.06 | [3.08] | 1.06 | [3.08] | 1.06 | [3.08] |
| Year of birth == 1988 X GER at 1996 | | | 1.94 | [2.67] | 1.95 | [2.66] | 1.95 | [2.66] |
| Year of birth == 1989 X GER at 1996 | | | -1.76 | [2.81] | -1.76 | [2.80] | -1.76 | [2.81] |
| TPC | | | | | 6.49 | [36.49] | -0.06 | [38.94] |
| Young X TPC | | | | | | | 12.64 | [16.13] |
| Age == 18 | 10.17*** | [0.67] | 8.85*** | [0.87] | 8.69*** | [1.24] | 8.76*** | [1.25] |
| Age == 19 | 10.43*** | [0.63] | 10.55*** | [2.79] | 10.39*** | [2.86] | 10.46*** | [2.87] |
| Age == 20 | 9.93*** | [0.55] | 7.11*** | [2.46] | 6.95*** | [2.55] | 7.02*** | [2.55] |
| Age == 21 | 10.06*** | [0.56] | 7.99*** | [2.76] | 7.84*** | [2.84] | 7.90*** | [2.84] |
| Age == 22 | 10.11*** | [0.59] | 8.54*** | [3.07] | 8.41*** | [3.13] | 8.47*** | [3.13] |
| Age == 23 | 11.11*** | [0.73] | 9.78*** | [0.93] | 9.62*** | [1.25] | 10.03*** | [1.38] |
| Age == 24 | 10.90*** | [0.66] | 11.02*** | [2.79] | 10.86*** | [2.87] | 11.27*** | [2.94] |
| Age == 25 | 10.18*** | [0.61] | 7.38*** | [2.47] | 7.22*** | [2.57] | 7.63*** | [2.64] |
| Age == 26 | 9.50*** | [0.71] | 7.42*** | [2.79] | 7.28** | [2.87] | 7.67*** | [2.93] |
| Age == 27 | 10.36*** | [0.62] | 8.80*** | [3.08] | 8.67*** | [3.14] | 9.05*** | [3.20] |
| Age == 28 | 10.48*** | [0.80] | 9.16*** | [0.98] | 9.00*** | [1.26] | 9.42*** | [1.39] |
| Age == 29 | 10.70*** | [0.78] | 10.81*** | [2.82] | 10.66*** | [2.90] | 11.06*** | [2.97] |
| Year of birth == 1974 | -1.76** | [0.79] | -2.56 | [1.99] | -2.55 | [1.98] | -2.88 | [2.04] |
| Year of birth == 1975 | -1.68** | [0.80] | -1.41 | [2.18] | -1.39 | [2.18] | -1.74 | [2.20] |
| Year of birth == 1976 | -0.64 | [0.66] | -2.98 | [2.44] | -2.99 | [2.44] | -3.32 | [2.49] |
| Year of birth == 1977 | 0.12 | [0.71] | -1.22 | [2.21] | -1.24 | [2.20] | -1.56 | [2.22] |
| Year of birth == 1978 | 0.02 | [0.61] | -1.06 | [1.40] | -1.07 | [1.40] | -1.39 | [1.44] |
| Year of birth == 1979 | -0.83 | [0.69] | -2.89* | [1.73] | -2.90* | [1.73] | -3.21* | [1.76] |
| Year of birth == 1980 | -0.79 | [0.75] | -3.41 | [2.10] | -3.40 | [2.10] | -3.75* | [2.15] |
| Year of birth == 1981 | -0.56 | [0.61] | -0.64 | [2.27] | -0.70 | [2.29] | -0.82 | [2.31] |
| Year of birth == 1982 | 0.43 | [0.57] | -0.45 | [1.83] | -0.50 | [1.86] | -0.66 | [1.87] |
| Year of birth == 1983 | 0.05 | [0.57] | -0.83 | [1.37] | -0.80 | [1.38] | -0.97 | [1.37] |
| Year of birth == 1984 | -0.71 | [0.63] | -3.21* | [1.66] | -3.18* | [1.66] | -3.36** | [1.69] |
| Year of birth == 1985 | -0.71 | [0.66] | -1.35 | [1.93] | -1.31 | [1.94] | -1.49 | [1.96] |
| Region of birth == TR2 | -1.80*** | [0.27] | -1.78*** | [0.30] | -1.90** | [0.74] | -1.84** | [0.76] |
| Region of birth == TR3 | -1.51*** | [0.20] | -1.32*** | [0.33] | -1.38*** | [0.48] | -1.35*** | [0.49] |
| Region of birth == TR4 | -1.67*** | [0.20] | -1.62*** | [0.22] | -1.67*** | [0.37] | -1.65*** | [0.38] |
| Region of birth == TR5 | 0.03 | [0.21] | 0.17 | [0.29] | 0.14 | [0.36] | 0.15 | [0.36] |
| Region of birth == TR6 | -1.86*** | [0.18] | -1.59*** | [0.36] | -1.63*** | [0.42] | -1.61*** | [0.43] |
| Region of birth == TR7 | -1.76*** | [0.25] | -1.40*** | [0.47] | -1.43*** | [0.50] | -1.42*** | [0.50] |
| Region of birth == TR8 | -1.76*** | [0.20] | -1.42*** | [0.43] | -1.47*** | [0.51] | -1.45*** | [0.51] |
| Region of birth == TR9 | -2.17*** | [0.22] | -1.62*** | [0.62] | -1.66** | [0.66] | -1.64** | [0.66] |
| Region of birth == TRA | -3.75*** | [0.27] | -2.99*** | [0.76] | -2.98*** | [0.76] | -2.98*** | [0.76] |
| Region of birth == TRB | -5.39*** | [0.19] | -4.51*** | [0.89] | -4.50*** | [0.89] | -4.51*** | [0.89] |
| Region of birth == TRC | -5.19*** | [0.23] | -4.36*** | [0.80] | -4.32*** | [0.82] | -4.34*** | [0.82] |
| Observations | 10,182 | | 10,182 | | 10,182 | | 10,182 | |
| Adjusted R-squared | 0.80 | | 0.80 | | 0.80 | | 0.80 | |

Robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

## Table 24: First stage estimation, years of schooling excluding age 22

| | Dependent variable: Years of schooling | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
| VARIABLES | Coefficient | Standard error | Coefficient | Standard error | Coefficient | Standard error | Coefficient | Standard error |
| Young X TPC X TDHS == 2008 | 33.87* | [17.88] | 67.99*** | [19.54] | 66.69*** | [20.35] | 49.80** | [22.59] |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Year of birth == 1974 X GER at 1996 | | | 0.53 | [2.56] | 0.57 | [2.54] | 0.71 | [2.56] |
| Year of birth == 1975 X GER at 1996 | | | 1.01 | [2.56] | 1.03 | [2.56] | 1.19 | [2.56] |
| Year of birth == 1976 X GER at 1996 | | | 4.51 | [2.80] | 4.51 | [2.80] | 4.72* | [2.80] |
| Year of birth == 1977 X GER at 1996 | | | 3.90 | [2.72] | 3.95 | [2.71] | 4.11 | [2.69] |
| Year of birth == 1978 X GER at 1996 | | | 4.51* | [2.48] | 4.58* | [2.47] | 4.69* | [2.46] |
| Year of birth == 1979 X GER at 1996 | | | 2.12 | [2.38] | 2.18 | [2.37] | 2.28 | [2.35] |
| Year of birth == 1980 X GER at 1996 | | | 4.54* | [2.47] | 4.58* | [2.46] | 4.75* | [2.51] |
| Year of birth == 1981 X GER at 1996 | | | 1.34 | [2.33] | 1.43 | [2.33] | 1.49 | [2.31] |
| Year of birth == 1982 X GER at 1996 | | | 3.33 | [2.40] | 3.45 | [2.40] | 3.25 | [2.42] |
| Year of birth == 1983 X GER at 1996 | | | 4.25* | [2.39] | 4.20* | [2.40] | 4.00* | [2.38] |
| Year of birth == 1984 X GER at 1996 | | | 2.65 | [2.28] | 2.57 | [2.29] | 2.43 | [2.29] |
| Year of birth == 1985 X GER at 1996 | | | 2.13 | [2.26] | 2.04 | [2.29] | 1.85 | [2.29] |
| Year of birth == 1987 X GER at 1996 | | | 0.99 | [2.95] | 1.01 | [2.94] | 1.00 | [2.94] |
| Year of birth == 1988 X GER at 1996 | | | 1.92 | [2.51] | 1.94 | [2.50] | 1.93 | [2.50] |
| Year of birth == 1989 X GER at 1996 | | | -1.78 | [2.69] | -1.79 | [2.67] | -1.78 | [2.68] |
| TPC | | | | | 12.55 | [37.71] | -0.23 | [40.49] |
| Young X TPC | | | | | | | 23.66 | [17.83] |
| Age == 18 | 10.02*** | [0.70] | 8.54*** | [0.82] | 8.23*** | [1.18] | 8.40*** | [1.20] |
| Age == 19 | 10.28*** | [0.67] | 10.27*** | [2.66] | 9.98*** | [2.73] | 10.13*** | [2.74] |
| Age == 20 | 9.78*** | [0.57] | 6.84*** | [2.29] | 6.54*** | [2.39] | 6.70*** | [2.40] |
| Age == 21 | 9.91*** | [0.58] | 7.75*** | [2.62] | 7.47*** | [2.70] | 7.62*** | [2.71] |
| Age == 23 | 10.95*** | [0.76] | 9.47*** | [0.87] | 9.16*** | [1.20] | 9.98*** | [1.36] |
| Age == 24 | 10.76*** | [0.70] | 10.74*** | [2.67] | 10.45*** | [2.74] | 11.24*** | [2.84] |
| Age == 25 | 10.04*** | [0.63] | 7.11*** | [2.30] | 6.81*** | [2.42] | 7.60*** | [2.50] |
| Age == 26 | 9.35*** | [0.73] | 7.18*** | [2.65] | 6.91** | [2.73] | 7.69*** | [2.81] |
| Age == 27 | 9.66*** | [0.31] | 5.60** | [2.53] | 5.34** | [2.60] | 5.46** | [2.59] |
| Age == 28 | 10.32*** | [0.83] | 8.85*** | [0.93] | 8.54*** | [1.21] | 9.36*** | [1.37] |
| Age == 29 | 10.55*** | [0.81] | 10.54*** | [2.70] | 10.25*** | [2.77] | 11.04*** | [2.87] |
| Year of birth == 1974 | -1.68** | [0.81] | -2.50 | [1.94] | -2.48 | [1.92] | -3.11 | [2.00] |
| Year of birth == 1975 | -1.59* | [0.83] | -1.31 | [2.14] | -1.28 | [2.13] | -1.94 | [2.17] |
| Year of birth == 1977 | 0.21 | [0.72] | -1.18 | [2.15] | -1.20 | [2.14] | -1.81 | [2.16] |
| Year of birth == 1978 | 0.11 | [0.63] | -1.03 | [1.36] | -1.05 | [1.36] | -1.64 | [1.41] |
| Year of birth == 1979 | -0.74 | [0.72] | -2.85* | [1.69] | -2.88* | [1.68] | -3.46** | [1.73] |
| Year of birth == 1980 | -0.69 | [0.78] | -3.30 | [2.05] | -3.28 | [2.03] | -3.94* | [2.11] |
| Year of birth == 1981 | 0.09 | [0.31] | 2.65* | [1.54] | 2.56 | [1.56] | 2.69* | [1.54] |
| Year of birth == 1982 | 0.52 | [0.58] | -0.42 | [1.80] | -0.52 | [1.83] | -0.82 | [1.84] |
| Year of birth == 1983 | 0.14 | [0.58] | -0.76 | [1.30] | -0.71 | [1.31] | -1.03 | [1.29] |
| Year of birth == 1984 | -0.62 | [0.65] | -3.16* | [1.60] | -3.10* | [1.59] | -3.45** | [1.65] |
| Year of birth == 1985 | -0.62 | [0.69] | -1.28 | [1.89] | -1.19 | [1.90] | -1.53 | [1.93] |
| Region of birth == TR2 | -1.69*** | [0.29] | -1.65*** | [0.31] | -1.89** | [0.77] | -1.75** | [0.79] |
| Region of birth == TR3 | -1.42*** | [0.20] | -1.21*** | [0.31] | -1.32*** | [0.48] | -1.26** | [0.49] |
| Region of birth == TR4 | -1.56*** | [0.21] | -1.50*** | [0.22] | -1.59*** | [0.38] | -1.54*** | [0.38] |
| Region of birth == TR5 | 0.10 | [0.23] | 0.27 | [0.28] | 0.20 | [0.35] | 0.24 | [0.36] |
| Region of birth == TR6 | -1.79*** | [0.19] | -1.49*** | [0.34] | -1.56*** | [0.41] | -1.52*** | [0.41] |
| Region of birth == TR7 | -1.73*** | [0.26] | -1.33*** | [0.44] | -1.39*** | [0.48] | -1.35*** | [0.49] |
| Region of birth == TR8 | -1.69*** | [0.20] | -1.32*** | [0.41] | -1.41*** | [0.49] | -1.37*** | [0.50] |
| Region of birth == TR9 | -2.11*** | [0.24] | -1.50** | [0.59] | -1.57** | [0.63] | -1.53** | [0.64] |
| Region of birth == TRA | -3.79*** | [0.27] | -2.96*** | [0.71] | -2.93*** | [0.71] | -2.94*** | [0.71] |
| Region of birth == TRB | -5.36*** | [0.19] | -4.40*** | [0.84] | -4.37*** | [0.84] | -4.38*** | [0.84] |
| Region of birth == TRC | -5.11*** | [0.23] | -4.20*** | [0.75] | -4.12*** | [0.77] | -4.16*** | [0.77] |
| Observations | 9,242 | | 9,242 | | 9,242 | | 9,242 | 9,242 |
| Adjusted R-squared | 0.81 | | 0.81 | | 0.81 | | 0.81 | 0.81 |

Robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

**Table 25: First stage estimation, completing eight years of schooling, ever-married subsample**

| | Dependent variable: Completing eight years of schooling | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 5 | | Model 6 | | Model 7 | | Model 8 | |
| VARIABLES | Coefficient | Standard error | Coefficient | Standard error | Coefficient | Standard error | Coefficient | Standard error |
| Young X TPC X TDHS == 2008 | 23.72*** | [5.91] | 21.89*** | [5.04] | 22.94*** | [5.10] | 22.86*** | [5.19] |
| Year of birth == 1974 X GER at 1996 | -0.77 | [0.55] | -0.44 | [0.54] | -0.34 | [0.51] | -0.21 | [0.50] |
| Year of birth == 1975 X GER at 1996 | -0.96 | [0.62] | -0.60 | [0.60] | -0.50 | [0.57] | -0.44 | [0.56] |
| Year of birth == 1976 X GER at 1996 | -0.42 | [0.56] | -0.29 | [0.56] | -0.21 | [0.53] | -0.21 | [0.52] |
| Year of birth == 1977 X GER at 1996 | -0.20 | [0.57] | -0.32 | [0.54] | -0.19 | [0.51] | -0.16 | [0.50] |
| Year of birth == 1978 X GER at 1996 | -0.34 | [0.54] | -0.21 | [0.53] | -0.15 | [0.50] | 0.04 | [0.49] |
| Year of birth == 1979 X GER at 1996 | -0.54 | [0.55] | -0.54 | [0.53] | -0.44 | [0.50] | -0.31 | [0.48] |
| Year of birth == 1980 X GER at 1996 | -0.33 | [0.53] | -0.24 | [0.53] | -0.14 | [0.50] | -0.12 | [0.49] |
| Year of birth == 1981 X GER at 1996 | -0.55 | [0.53] | -0.34 | [0.52] | -0.27 | [0.49] | -0.13 | [0.48] |
| Year of birth == 1982 X GER at 1996 | -0.58 | [0.55] | -0.37 | [0.53] | -0.26 | [0.50] | -0.12 | [0.50] |
| Year of birth == 1983 X GER at 1996 | -0.65 | [0.53] | -0.58 | [0.53] | -0.48 | [0.50] | -0.40 | [0.49] |
| Year of birth == 1984 X GER at 1996 | -0.66 | [0.55] | -0.41 | [0.56] | -0.26 | [0.53] | -0.19 | [0.52] |
| Year of birth == 1985 X GER at 1996 | -0.78 | [0.60] | -0.57 | [0.56] | -0.44 | [0.53] | -0.49 | [0.52] |
| Year of birth == 1986 X GER at 1996 | -1.57*** | [0.48] | -1.21** | [0.49] | -1.12** | [0.47] | -1.16** | [0.46] |
| Year of birth == 1987 X GER at 1996 | -1.07 | [0.68] | -0.86 | [0.62] | -0.80 | [0.60] | -0.80 | [0.57] |
| Year of birth == 1988 X GER at 1996 | -0.15 | [0.51] | -0.17 | [0.50] | -0.12 | [0.47] | -0.10 | [0.46] |
| Year of birth == 1989 X GER at 1996 | -0.91 | [0.63] | -0.68 | [0.59] | -0.59 | [0.56] | -0.61 | [0.55] |
| TPC | 12.04* | [6.58] | 11.81* | [6.05] | 11.33* | [6.03] | 14.49** | [6.42] |
| Young X TPC | -4.50* | [2.46] | -4.65** | [2.11] | -5.92*** | [2.11] | -4.94** | [1.97] |
| Age == 18 | 0.05 | [0.32] | -0.24 | [0.28] | -0.20 | [0.28] | -0.28 | [0.29] |
| Age == 19 | 0.83 | [0.60] | 0.35 | [0.54] | 0.31 | [0.52] | 0.22 | [0.52] |
| Age == 20 | 0.27 | [0.54] | -0.03 | [0.54] | -0.03 | [0.51] | -0.14 | [0.50] |
| Age == 21 | 0.94 | [0.60] | 0.45 | [0.60] | 0.43 | [0.57] | 0.36 | [0.54] |
| Age == 22 | 1.20** | [0.51] | 0.62 | [0.51] | 0.58 | [0.48] | 0.55 | [0.47] |
| Age == 23 | -0.02 | [0.33] | -0.40 | [0.29] | -0.41 | [0.29] | -0.45 | [0.30] |
| Age == 24 | 0.72 | [0.61] | 0.22 | [0.55] | 0.14 | [0.53] | 0.07 | [0.52] |
| Age == 25 | 0.24 | [0.55] | -0.10 | [0.54] | -0.15 | [0.52] | -0.25 | [0.51] |
| Age == 26 | 0.89 | [0.61] | 0.39 | [0.60] | 0.33 | [0.57] | 0.25 | [0.55] |
| Age == 27 | 1.17** | [0.51] | 0.54 | [0.52] | 0.47 | [0.49] | 0.44 | [0.48] |
| Age == 28 | 0.02 | [0.33] | -0.40 | [0.30] | -0.40 | [0.30] | -0.46 | [0.30] |
| Age == 29 | 0.80 | [0.62] | 0.26 | [0.55] | 0.17 | [0.53] | 0.08 | [0.52] |
| Year of birth == 1974 | 0.24 | [0.39] | 0.24 | [0.30] | 0.25 | [0.31] | 0.21 | [0.30] |
| Year of birth == 1975 | 1.16*** | [0.44] | 0.97** | [0.44] | 0.91** | [0.41] | 0.89** | [0.39] |
| Year of birth == 1976 | -0.38* | [0.21] | -0.16 | [0.24] | -0.15 | [0.25] | -0.15 | [0.25] |
| Year of birth == 1977 | -0.27 | [0.48] | -0.01 | [0.39] | -0.04 | [0.39] | -0.03 | [0.36] |
| Year of birth == 1978 | 0.52** | [0.22] | 0.42** | [0.19] | 0.44** | [0.19] | 0.36** | [0.18] |
| Year of birth == 1979 | 0.12 | [0.39] | 0.29 | [0.29] | 0.32 | [0.30] | 0.26 | [0.29] |
| Year of birth == 1980 | 0.76** | [0.38] | 0.74* | [0.39] | 0.69* | [0.36] | 0.68** | [0.34] |
| Year of birth == 1981 | -0.27* | [0.15] | -0.16 | [0.17] | -0.12 | [0.19] | -0.27 | [0.18] |
| Year of birth == 1982 | 0.03 | [0.46] | 0.01 | [0.39] | -0.00 | [0.39] | -0.09 | [0.36] |
| Year of birth == 1983 | 0.73*** | [0.20] | 0.63*** | [0.18] | 0.62*** | [0.18] | 0.60*** | [0.18] |
| Year of birth == 1984 | 0.25 | [0.39] | 0.19 | [0.31] | 0.16 | [0.31] | 0.12 | [0.30] |
| Year of birth == 1985 | 0.99** | [0.42] | 0.86** | [0.40] | 0.79** | [0.37] | 0.83** | [0.36] |
| Region of birth == TR2 | -0.51*** | [0.12] | -0.41*** | [0.12] | -0.40*** | [0.12] | -0.37*** | [0.13] |
| Region of birth == TR3 | -0.42*** | [0.09] | -0.30*** | [0.09] | -0.29*** | [0.09] | -0.23*** | [0.09] |
| Region of birth == TR4 | -0.33*** | [0.07] | -0.29*** | [0.06] | -0.28*** | [0.06] | -0.22*** | [0.06] |
| Region of birth == TR5 | -0.19** | [0.07] | -0.17** | [0.07] | -0.16** | [0.07] | -0.11* | [0.07] |
| Region of birth == TR6 | -0.41*** | [0.09] | -0.28*** | [0.09] | -0.24*** | [0.08] | -0.17** | [0.08] |
| Region of birth == TR7 | -0.39*** | [0.11] | -0.27** | [0.10] | -0.25** | [0.10] | -0.16* | [0.10] |
| Region of birth == TR8 | -0.45*** | [0.11] | -0.32*** | [0.11] | -0.31*** | [0.10] | -0.22** | [0.10] |
| Region of birth == TR9 | -0.55*** | [0.15] | -0.38** | [0.15] | -0.36** | [0.14] | -0.26* | [0.14] |
| Region of birth == TRA | -0.54*** | [0.17] | -0.35** | [0.17] | -0.29* | [0.16] | -0.19 | [0.16] |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Region of birth == TRB | -0.66*** | [0.20] | -0.40** | [0.20] | -0.30 | [0.19] | -0.19 | [0.19] |
| Region of birth == TRC | -0.55*** | [0.19] | -0.29 | [0.19] | -0.20 | [0.18] | -0.09 | [0.17] |
| Mother's education == Primary incomplete | | | 0.02 | [0.02] | 0.00 | [0.02] | 0.01 | [0.02] |
| Mother's education == Primary complete | | | 0.21*** | [0.02] | 0.19*** | [0.02] | 0.18*** | [0.02] |
| Mother's education == Secondary complete | | | 0.42*** | [0.04] | 0.41*** | [0.04] | 0.36*** | [0.04] |
| Mother's education == High school | | | 0.43*** | [0.03] | 0.41*** | [0.03] | 0.36*** | [0.03] |
| Mother's education == More than high school | | | 0.40*** | [0.06] | 0.38*** | [0.05] | 0.34*** | [0.05] |
| Mother's education == Don't know | | | 0.05 | [0.06] | 0.04 | [0.06] | 0.05 | [0.06] |
| Father's education == Primary incomplete | | | 0.01 | [0.03] | 0.00 | [0.03] | -0.01 | [0.02] |
| Father's education == Primary complete | | | 0.10*** | [0.02] | 0.08*** | [0.02] | 0.07*** | [0.02] |
| Father's education == Secondary complete | | | 0.34*** | [0.03] | 0.32*** | [0.03] | 0.27*** | [0.03] |
| Father's education == High school | | | 0.41*** | [0.03] | 0.39*** | [0.03] | 0.33*** | [0.03] |
| Father's education == More than high school | | | 0.49*** | [0.04] | 0.48*** | [0.04] | 0.42*** | [0.04] |
| Father's education == Don't know | | | 0.01 | [0.03] | 0.01 | [0.03] | -0.00 | [0.03] |
| Mother's tongue == Kurdish | | | | | -0.13*** | [0.02] | -0.10*** | [0.02] |
| Mother's tongue == Arabic | | | | | -0.13*** | [0.03] | -0.10*** | [0.03] |
| Mother's tongue == Other | | | | | -0.02 | [0.07] | -0.03 | [0.10] |
| Childhood's place == Rural | | | | | | | -0.22*** | [0.02] |
| Observations | 5,143 | | 5,131 | | 5,131 | | 5,124 | |
| Adjusted R-squared | 0.41 | | 0.53 | | 0.53 | | 0.56 | |

Robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

## Table 26: First stage estimation, completing eight years of schooling, ever-married subsample excluding age 22

| | Dependent variable: Completing eight years of schooling | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 5 | | Model 6 | | Model 7 | | Model 8 | |
| VARIABLES | Coefficient | Standard error | Coefficient | Standard error | Coefficient | Standard error | Coefficient | Standard error |
| Young X TPC X TDHS == 2008 | 28.27*** | [6.65] | 27.53*** | [5.44] | 28.53*** | [5.45] | 30.16*** | [5.30] |
| Year of birth == 1974 X GER at 1996 | -0.50 | [0.58] | -0.18 | [0.55] | -0.07 | [0.52] | 0.09 | [0.51] |
| Year of birth == 1975 X GER at 1996 | -0.70 | [0.65] | -0.35 | [0.61] | -0.24 | [0.59] | -0.13 | [0.57] |
| Year of birth == 1976 X GER at 1996 | -0.16 | [0.60] | -0.04 | [0.57] | 0.05 | [0.55] | 0.08 | [0.54] |
| Year of birth == 1977 X GER at 1996 | 0.07 | [0.60] | -0.06 | [0.55] | 0.07 | [0.52] | 0.14 | [0.51] |
| Year of birth == 1978 X GER at 1996 | -0.06 | [0.58] | 0.06 | [0.54] | 0.12 | [0.51] | 0.34 | [0.50] |
| Year of birth == 1979 X GER at 1996 | -0.27 | [0.58] | -0.28 | [0.54] | -0.17 | [0.51] | -0.00 | [0.50] |
| Year of birth == 1980 X GER at 1996 | -0.06 | [0.57] | 0.03 | [0.55] | 0.13 | [0.52] | 0.19 | [0.50] |
| Year of birth == 1981 X GER at 1996 | -0.26 | [0.57] | -0.21 | [0.54] | -0.14 | [0.51] | 0.01 | [0.50] |
| Year of birth == 1982 X GER at 1996 | -0.30 | [0.58] | -0.08 | [0.54] | 0.03 | [0.51] | 0.20 | [0.51] |
| Year of birth == 1983 X GER at 1996 | -0.42 | [0.58] | -0.33 | [0.55] | -0.23 | [0.51] | -0.09 | [0.51] |
| Year of birth == 1984 X GER at 1996 | -0.43 | [0.59] | -0.17 | [0.58] | -0.01 | [0.55] | 0.13 | [0.54] |
| Year of birth == 1985 X GER at 1996 | -0.55 | [0.64] | -0.33 | [0.58] | -0.20 | [0.55] | -0.19 | [0.53] |
| Year of birth == 1987 X GER at 1996 | -1.02 | [0.68] | -0.80 | [0.62] | -0.74 | [0.60] | -0.73 | [0.57] |
| Year of birth == 1988 X GER at 1996 | -0.10 | [0.53] | -0.13 | [0.52] | -0.07 | [0.48] | -0.04 | [0.47] |
| Year of birth == 1989 X GER at 1996 | -0.88 | [0.65] | -0.65 | [0.59] | -0.56 | [0.56] | -0.57 | [0.55] |
| TPC | 14.62** | [6.53] | 14.06** | [6.27] | 13.38** | [6.23] | 15.58** | [6.54] |
| Young X TPC | -3.88 | [2.89] | -5.24** | [2.49] | -6.47*** | [2.46] | -6.29*** | [1.98] |
| Age == 18 | -0.24 | [0.31] | -0.52** | [0.26] | -0.48* | [0.26] | -0.56** | [0.27] |
| Age == 19 | 0.53 | [0.63] | 0.05 | [0.54] | 0.02 | [0.51] | -0.08 | [0.51] |
| Age == 20 | -0.03 | [0.57] | -0.32 | [0.55] | -0.32 | [0.51] | -0.44 | [0.50] |
| Age == 21 | 0.64 | [0.62] | 0.15 | [0.60] | 0.14 | [0.57] | 0.05 | [0.55] |
| Age == 23 | -0.30 | [0.33] | -0.70** | [0.28] | -0.70** | [0.28] | -0.78*** | [0.28] |
| Age == 24 | 0.43 | [0.64] | -0.09 | [0.55] | -0.16 | [0.52] | -0.27 | [0.52] |
| Age == 25 | -0.04 | [0.58] | -0.41 | [0.55] | -0.45 | [0.52] | -0.59 | [0.51] |
| Age == 26 | 0.60 | [0.63] | 0.07 | [0.61] | 0.02 | [0.58] | -0.09 | [0.55] |
| Age == 27 | 0.48 | [0.59] | 0.07 | [0.55] | 0.02 | [0.52] | -0.03 | [0.52] |
| Age == 28 | -0.26 | [0.33] | -0.70** | [0.28] | -0.70** | [0.28] | -0.79*** | [0.28] |
| Age == 29 | 0.51 | [0.64] | -0.05 | [0.55] | -0.13 | [0.52] | -0.25 | [0.52] |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Year of birth == 1974 | 0.21 | [0.39] | 0.24 | [0.28] | 0.25 | [0.29] | 0.22 | [0.28] |
| Year of birth == 1975 | 1.12** | [0.46] | 0.96** | [0.46] | 0.89** | [0.42] | 0.89** | [0.41] |
| Year of birth == 1977 | -0.30 | [0.46] | -0.01 | [0.38] | -0.04 | [0.37] | -0.00 | [0.34] |
| Year of birth == 1978 | 0.48** | [0.21] | 0.42** | [0.18] | 0.44** | [0.18] | 0.38** | [0.16] |
| Year of birth == 1979 | 0.09 | [0.38] | 0.29 | [0.27] | 0.31 | [0.28] | 0.27 | [0.27] |
| Year of birth == 1980 | 0.72* | [0.41] | 0.73* | [0.41] | 0.67* | [0.37] | 0.68* | [0.36] |
| Year of birth == 1981 | 0.09 | [0.18] | 0.10 | [0.20] | 0.13 | [0.20] | 0.01 | [0.21] |
| Year of birth == 1982 | -0.02 | [0.44] | -0.01 | [0.37] | -0.02 | [0.37] | -0.09 | [0.34] |
| Year of birth == 1983 | 0.72*** | [0.19] | 0.63*** | [0.17] | 0.62*** | [0.17] | 0.61*** | [0.16] |
| Year of birth == 1984 | 0.24 | [0.38] | 0.19 | [0.29] | 0.16 | [0.29] | 0.13 | [0.28] |
| Year of birth == 1985 | 0.97** | [0.44] | 0.86** | [0.42] | 0.79** | [0.38] | 0.83** | [0.37] |
| Region of birth == TR2 | -0.53*** | [0.13] | -0.43*** | [0.13] | -0.41*** | [0.13] | -0.36*** | [0.14] |
| Region of birth == TR3 | -0.41*** | [0.10] | -0.29*** | [0.10] | -0.28*** | [0.09] | -0.21** | [0.09] |
| Region of birth == TR4 | -0.34*** | [0.07] | -0.29*** | [0.07] | -0.27*** | [0.07] | -0.20*** | [0.07] |
| Region of birth == TR5 | -0.16** | [0.08] | -0.14* | [0.07] | -0.13* | [0.07] | -0.08 | [0.07] |
| Region of birth == TR6 | -0.40*** | [0.10] | -0.26*** | [0.09] | -0.22** | [0.09] | -0.14 | [0.09] |
| Region of birth == TR7 | -0.38*** | [0.12] | -0.25** | [0.11] | -0.23** | [0.10] | -0.13 | [0.10] |
| Region of birth == TR8 | -0.41*** | [0.12] | -0.28** | [0.11] | -0.26** | [0.11] | -0.17 | [0.11] |
| Region of birth == TR9 | -0.50*** | [0.16] | -0.32** | [0.16] | -0.30** | [0.15] | -0.18 | [0.15] |
| Region of birth == TRA | -0.45** | [0.19] | -0.26 | [0.17] | -0.19 | [0.16] | -0.08 | [0.16] |
| Region of birth == TRB | -0.55** | [0.22] | -0.29 | [0.21] | -0.19 | [0.19] | -0.06 | [0.19] |
| Region of birth == TRC | -0.44** | [0.20] | -0.19 | [0.19] | -0.09 | [0.18] | 0.03 | [0.17] |
| Mother's education == Primary incomplete | | | 0.02 | [0.03] | 0.01 | [0.03] | 0.01 | [0.02] |
| Mother's education == Primary complete | | | 0.21*** | [0.02] | 0.20*** | [0.02] | 0.18*** | [0.02] |
| Mother's education == Secondary complete | | | 0.44*** | [0.04] | 0.42*** | [0.04] | 0.36*** | [0.04] |
| Mother's education == High school | | | 0.43*** | [0.03] | 0.41*** | [0.03] | 0.36*** | [0.03] |
| Mother's education == More than high school | | | 0.40*** | [0.06] | 0.38*** | [0.05] | 0.33*** | [0.05] |
| Mother's education == Don't know | | | 0.04 | [0.06] | 0.03 | [0.06] | 0.05 | [0.06] |
| Father's education == Primary incomplete | | | 0.02 | [0.03] | 0.01 | [0.03] | -0.00 | [0.03] |
| Father's education == Primary complete | | | 0.10*** | [0.02] | 0.08*** | [0.02] | 0.07*** | [0.02] |
| Father's education == Secondary complete | | | 0.34*** | [0.03] | 0.32*** | [0.03] | 0.27*** | [0.03] |
| Father's education == High school | | | 0.41*** | [0.03] | 0.39*** | [0.04] | 0.33*** | [0.03] |
| Father's education == More than high school | | | 0.50*** | [0.04] | 0.48*** | [0.03] | 0.43*** | [0.04] |
| Father's education == Don't know | | | 0.01 | [0.03] | 0.00 | [0.03] | -0.01 | [0.03] |
| Mother's tongue == Kurdish | | | | | -0.14*** | [0.02] | -0.11*** | [0.02] |
| Mother's tongue == Arabic | | | | | -0.13*** | [0.04] | -0.10*** | [0.03] |
| Mother's tongue == Other | | | | | -0.03 | [0.07] | -0.03 | [0.10] |
| Childhood's place == Rural | | | | | | | -0.22*** | [0.02] |
| Observations | 4,958 | | 4,946 | | 4,946 | | 4,939 | |
| Adjusted R-squared | 0.41 | | 0.53 | | 0.53 | | 0.56 | |

Robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

## Table 27: First stage estimation, years of schooling, ever-married subsample

| | Dependent variable: Years of schooling | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 5 | | Model 6 | | Model 7 | | Model 8 | |
| VARIABLES | Coefficient | Standard error | Coefficient | Standard error | Coefficient | Standard error | Coefficient | Standard error |
| Young X TPC X TDHS == 2008 | 80.79** | [33.77] | 67.28*** | [25.14] | 84.14*** | [23.95] | 82.91*** | [24.59] |
| Year of birth == 1974 X GER at 1996 | -5.01 | [4.88] | -2.62 | [4.77] | -1.09 | [4.17] | -0.29 | [4.09] |
| Year of birth == 1975 X GER at 1996 | -6.04 | [4.91] | -3.47 | [4.84] | -1.85 | [4.27] | -1.49 | [4.14] |
| Year of birth == 1976 X GER at 1996 | 0.54 | [4.80] | 1.08 | [4.67] | 2.47 | [4.01] | 2.26 | [3.89] |
| Year of birth == 1977 X GER at 1996 | -1.29 | [4.78] | -2.75 | [4.53] | -0.66 | [3.90] | -0.53 | [3.77] |
| Year of birth == 1978 X GER at 1996 | -4.64 | [4.51] | -3.87 | [4.40] | -3.05 | [3.79] | -1.89 | [3.65] |
| Year of birth == 1979 X GER at 1996 | -4.48 | [4.55] | -4.84 | [4.39] | -3.35 | [3.79] | -2.46 | [3.63] |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Year of birth == 1980 X GER at 1996 | -2.84 | [4.52] | -2.43 | [4.54] | -0.84 | [3.94] | -0.77 | [3.77] |
| Year of birth == 1981 X GER at 1996 | -6.55 | [4.40] | -4.98 | [4.36] | -3.85 | [3.74] | -3.01 | [3.61] |
| Year of birth == 1982 X GER at 1996 | -4.77 | [4.57] | -3.04 | [4.50] | -1.33 | [3.86] | -0.54 | [3.74] |
| Year of birth == 1983 X GER at 1996 | -4.49 | [4.48] | -3.93 | [4.45] | -2.49 | [3.83] | -2.00 | [3.70] |
| Year of birth == 1984 X GER at 1996 | -6.10 | [4.62] | -4.05 | [4.64] | -1.59 | [3.98] | -1.23 | [3.85] |
| Year of birth == 1985 X GER at 1996 | -5.59 | [4.62] | -3.93 | [4.53] | -2.01 | [3.99] | -2.42 | [3.91] |
| Year of birth == 1986 X GER at 1996 | -8.09* | [4.39] | -5.26 | [4.43] | -3.94 | [3.90] | -4.27 | [3.70] |
| Year of birth == 1987 X GER at 1996 | -8.53 | [5.36] | -6.79 | [5.16] | -6.09 | [4.49] | -6.29 | [4.25] |
| Year of birth == 1988 X GER at 1996 | -3.07 | [4.73] | -3.24 | [4.58] | -2.54 | [3.99] | -2.45 | [3.76] |
| Year of birth == 1989 X GER at 1996 | -7.28 | [5.95] | -5.40 | [4.94] | -4.13 | [4.08] | -4.27 | [3.94] |
| TPC | 30.92 | [44.79] | 23.97 | [39.94] | 14.71 | [39.74] | 35.64 | [42.60] |
| Young X TPC | -7.16 | [19.78] | -8.35 | [17.32] | -29.75* | [16.16] | -23.20 | [16.65] |
| Age == 18 | 6.87*** | [1.80] | 4.10*** | [1.45] | 4.85*** | [1.39] | 4.36*** | [1.45] |
| Age == 19 | 12.91** | [5.81] | 8.50* | [4.71] | 8.20** | [3.86] | 7.65** | [3.74] |
| Age == 20 | 9.66** | [4.67] | 6.75 | [4.52] | 6.90* | [3.94] | 6.28* | [3.74] |
| Age == 21 | 13.73*** | [5.04] | 9.28* | [5.03] | 9.39** | [4.35] | 9.09** | [4.12] |
| Age == 22 | 13.01*** | [4.36] | 7.82* | [4.37] | 7.49* | [3.84] | 7.37** | [3.66] |
| Age == 23 | 8.07*** | [1.94] | 4.43*** | [1.61] | 4.44*** | [1.53] | 4.17*** | [1.60] |
| Age == 24 | 13.55** | [5.85] | 8.96* | [4.74] | 7.92** | [3.90] | 7.51** | [3.77] |
| Age == 25 | 10.63** | [4.70] | 7.25 | [4.55] | 6.72* | [3.97] | 6.11 | [3.77] |
| Age == 26 | 14.19*** | [5.08] | 9.66* | [5.06] | 8.97** | [4.38] | 8.67** | [4.16] |
| Age == 27 | 14.10*** | [4.41] | 8.52* | [4.41] | 7.58* | [3.89] | 7.49** | [3.72] |
| Age == 28 | 8.72*** | [1.97] | 4.80*** | [1.65] | 4.80*** | [1.56] | 4.40*** | [1.63] |
| Age == 29 | 14.13** | [5.87] | 9.17* | [4.75] | 8.07** | [3.91] | 7.51** | [3.78] |
| Year of birth == 1974 | -1.59 | [3.99] | -1.14 | [2.56] | -0.97 | [2.09] | -1.26 | [2.11] |
| Year of birth == 1975 | 4.54 | [4.03] | 3.37 | [4.02] | 2.43 | [3.49] | 2.39 | [3.37] |
| Year of birth == 1976 | -5.40*** | [1.78] | -3.24* | [1.70] | -3.09* | [1.74] | -3.05* | [1.67] |
| Year of birth == 1977 | -4.06 | [3.23] | -1.52 | [2.73] | -2.18 | [2.49] | -2.20 | [2.33] |
| Year of birth == 1978 | 2.20 | [1.98] | 1.81 | [1.49] | 2.11 | [1.51] | 1.58 | [1.32] |
| Year of birth == 1979 | -1.19 | [3.71] | 0.59 | [2.05] | 0.91 | [1.54] | 0.48 | [1.48] |
| Year of birth == 1980 | 2.84 | [3.70] | 3.03 | [3.73] | 2.22 | [3.16] | 2.22 | [2.99] |
| Year of birth == 1981 | 0.49 | [0.97] | 1.43 | [0.91] | 1.97 | [1.20] | 1.00 | [1.06] |
| Year of birth == 1982 | -1.24 | [3.02] | -1.36 | [2.67] | -1.69 | [2.45] | -2.43 | [2.30] |
| Year of birth == 1983 | 2.00 | [1.85] | 1.34 | [1.47] | 1.16 | [1.48] | 1.01 | [1.29] |
| Year of birth == 1984 | 0.38 | [3.75] | -0.06 | [2.27] | -0.59 | [1.61] | -0.83 | [1.59] |
| Year of birth == 1985 | 4.65 | [3.75] | 3.82 | [3.71] | 2.79 | [3.17] | 3.13 | [3.04] |
| Region of birth == TR2 | -2.34** | [0.91] | -1.47* | [0.88] | -1.20 | [0.85] | -1.03 | [0.91] |
| Region of birth == TR3 | -2.38*** | [0.73] | -1.37* | [0.71] | -1.13* | [0.65] | -0.75 | [0.65] |
| Region of birth == TR4 | -1.85*** | [0.48] | -1.42*** | [0.45] | -1.27*** | [0.43] | -0.83* | [0.44] |
| Region of birth == TR5 | -0.79 | [0.58] | -0.71 | [0.55] | -0.58 | [0.50] | -0.27 | [0.49] |
| Region of birth == TR6 | -2.87*** | [0.74] | -1.73** | [0.73] | -1.17* | [0.64] | -0.70 | [0.63] |
| Region of birth == TR7 | -2.71*** | [0.88] | -1.66* | [0.86] | -1.43* | [0.75] | -0.85 | [0.73] |
| Region of birth == TR8 | -2.73*** | [0.89] | -1.65* | [0.88] | -1.43* | [0.77] | -0.86 | [0.75] |
| Region of birth == TR9 | -3.56*** | [1.24] | -2.07* | [1.24] | -1.75 | [1.08] | -1.09 | [1.06] |
| Region of birth == TRA | -4.82*** | [1.45] | -3.26** | [1.42] | -2.31* | [1.22] | -1.65 | [1.17] |
| Region of birth == TRB | -6.31*** | [1.70] | -4.12** | [1.69] | -2.43* | [1.45] | -1.71 | [1.39] |
| Region of birth == TRC | -5.69*** | [1.56] | -3.46** | [1.53] | -1.81 | [1.32] | -1.14 | [1.27] |
| Mother's education == Primary incomplete | | | 0.63*** | [0.17] | 0.42** | [0.16] | 0.44*** | [0.15] |
| Mother's education == Primary complete | | | 1.70*** | [0.13] | 1.44*** | [0.13] | 1.33*** | [0.12] |
| Mother's education == Secondary complete | | | 3.13*** | [0.37] | 2.86*** | [0.37] | 2.52*** | [0.34] |
| Mother's education == High school | | | 4.13*** | [0.38] | 3.84*** | [0.37] | 3.55*** | [0.36] |
| Mother's education == More than high school | | | 5.49*** | [0.44] | 5.14*** | [0.40] | 4.79*** | [0.39] |
| Mother's education == Don't know | | | 0.19 | [0.40] | 0.07 | [0.36] | 0.16 | [0.38] |
| Father's education == Primary incomplete | | | 0.53*** | [0.20] | 0.33* | [0.19] | 0.27 | [0.18] |
| Father's education == Primary complete | | | 1.32*** | [0.14] | 1.01*** | [0.12] | 0.96*** | [0.13] |
| Father's education == Secondary complete | | | 3.10*** | [0.23] | 2.75*** | [0.22] | 2.41*** | [0.22] |
| Father's education == High school | | | 4.06*** | [0.27] | 3.76*** | [0.26] | 3.35*** | [0.26] |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Father's education == More than high school | | | 5.16*** | [0.29] | 4.87*** | [0.28] | 4.54*** | [0.30] |
| Father's education == Don't know | | | 0.31 | [0.24] | 0.15 | [0.22] | 0.10 | [0.20] |
| Mother's tongue == Kurdish | | | | | -2.39*** | [0.17] | -2.19*** | [0.17] |
| Mother's tongue == Arabic | | | | | -1.68*** | [0.33] | -1.39*** | [0.32] |
| Mother's tongue == Other | | | | | -0.74 | [0.64] | -0.86 | [0.76] |
| Childhood's place == Rural | | | | | | | -1.44*** | [0.10] |
| Observations | 5,143 | | 5,131 | | 5,131 | | 5,124 | |
| Adjusted R-squared | 0.78 | | 0.84 | | 0.85 | | 0.86 | |

Robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

## Table 28: First stage estimation, years of schooling, ever-married subsample excluding age 22

| | Dependent variable: Years of schooling | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 5 | | Model 6 | | Model 7 | | Model 8 | |
| VARIABLES | Coefficient | Standard error | Coefficient | Standard error | Coefficient | Standard error | Coefficient | Standard error |
| Young X TPC X TDHS == 2008 | 86.16* | [44.35] | 87.38*** | [31.82] | 104.36*** | [30.20] | 114.30*** | [29.23] |
| Year of birth == 1974 X GER at 1996 | -4.75 | [5.07] | -2.20 | [4.91] | -0.57 | [4.27] | 0.46 | [4.18] |
| Year of birth == 1975 X GER at 1996 | -5.85 | [5.03] | -3.11 | [4.93] | -1.36 | [4.34] | -0.75 | [4.21] |
| Year of birth == 1976 X GER at 1996 | 0.75 | [4.96] | 1.45 | [4.81] | 2.95 | [4.10] | 3.01 | [3.98] |
| Year of birth == 1977 X GER at 1996 | -1.06 | [4.91] | -2.39 | [4.64] | -0.17 | [3.98] | 0.20 | [3.85] |
| Year of birth == 1978 X GER at 1996 | -4.41 | [4.67] | -3.52 | [4.53] | -2.62 | [3.87] | -1.24 | [3.74] |
| Year of birth == 1979 X GER at 1996 | -4.25 | [4.70] | -4.52 | [4.53] | -2.94 | [3.89] | -1.81 | [3.73] |
| Year of birth == 1980 X GER at 1996 | -2.62 | [4.70] | -2.05 | [4.68] | -0.36 | [4.06] | -0.05 | [3.88] |
| Year of birth == 1981 X GER at 1996 | -5.79 | [4.60] | -5.71 | [4.64] | -4.69 | [4.03] | -3.75 | [3.92] |
| Year of birth == 1982 X GER at 1996 | -4.47 | [4.71] | -2.46 | [4.59] | -0.66 | [3.92] | 0.40 | [3.80] |
| Year of birth == 1983 X GER at 1996 | -4.34 | [4.68] | -3.48 | [4.61] | -1.94 | [3.96] | -1.07 | [3.82] |
| Year of birth == 1984 X GER at 1996 | -5.98 | [4.78] | -3.63 | [4.77] | -1.01 | [4.08] | -0.25 | [3.95] |
| Year of birth == 1985 X GER at 1996 | -5.48 | [4.81] | -3.53 | [4.68] | -1.49 | [4.12] | -1.49 | [4.03] |
| Year of birth == 1987 X GER at 1996 | -8.61 | [5.43] | -6.72 | [5.22] | -5.95 | [4.49] | -6.08 | [4.27] |
| Year of birth == 1988 X GER at 1996 | -3.14 | [4.82] | -3.29 | [4.69] | -2.54 | [4.05] | -2.36 | [3.84] |
| Year of birth == 1989 X GER at 1996 | -7.32 | [6.05] | -5.38 | [4.99] | -4.06 | [4.09] | -4.14 | [3.98] |
| TPC | 43.95 | [47.33] | 37.43 | [43.86] | 25.06 | [43.67] | 39.73 | [46.31] |
| Young X TPC | -7.36 | [23.44] | -22.09 | [18.92] | -43.36** | [16.97] | -42.22*** | [15.53] |
| Age == 18 | 6.37*** | [2.04] | 3.51** | [1.57] | 4.33*** | [1.51] | 3.79** | [1.54] |
| Age == 19 | 12.46** | [6.00] | 7.90 | [4.80] | 7.61* | [3.91] | 6.99* | [3.80] |
| Age == 20 | 9.26* | [4.81] | 6.24 | [4.64] | 6.42 | [4.03] | 5.69 | [3.83] |
| Age == 21 | 13.36** | [5.15] | 8.70* | [5.14] | 8.81** | [4.39] | 8.43** | [4.17] |
| Age == 23 | 7.58*** | [2.20] | 3.44** | [1.74] | 3.51** | [1.65] | 3.06* | [1.66] |
| Age == 24 | 13.10** | [6.05] | 8.01* | [4.83] | 6.98* | [3.94] | 6.35* | [3.83] |
| Age == 25 | 10.22** | [4.86] | 6.38 | [4.68] | 5.87 | [4.07] | 5.00 | [3.86] |
| Age == 26 | 13.81*** | [5.21] | 8.71* | [5.17] | 8.01* | [4.42] | 7.48* | [4.20] |
| Age == 27 | 8.30* | [4.79] | 4.69 | [4.64] | 3.85 | [3.95] | 3.70 | [3.83] |
| Age == 28 | 8.23*** | [2.23] | 3.81** | [1.78] | 3.86** | [1.68] | 3.28* | [1.69] |
| Age == 29 | 13.69** | [6.07] | 8.22* | [4.84] | 7.12* | [3.95] | 6.34 | [3.84] |
| Year of birth == 1974 | -1.58 | [4.06] | -0.79 | [2.56] | -0.67 | [2.06] | -0.83 | [2.08] |
| Year of birth == 1975 | 4.63 | [4.08] | 3.77 | [4.08] | 2.72 | [3.51] | 2.77 | [3.40] |
| Year of birth == 1977 | -4.10 | [3.27] | -1.17 | [2.71] | -1.87 | [2.44] | -1.75 | [2.28] |
| Year of birth == 1978 | 2.18 | [2.05] | 2.09 | [1.55] | 2.36 | [1.55] | 2.01 | [1.35] |
| Year of birth == 1979 | -1.18 | [3.74] | 0.98 | [2.03] | 1.27 | [1.52] | 0.98 | [1.44] |
| Year of birth == 1980 | 2.91 | [3.77] | 3.41 | [3.81] | 2.51 | [3.20] | 2.61 | [3.03] |
| Year of birth == 1981 | 5.41*** | [1.64] | 5.55*** | [1.81] | 6.12*** | [1.68] | 5.26*** | [1.79] |
| Year of birth == 1982 | -1.36 | [3.04] | -1.20 | [2.64] | -1.56 | [2.39] | -2.15 | [2.25] |
| Year of birth == 1983 | 2.02 | [1.94] | 1.52 | [1.54] | 1.29 | [1.53] | 1.21 | [1.34] |
| Year of birth == 1984 | 0.47 | [3.78] | 0.23 | [2.22] | -0.39 | [1.55] | -0.61 | [1.53] |
| Year of birth == 1985 | 4.78 | [3.83] | 4.16 | [3.78] | 3.02 | [3.20] | 3.35 | [3.08] |
| Region of birth == TR2 | -2.63*** | [0.99] | -1.76* | [0.98] | -1.40 | [0.96] | -1.06 | [1.01] |
| Region of birth == TR3 | -2.52*** | [0.78] | -1.46* | [0.76] | -1.17* | [0.69] | -0.72 | [0.70] |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Region of birth == TR4 | -2.07*** | [0.51] | -1.58*** | [0.49] | -1.38*** | [0.47] | -0.87* | [0.48] |
| Region of birth == TR5 | -0.85 | [0.61] | -0.79 | [0.58] | -0.61 | [0.53] | -0.26 | [0.52] |
| Region of birth == TR6 | -3.02*** | [0.78] | -1.83** | [0.77] | -1.23* | [0.68] | -0.70 | [0.67] |
| Region of birth == TR7 | -2.92*** | [0.92] | -1.79** | [0.90] | -1.51* | [0.78] | -0.86 | [0.76] |
| Region of birth == TR8 | -2.82*** | [0.93] | -1.70* | [0.92] | -1.43* | [0.81] | -0.77 | [0.79] |
| Region of birth == TR9 | -3.64*** | [1.31] | -2.09 | [1.30] | -1.71 | [1.14] | -0.94 | [1.11] |
| Region of birth == TRA | -4.85*** | [1.50] | -3.15** | [1.46] | -2.09* | [1.25] | -1.37 | [1.20] |
| Region of birth == TRB | -6.23*** | [1.77] | -3.98** | [1.74] | -2.19 | [1.49] | -1.40 | [1.43] |
| Region of birth == TRC | -5.61*** | [1.62] | -3.32** | [1.57] | -1.57 | [1.35] | -0.85 | [1.30] |
| Mother's education == Primary incomplete | | | 0.60*** | [0.18] | 0.37** | [0.17] | 0.40** | [0.16] |
| Mother's education == Primary complete | | | 1.74*** | [0.15] | 1.47*** | [0.14] | 1.35*** | [0.13] |
| Mother's education == Secondary complete | | | 3.35*** | [0.34] | 3.08*** | [0.33] | 2.68*** | [0.32] |
| Mother's education == High school | | | 4.20*** | [0.39] | 3.92*** | [0.38] | 3.61*** | [0.37] |
| Mother's education == More than high school | | | 5.40*** | [0.44] | 5.05*** | [0.40] | 4.68*** | [0.38] |
| Mother's education == Don't know | | | 0.16 | [0.43] | 0.04 | [0.38] | 0.16 | [0.40] |
| Father's education == Primary incomplete | | | 0.56*** | [0.21] | 0.35* | [0.20] | 0.27 | [0.20] |
| Father's education == Primary complete | | | 1.28*** | [0.15] | 0.96*** | [0.13] | 0.90*** | [0.13] |
| Father's education == Secondary complete | | | 3.10*** | [0.24] | 2.72*** | [0.22] | 2.39*** | [0.22] |
| Father's education == High school | | | 4.04*** | [0.29] | 3.72*** | [0.28] | 3.31*** | [0.28] |
| Father's education == More than high school | | | 5.21*** | [0.28] | 4.92*** | [0.28] | 4.61*** | [0.30] |
| Father's education == Don't know | | | 0.30 | [0.25] | 0.13 | [0.23] | 0.07 | [0.21] |
| Mother's tongue == Kurdish | | | | | -2.50*** | [0.16] | -2.30*** | [0.17] |
| Mother's tongue == Arabic | | | | | -1.74*** | [0.37] | -1.44*** | [0.36] |
| Mother's tongue == Other | | | | | -0.77 | [0.63] | -0.87 | [0.76] |
| Childhood's place == Rural | | | | | | | -1.46*** | [0.11] |
| Observations | 4,707 | | 4,695 | | 4,695 | | 4,688 | |
| Adjusted R-squared | 0.78 | | 0.85 | | 0.85 | | 0.86 | |

Robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

## Table 29: Reduced form estimations

| | Dependent variables | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | First marriage at age 16 or earlier | | First marriage at age 16 or earlier, excluding age 22 | | First birth at age 17 or earlier | | First birth at age 17 or earlier, excluding age 22 | |
| VARIABLES | Coefficient | Standard error | Coefficient | Standard error | Coefficient | Standard error | Coefficient | Standard error |
| Young X TPC X TDHS == 2008 | 0.36 | [1.22] | 0.42 | [1.30] | 0.10 | [1.16] | 0.04 | [1.25] |
| Year of birth == 1974 X GER at 1996 | -0.27 | [0.18] | -0.26 | [0.17] | -0.26* | [0.14] | -0.26* | [0.14] |
| Year of birth == 1975 X GER at 1996 | -0.15 | [0.19] | -0.15 | [0.19] | -0.36** | [0.16] | -0.36** | [0.15] |
| Year of birth == 1976 X GER at 1996 | -0.18 | [0.19] | -0.19 | [0.19] | -0.29** | [0.14] | -0.29** | [0.14] |
| Year of birth == 1977 X GER at 1996 | -0.09 | [0.14] | -0.10 | [0.13] | -0.18 | [0.14] | -0.18 | [0.13] |
| Year of birth == 1978 X GER at 1996 | -0.44*** | [0.16] | -0.43*** | [0.16] | -0.55*** | [0.19] | -0.55*** | [0.18] |
| Year of birth == 1979 X GER at 1996 | -0.08 | [0.14] | -0.07 | [0.14] | -0.17 | [0.15] | -0.16 | [0.15] |
| Year of birth == 1980 X GER at 1996 | -0.05 | [0.14] | -0.05 | [0.13] | -0.20 | [0.14] | -0.20 | [0.13] |
| Year of birth == 1981 X GER at 1996 | -0.03 | [0.14] | -0.12 | [0.19] | -0.13 | [0.16] | -0.22 | [0.20] |
| Year of birth == 1982 X GER at 1996 | 0.06 | [0.13] | 0.06 | [0.13] | -0.00 | [0.14] | 0.00 | [0.13] |
| Year of birth == 1983 X GER at 1996 | -0.01 | [0.14] | -0.02 | [0.14] | -0.03 | [0.14] | -0.03 | [0.13] |
| Year of birth == 1984 X GER at 1996 | -0.02 | [0.13] | -0.03 | [0.13] | -0.10 | [0.16] | -0.11 | [0.15] |
| Year of birth == 1985 X GER at 1996 | 0.01 | [0.14] | 0.01 | [0.13] | -0.13 | [0.13] | -0.13 | [0.13] |
| Year of birth == 1986 X GER at 1996 | -0.27 | [0.19] | | | -0.33** | [0.16] | | |
| Year of birth == 1987 X GER at 1996 | 0.16 | [0.19] | 0.16 | [0.19] | 0.03 | [0.17] | 0.03 | [0.16] |
| Year of birth == 1988 X GER at 1996 | -0.06 | [0.13] | -0.06 | [0.13] | -0.11 | [0.15] | -0.11 | [0.14] |
| Year of birth == 1989 X GER at 1996 | 0.06 | [0.13] | 0.06 | [0.13] | -0.05 | [0.14] | -0.05 | [0.13] |
| TPC | -1.87 | [3.32] | -1.29 | [3.36] | -2.69 | [2.41] | -2.39 | [2.39] |
| Young X TPC | 0.66 | [1.12] | 0.43 | [1.13] | 0.05 | [0.98] | 0.01 | [1.07] |
| Age == 18 | 0.01 | [0.08] | 0.00 | [0.08] | 0.08 | [0.06] | 0.07 | [0.06] |
| Age == 19 | -0.05 | [0.14] | -0.06 | [0.13] | 0.12 | [0.14] | 0.11 | [0.13] |
| Age == 20 | 0.08 | [0.14] | 0.07 | [0.13] | 0.18 | [0.14] | 0.17 | [0.14] |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Age == 21 | -0.11 | [0.18] | -0.11 | [0.18] | 0.06 | [0.16] | 0.06 | [0.15] |
| Age == 22 | 0.27 | [0.18] | | | 0.37** | [0.15] | | |
| Age == 23 | 0.06 | [0.09] | 0.04 | [0.09] | 0.12 | [0.08] | 0.11 | [0.08] |
| Age == 24 | -0.03 | [0.15] | -0.05 | [0.14] | 0.11 | [0.14] | 0.10 | [0.13] |
| Age == 25 | 0.12 | [0.15] | 0.10 | [0.14] | 0.18 | [0.15] | 0.17 | [0.14] |
| Age == 26 | -0.06 | [0.19] | -0.08 | [0.19] | 0.10 | [0.17] | 0.09 | [0.16] |
| Age == 27 | 0.24 | [0.19] | 0.24 | [0.18] | 0.34** | [0.16] | 0.35** | [0.13] |
| Age == 28 | 0.08 | [0.10] | 0.06 | [0.10] | 0.13 | [0.08] | 0.12 | [0.08] |
| Age == 29 | -0.01 | [0.15] | -0.03 | [0.14] | 0.13 | [0.14] | 0.12 | [0.14] |
| Year of birth == 1974 | 0.39*** | [0.11] | 0.40*** | [0.10] | 0.26*** | [0.06] | 0.26*** | [0.06] |
| Year of birth == 1975 | 0.19 | [0.18] | 0.20 | [0.18] | 0.33** | [0.15] | 0.33** | [0.15] |
| Year of birth == 1976 | 0.01 | [0.18] | | | 0.01 | [0.10] | | |
| Year of birth == 1977 | 0.24* | [0.13] | 0.25* | [0.13] | 0.20* | [0.10] | 0.19** | [0.10] |
| Year of birth == 1978 | 0.35*** | [0.10] | 0.35*** | [0.10] | 0.39*** | [0.13] | 0.39*** | [0.13] |
| Year of birth == 1979 | 0.17*** | [0.06] | 0.18*** | [0.06] | 0.12* | [0.07] | 0.12 | [0.08] |
| Year of birth == 1980 | 0.06 | [0.13] | 0.07 | [0.13] | 0.16 | [0.13] | 0.16 | [0.13] |
| Year of birth == 1981 | -0.16 | [0.13] | -0.10 | [0.19] | -0.14 | [0.11] | -0.07 | [0.16] |
| Year of birth == 1982 | 0.09 | [0.12] | 0.09 | [0.12] | 0.01 | [0.10] | 0.00 | [0.10] |
| Year of birth == 1983 | -0.02 | [0.06] | -0.02 | [0.06] | -0.05 | [0.07] | -0.05 | [0.07] |
| Year of birth == 1984 | 0.12** | [0.06] | 0.13** | [0.05] | 0.07 | [0.10] | 0.08 | [0.09] |
| Year of birth == 1985 | 0.01 | [0.12] | 0.01 | [0.12] | 0.10 | [0.13] | 0.10 | [0.12] |
| Region of birth == TR2 | 0.11* | [0.06] | 0.10 | [0.06] | 0.10** | [0.05] | 0.09* | [0.05] |
| Region of birth == TR3 | 0.08** | [0.04] | 0.08** | [0.04] | 0.06** | [0.03] | 0.06** | [0.03] |
| Region of birth == TR4 | 0.05* | [0.03] | 0.06** | [0.03] | 0.04* | [0.02] | 0.04** | [0.02] |
| Region of birth == TR5 | 0.07*** | [0.02] | 0.07*** | [0.02] | 0.06*** | [0.02] | 0.06*** | [0.02] |
| Region of birth == TR6 | 0.07** | [0.03] | 0.07** | [0.03] | 0.04 | [0.03] | 0.04 | [0.02] |
| Region of birth == TR7 | 0.08*** | [0.03] | 0.08** | [0.03] | 0.05* | [0.03] | 0.05* | [0.03] |
| Region of birth == TR8 | 0.06 | [0.03] | 0.05 | [0.04] | 0.04 | [0.03] | 0.03 | [0.03] |
| Region of birth == TR9 | 0.04 | [0.04] | 0.05 | [0.04] | 0.01 | [0.04] | 0.02 | [0.04] |
| Region of birth == TRA | 0.07 | [0.04] | 0.06 | [0.04] | 0.01 | [0.04] | 0.01 | [0.04] |
| Region of birth == TRB | 0.09* | [0.05] | 0.09** | [0.05] | 0.03 | [0.05] | 0.03 | [0.05] |
| Region of birth == TRC | 0.12*** | [0.05] | 0.13*** | [0.04] | 0.06 | [0.05] | 0.06 | [0.04] |
| Observations | 9,791 | | 8,875 | | 9,791 | | 8,875 | 8,875 |
| Adjusted R-squared | 0.13 | | 0.13 | | 0.10 | | 0.10 | |

Robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

## Table 30: OLS estimations, completing eight years of schooling

| | Dependent variables | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | First marriage at age 16 or earlier | | First marriage at age 16 or earlier, excluding age 22 | | First birth at age 17 or earlier | | First birth at age 17 or earlier, excluding age 22 | |
| VARIABLES | Coefficient | Standard error | Coefficient | Standard error | Coefficient | Standard error | Coefficient | Standard error |
| Completing eight years of schooling | -0.13*** | [0.01] | -0.13*** | [0.01] | -0.10*** | [0.01] | -0.10*** | [0.01] |
| Year of birth == 1974 X GER at 1996 | -0.33* | [0.18] | -0.32* | [0.17] | -0.30** | [0.15] | -0.29** | [0.14] |
| Year of birth == 1975 X GER at 1996 | -0.20 | [0.18] | -0.20 | [0.18] | -0.40** | [0.17] | -0.39** | [0.16] |
| Year of birth == 1976 X GER at 1996 | -0.22 | [0.18] | -0.22 | [0.18] | -0.31** | [0.15] | -0.31** | [0.14] |
| Year of birth == 1977 X GER at 1996 | -0.07 | [0.14] | -0.06 | [0.14] | -0.16 | [0.15] | -0.15 | [0.14] |
| Year of birth == 1978 X GER at 1996 | -0.42** | [0.17] | -0.42** | [0.16] | -0.54*** | [0.20] | -0.53*** | [0.19] |
| Year of birth == 1979 X GER at 1996 | -0.10 | [0.14] | -0.09 | [0.14] | -0.18 | [0.15] | -0.17 | [0.15] |
| Year of birth == 1980 X GER at 1996 | -0.02 | [0.14] | -0.02 | [0.14] | -0.18 | [0.14] | -0.18 | [0.13] |
| Year of birth == 1981 X GER at 1996 | -0.05 | [0.16] | -0.13 | [0.20] | -0.14 | [0.18] | -0.23 | [0.21] |
| Year of birth == 1982 X GER at 1996 | 0.05 | [0.14] | 0.06 | [0.13] | -0.00 | [0.14] | 0.01 | [0.14] |
| Year of birth == 1983 X GER at 1996 | -0.03 | [0.14] | -0.03 | [0.14] | -0.04 | [0.15] | -0.04 | [0.14] |
| Year of birth == 1984 X GER at 1996 | -0.04 | [0.14] | -0.04 | [0.13] | -0.11 | [0.17] | -0.11 | [0.16] |
| Year of birth == 1985 X GER at 1996 | -0.03 | [0.14] | -0.03 | [0.13] | -0.16 | [0.14] | -0.15 | [0.13] |
| Year of birth == 1986 X GER at 1996 | -0.28 | [0.18] | | | -0.33** | [0.16] | | |
| Year of birth == 1987 X GER at 1996 | 0.16 | [0.20] | 0.16 | [0.20] | 0.03 | [0.18] | 0.03 | [0.17] |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Year of birth == 1988 X GER at 1996 | -0.03 | [0.14] | -0.03 | [0.13] | -0.09 | [0.15] | -0.09 | [0.14] |
| Year of birth == 1989 X GER at 1996 | 0.03 | [0.13] | 0.03 | [0.13] | -0.07 | [0.14] | -0.07 | [0.13] |
| TPC | -0.66 | [3.33] | 0.02 | [3.39] | -1.80 | [2.44] | -1.43 | [2.41] |
| Young X TPC | 1.48 | [1.06] | 1.48 | [1.10] | 0.60 | [0.84] | 0.70 | [0.90] |
| Age == 18 | 0.11 | [0.09] | 0.09 | [0.09] | 0.15** | [0.07] | 0.13** | [0.07] |
| Age == 19 | 0.08 | [0.14] | 0.05 | [0.14] | 0.21 | [0.15] | 0.19 | [0.14] |
| Age == 20 | 0.15 | [0.15] | 0.13 | [0.15] | 0.22 | [0.15] | 0.21 | [0.15] |
| Age == 21 | -0.02 | [0.19] | -0.04 | [0.19] | 0.12 | [0.18] | 0.11 | [0.17] |
| Age == 22 | 0.35* | [0.18] | | | 0.43*** | [0.16] | | |
| Age == 23 | 0.17* | [0.10] | 0.15 | [0.10] | 0.20*** | [0.08] | 0.18** | [0.07] |
| Age == 24 | 0.11 | [0.15] | 0.09 | [0.15] | 0.21 | [0.15] | 0.20 | [0.14] |
| Age == 25 | 0.20 | [0.16] | 0.18 | [0.15] | 0.24 | [0.16] | 0.23 | [0.15] |
| Age == 26 | 0.04 | [0.20] | 0.02 | [0.20] | 0.17 | [0.18] | 0.16 | [0.17] |
| Age == 27 | 0.35* | [0.18] | 0.33* | [0.17] | 0.42*** | [0.16] | 0.40*** | [0.14] |
| Age == 28 | 0.18* | [0.10] | 0.16 | [0.10] | 0.20** | [0.08] | 0.19** | [0.08] |
| Age == 29 | 0.13 | [0.16] | 0.11 | [0.15] | 0.23 | [0.15] | 0.22 | [0.14] |
| Year of birth == 1974 | 0.35*** | [0.11] | 0.36*** | [0.10] | 0.23*** | [0.07] | 0.23*** | [0.07] |
| Year of birth == 1975 | 0.18 | [0.16] | 0.19 | [0.17] | 0.33** | [0.15] | 0.32** | [0.15] |
| Year of birth == 1976 | -0.01 | [0.16] | | | -0.00 | [0.08] | | |
| Year of birth == 1977 | 0.18 | [0.14] | 0.18 | [0.14] | 0.16 | [0.11] | 0.15 | [0.11] |
| Year of birth == 1978 | 0.33*** | [0.11] | 0.33*** | [0.11] | 0.38*** | [0.13] | 0.38*** | [0.13] |
| Year of birth == 1979 | 0.12** | [0.06] | 0.11* | [0.06] | 0.08 | [0.07] | 0.08 | [0.07] |
| Year of birth == 1980 | 0.01 | [0.12] | 0.01 | [0.12] | 0.12 | [0.13] | 0.12 | [0.12] |
| Year of birth == 1981 | -0.18 | [0.13] | -0.11 | [0.19] | -0.16 | [0.11] | -0.08 | [0.16] |
| Year of birth == 1982 | 0.06 | [0.13] | 0.05 | [0.13] | -0.01 | [0.11] | -0.02 | [0.10] |
| Year of birth == 1983 | -0.02 | [0.07] | -0.02 | [0.07] | -0.05 | [0.07] | -0.05 | [0.07] |
| Year of birth == 1984 | 0.07 | [0.06] | 0.08 | [0.05] | 0.03 | [0.10] | 0.04 | [0.09] |
| Year of birth == 1985 | -0.01 | [0.12] | 0.00 | [0.12] | 0.09 | [0.12] | 0.09 | [0.12] |
| Region of birth == TR2 | 0.05 | [0.06] | 0.04 | [0.06] | 0.06 | [0.05] | 0.05 | [0.05] |
| Region of birth == TR3 | 0.04 | [0.04] | 0.04 | [0.04] | 0.03 | [0.03] | 0.03 | [0.03] |
| Region of birth == TR4 | 0.01 | [0.03] | 0.02 | [0.03] | 0.01 | [0.02] | 0.01 | [0.02] |
| Region of birth == TR5 | 0.06** | [0.02] | 0.06*** | [0.02] | 0.05** | [0.02] | 0.06*** | [0.02] |
| Region of birth == TR6 | 0.03 | [0.03] | 0.03 | [0.03] | 0.01 | [0.03] | 0.01 | [0.02] |
| Region of birth == TR7 | 0.05 | [0.03] | 0.04 | [0.03] | 0.02 | [0.03] | 0.02 | [0.03] |
| Region of birth == TR8 | 0.02 | [0.03] | 0.01 | [0.03] | 0.01 | [0.03] | 0.00 | [0.03] |
| Region of birth == TR9 | -0.00 | [0.04] | 0.00 | [0.04] | -0.02 | [0.04] | -0.02 | [0.04] |
| Region of birth == TRA | 0.01 | [0.04] | 0.01 | [0.04] | -0.03 | [0.04] | -0.03 | [0.04] |
| Region of birth == TRB | 0.02 | [0.05] | 0.03 | [0.05] | -0.02 | [0.05] | -0.02 | [0.05] |
| Region of birth == TRC | 0.06 | [0.05] | 0.07 | [0.05] | 0.01 | [0.05] | 0.02 | [0.05] |
| Observations | 9,791 | | 8,875 | | 9,791 | | 8,875 | |
| Adjusted R-squared | 0.16 | | 0.16 | | 0.13 | | 0.13 | |

Robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

## Table 31: OLS estimations, years of schooling

| | Dependent variables | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | First marriage at age 16 or earlier | | First marriage at age 16 or earlier, excluding age 22 | | First birth at age 17 or earlier | | First birth at age 17 or earlier, excluding age 22 | |
| VARIABLES | Coefficient | Standard error | Coefficient | Standard error | Coefficient | Standard error | Coefficient | Standard error |
| Years of schooling | -0.02*** | [0.00] | -0.02*** | [0.00] | -0.01*** | [0.00] | -0.01*** | [0.00] |
| Year of birth == 1974 X GER at 1996 | -0.29* | [0.16] | -0.28* | [0.16] | -0.27* | [0.14] | -0.26** | [0.13] |
| Year of birth == 1975 X GER at 1996 | -0.16 | [0.16] | -0.17 | [0.17] | -0.37** | [0.15] | -0.37** | [0.15] |
| Year of birth == 1976 X GER at 1996 | -0.12 | [0.16] | -0.13 | [0.16] | -0.24* | [0.13] | -0.24* | [0.13] |
| Year of birth == 1977 X GER at 1996 | -0.03 | [0.13] | -0.03 | [0.12] | -0.14 | [0.13] | -0.13 | [0.12] |
| Year of birth == 1978 X GER at 1996 | -0.39** | [0.16] | -0.39** | [0.16] | -0.52*** | [0.19] | -0.51*** | [0.18] |
| Year of birth == 1979 X GER at 1996 | -0.07 | [0.13] | -0.06 | [0.13] | -0.16 | [0.14] | -0.15 | [0.14] |
| Year of birth == 1980 X GER at 1996 | 0.01 | [0.13] | 0.01 | [0.12] | -0.16 | [0.13] | -0.15 | [0.12] |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Year of birth == 1981 X GER at 1996 | -0.04 | [0.14] | -0.12 | [0.19] | -0.13 | [0.17] | -0.22 | [0.21] |
| Year of birth == 1982 X GER at 1996 | 0.09 | [0.12] | 0.09 | [0.12] | 0.02 | [0.13] | 0.03 | [0.12] |
| Year of birth == 1983 X GER at 1996 | 0.02 | [0.12] | 0.02 | [0.12] | -0.00 | [0.14] | -0.00 | [0.13] |
| Year of birth == 1984 X GER at 1996 | -0.02 | [0.12] | -0.02 | [0.12] | -0.10 | [0.16] | -0.10 | [0.15] |
| Year of birth == 1985 X GER at 1996 | 0.00 | [0.12] | -0.00 | [0.11] | -0.13 | [0.13] | -0.13 | [0.12] |
| Year of birth == 1986 X GER at 1996 | -0.25 | [0.16] | | | -0.31** | [0.14] | | |
| Year of birth == 1987 X GER at 1996 | 0.18 | [0.19] | 0.18 | [0.19] | 0.04 | [0.17] | 0.04 | [0.16] |
| Year of birth == 1988 X GER at 1996 | -0.03 | [0.12] | -0.03 | [0.11] | -0.09 | [0.14] | -0.09 | [0.13] |
| Year of birth == 1989 X GER at 1996 | 0.02 | [0.11] | 0.02 | [0.11] | -0.08 | [0.13] | -0.08 | [0.12] |
| TPC | -1.46 | [3.30] | -0.93 | [3.37] | -2.41 | [2.41] | -2.14 | [2.39] |
| Young X TPC | 1.28 | [1.05] | 1.22 | [1.07] | 0.45 | [0.82] | 0.50 | [0.88] |
| Age == 18 | 0.20** | [0.09] | 0.18** | [0.09] | 0.21*** | [0.07] | 0.20*** | [0.07] |
| Age == 19 | 0.17 | [0.13] | 0.15 | [0.13] | 0.28** | [0.13] | 0.26** | [0.13] |
| Age == 20 | 0.24* | [0.13] | 0.22* | [0.13] | 0.29** | [0.14] | 0.28** | [0.14] |
| Age == 21 | 0.06 | [0.18] | 0.05 | [0.18] | 0.18 | [0.17] | 0.17 | [0.16] |
| Age == 22 | 0.43*** | [0.17] | | | 0.49*** | [0.14] | | |
| Age == 23 | 0.27*** | [0.10] | 0.25** | [0.10] | 0.27*** | [0.07] | 0.26*** | [0.07] |
| Age == 24 | 0.21 | [0.14] | 0.19 | [0.14] | 0.28** | [0.14] | 0.27** | [0.13] |
| Age == 25 | 0.29** | [0.14] | 0.27* | [0.14] | 0.31** | [0.15] | 0.29** | [0.14] |
| Age == 26 | 0.11 | [0.19] | 0.09 | [0.18] | 0.22 | [0.17] | 0.21 | [0.16] |
| Age == 27 | 0.43** | [0.17] | 0.36** | [0.16] | 0.48*** | [0.15] | 0.43*** | [0.13] |
| Age == 28 | 0.28*** | [0.10] | 0.26** | [0.10] | 0.27*** | [0.08] | 0.26*** | [0.08] |
| Age == 29 | 0.22 | [0.14] | 0.20 | [0.14] | 0.30** | [0.14] | 0.29** | [0.13] |
| Year of birth == 1974 | 0.33*** | [0.10] | 0.33*** | [0.10] | 0.21*** | [0.07] | 0.21*** | [0.07] |
| Year of birth == 1975 | 0.15 | [0.15] | 0.15 | [0.15] | 0.30** | [0.14] | 0.30** | [0.13] |
| Year of birth == 1976 | -0.06 | [0.16] | | | -0.04 | [0.08] | | |
| Year of birth == 1977 | 0.18 | [0.14] | 0.19 | [0.14] | 0.16 | [0.11] | 0.15 | [0.11] |
| Year of birth == 1978 | 0.31*** | [0.11] | 0.31*** | [0.11] | 0.37*** | [0.14] | 0.37*** | [0.14] |
| Year of birth == 1979 | 0.10* | [0.06] | 0.10* | [0.06] | 0.07 | [0.07] | 0.07 | [0.07] |
| Year of birth == 1980 | -0.02 | [0.11] | -0.01 | [0.11] | 0.10 | [0.12] | 0.10 | [0.11] |
| Year of birth == 1981 | -0.17 | [0.13] | -0.05 | [0.18] | -0.15 | [0.11] | -0.04 | [0.16] |
| Year of birth == 1982 | 0.06 | [0.13] | 0.06 | [0.13] | -0.01 | [0.11] | -0.02 | [0.11] |
| Year of birth == 1983 | -0.05 | [0.07] | -0.04 | [0.06] | -0.07 | [0.07] | -0.07 | [0.08] |
| Year of birth == 1984 | 0.06 | [0.06] | 0.07 | [0.05] | 0.02 | [0.10] | 0.03 | [0.09] |
| Year of birth == 1985 | -0.03 | [0.10] | -0.02 | [0.10] | 0.07 | [0.11] | 0.07 | [0.10] |
| Region of birth == TR2 | 0.07 | [0.06] | 0.06 | [0.06] | 0.07 | [0.05] | 0.07 | [0.05] |
| Region of birth == TR3 | 0.06 | [0.03] | 0.05 | [0.04] | 0.04 | [0.03] | 0.04 | [0.03] |
| Region of birth == TR4 | 0.02 | [0.03] | 0.02 | [0.03] | 0.01 | [0.02] | 0.02 | [0.02] |
| Region of birth == TR5 | 0.07*** | [0.02] | 0.07*** | [0.02] | 0.06*** | [0.02] | 0.06*** | [0.02] |
| Region of birth == TR6 | 0.04 | [0.03] | 0.04 | [0.03] | 0.02 | [0.02] | 0.01 | [0.02] |
| Region of birth == TR7 | 0.05* | [0.03] | 0.05* | [0.03] | 0.02 | [0.03] | 0.03 | [0.03] |
| Region of birth == TR8 | 0.02 | [0.03] | 0.02 | [0.03] | 0.01 | [0.03] | 0.01 | [0.03] |
| Region of birth == TR9 | 0.00 | [0.04] | 0.01 | [0.04] | -0.02 | [0.04] | -0.01 | [0.04] |
| Region of birth == TRA | 0.00 | [0.04] | -0.00 | [0.03] | -0.03 | [0.04] | -0.03 | [0.04] |
| Region of birth == TRB | -0.00 | [0.04] | 0.01 | [0.04] | -0.04 | [0.05] | -0.03 | [0.04] |
| Region of birth == TRC | 0.04 | [0.04] | 0.05 | [0.04] | -0.00 | [0.05] | 0.00 | [0.04] |
| Observations | 9,790 | | 8,874 | | 9,790 | | 8,874 | |
| Adjusted R-squared | 0.18 | | 0.17 | | 0.14 | | 0.14 | |

Robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

## Table 32: TSLS estimations, completing eight years of schooling

| | Dependent variables | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | First marriage at age 16 or earlier | | First marriage at age 16 or earlier, excluding 1986 cohort | | First birth at age 17 or earlier | | First birth at age 17 or earlier, excluding 1986 cohort | |
| VARIABLES | Coefficient | Standard error | Coefficient | Standard error | Coefficient | Standard error | Coefficient | Standard error |
| Completing eight years of schooling | 0.03 | [0.10] | 0.03 | [0.11] | 0.01 | [0.10] | 0.00 | [0.10] |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Year of birth == 1974 X GER at 1996 | -0.26 | [0.18] | -0.26 | [0.17] | -0.26* | [0.14] | -0.26* | [0.13] |
| Year of birth == 1975 X GER at 1996 | -0.14 | [0.19] | -0.15 | [0.19] | -0.36** | [0.16] | -0.36** | [0.15] |
| Year of birth == 1976 X GER at 1996 | -0.19 | [0.20] | -0.19 | [0.19] | -0.29** | [0.14] | -0.29** | [0.14] |
| Year of birth == 1977 X GER at 1996 | -0.11 | [0.15] | -0.12 | [0.15] | -0.19 | [0.15] | -0.18 | [0.15] |
| Year of birth == 1978 X GER at 1996 | -0.45*** | [0.17] | -0.45*** | [0.17] | -0.56*** | [0.19] | -0.55*** | [0.19] |
| Year of birth == 1979 X GER at 1996 | -0.08 | [0.15] | -0.08 | [0.15] | -0.17 | [0.15] | -0.16 | [0.15] |
| Year of birth == 1980 X GER at 1996 | -0.06 | [0.15] | -0.07 | [0.15] | -0.21 | [0.15] | -0.21 | [0.14] |
| Year of birth == 1981 X GER at 1996 | -0.04 | [0.14] | -0.13 | [0.20] | -0.13 | [0.16] | -0.22 | [0.21] |
| Year of birth == 1982 X GER at 1996 | 0.05 | [0.14] | 0.05 | [0.14] | -0.01 | [0.14] | -0.00 | [0.14] |
| Year of birth == 1983 X GER at 1996 | -0.02 | [0.14] | -0.03 | [0.14] | -0.03 | [0.15] | -0.04 | [0.14] |
| Year of birth == 1984 X GER at 1996 | -0.03 | [0.14] | -0.03 | [0.13] | -0.11 | [0.17] | -0.11 | [0.16] |
| Year of birth == 1985 X GER at 1996 | 0.01 | [0.14] | 0.00 | [0.13] | -0.13 | [0.14] | -0.13 | [0.13] |
| Year of birth == 1986 X GER at 1996 | -0.27 | [0.19] | | | -0.33** | [0.16] | | |
| Year of birth == 1987 X GER at 1996 | 0.16 | [0.19] | 0.16 | [0.19] | 0.03 | [0.17] | 0.03 | [0.16] |
| Year of birth == 1988 X GER at 1996 | -0.07 | [0.14] | -0.07 | [0.14] | -0.12 | [0.15] | -0.12 | [0.15] |
| Year of birth == 1989 X GER at 1996 | 0.06 | [0.13] | 0.07 | [0.13] | -0.05 | [0.14] | -0.05 | [0.13] |
| TPC | -2.10 | [3.54] | -1.60 | [3.66] | -2.75 | [2.60] | -2.43 | [2.65] |
| Young X TPC | 0.64 | [1.15] | 0.35 | [1.23] | 0.05 | [1.01] | 0.01 | [1.22] |
| Age == 18 | 0.00 | [0.10] | -0.01 | [0.09] | 0.08 | [0.08] | 0.07 | [0.07] |
| Age == 19 | -0.06 | [0.15] | -0.08 | [0.14] | 0.11 | [0.14] | 0.11 | [0.13] |
| Age == 20 | 0.08 | [0.14] | 0.07 | [0.13] | 0.18 | [0.14] | 0.17 | [0.14] |
| Age == 21 | -0.12 | [0.19] | -0.13 | [0.18] | 0.06 | [0.17] | 0.06 | [0.16] |
| Age == 22 | 0.25 | [0.19] | | | 0.36** | [0.16] | | |
| Age == 23 | 0.04 | [0.11] | 0.02 | [0.11] | 0.11 | [0.10] | 0.11 | [0.10] |
| Age == 24 | -0.05 | [0.16] | -0.07 | [0.15] | 0.10 | [0.15] | 0.10 | [0.15] |
| Age == 25 | 0.11 | [0.15] | 0.09 | [0.14] | 0.18 | [0.15] | 0.17 | [0.14] |
| Age == 26 | -0.07 | [0.19] | -0.09 | [0.19] | 0.09 | [0.17] | 0.09 | [0.16] |
| Age == 27 | 0.23 | [0.20] | 0.23 | [0.18] | 0.34** | [0.16] | 0.35*** | [0.13] |
| Age == 28 | 0.07 | [0.11] | 0.05 | [0.11] | 0.12 | [0.10] | 0.12 | [0.10] |
| Age == 29 | -0.03 | [0.16] | -0.05 | [0.15] | 0.13 | [0.15] | 0.12 | [0.15] |
| Year of birth == 1974 | 0.39*** | [0.11] | 0.40*** | [0.11] | 0.26*** | [0.07] | 0.26*** | [0.07] |
| Year of birth == 1975 | 0.19 | [0.18] | 0.19 | [0.18] | 0.33** | [0.15] | 0.33** | [0.15] |
| Year of birth == 1976 | 0.01 | [0.18] | | | 0.01 | [0.10] | | |
| Year of birth == 1977 | 0.25* | [0.14] | 0.26* | [0.14] | 0.20* | [0.11] | 0.20* | [0.11] |
| Year of birth == 1978 | 0.35*** | [0.10] | 0.35*** | [0.09] | 0.39*** | [0.13] | 0.39*** | [0.13] |
| Year of birth == 1979 | 0.18** | [0.07] | 0.18** | [0.08] | 0.12 | [0.08] | 0.12 | [0.09] |
| Year of birth == 1980 | 0.07 | [0.14] | 0.08 | [0.14] | 0.16 | [0.14] | 0.16 | [0.14] |
| Year of birth == 1981 | -0.16 | [0.14] | -0.10 | [0.19] | -0.14 | [0.11] | -0.07 | [0.16] |
| Year of birth == 1982 | 0.09 | [0.12] | 0.09 | [0.13] | 0.01 | [0.10] | 0.00 | [0.10] |
| Year of birth == 1983 | -0.03 | [0.06] | -0.02 | [0.06] | -0.05 | [0.07] | -0.05 | [0.07] |
| Year of birth == 1984 | 0.13* | [0.07] | 0.14** | [0.07] | 0.07 | [0.11] | 0.08 | [0.11] |
| Year of birth == 1985 | 0.00 | [0.13] | 0.01 | [0.13] | 0.09 | [0.13] | 0.10 | [0.12] |
| Region of birth == TR2 | 0.12 | [0.08] | 0.11 | [0.08] | 0.10* | [0.06] | 0.09 | [0.06] |
| Region of birth == TR3 | 0.09** | [0.05] | 0.09* | [0.05] | 0.06 | [0.04] | 0.06 | [0.04] |
| Region of birth == TR4 | 0.06 | [0.04] | 0.07 | [0.04] | 0.04 | [0.04] | 0.04 | [0.04] |
| Region of birth == TR5 | 0.07*** | [0.03] | 0.08*** | [0.02] | 0.06*** | [0.02] | 0.06*** | [0.02] |
| Region of birth == TR6 | 0.08* | [0.04] | 0.08* | [0.04] | 0.04 | [0.04] | 0.04 | [0.03] |
| Region of birth == TR7 | 0.09** | [0.04] | 0.09** | [0.04] | 0.05 | [0.04] | 0.05 | [0.04] |
| Region of birth == TR8 | 0.06 | [0.05] | 0.06 | [0.04] | 0.04 | [0.04] | 0.03 | [0.04] |
| Region of birth == TR9 | 0.05 | [0.05] | 0.06 | [0.05] | 0.01 | [0.05] | 0.02 | [0.05] |
| Region of birth == TRA | 0.08 | [0.05] | 0.07 | [0.05] | 0.01 | [0.05] | 0.01 | [0.05] |
| Region of birth == TRB | 0.10 | [0.06] | 0.11* | [0.06] | 0.03 | [0.06] | 0.03 | [0.06] |
| Region of birth == TRC | 0.14** | [0.06] | 0.14*** | [0.05] | 0.06 | [0.05] | 0.06 | [0.05] |
| Observations | 9,791 | | 8,875 | | 9,791 | | 8,875 | |

Robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

**Table 33: TSLS estimations, years of schooling**

| | Dependent variables | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | First marriage at age 16 or earlier | | First marriage at age 16 or earlier, excluding 1986 cohort | | First birth at age 17 or earlier | | First birth at age 17 or earlier, excluding 1986 cohort | |
| VARIABLES | Coefficient | Standard error | Coefficient | Standard error | Coefficient | Standard error | Coefficient | Standard error |
| Years of schooling | 0.01 | [0.02] | 0.01 | [0.03] | 0.00 | [0.02] | 0.00 | [0.02] |
| Year of birth == 1974 X GER at 1996 | -0.27 | [0.18] | -0.27 | [0.18] | -0.26* | [0.14] | -0.26* | [0.14] |
| Year of birth == 1975 X GER at 1996 | -0.15 | [0.20] | -0.16 | [0.20] | -0.36** | [0.16] | -0.36** | [0.16] |
| Year of birth == 1976 X GER at 1996 | -0.22 | [0.24] | -0.24 | [0.25] | -0.31 | [0.19] | -0.30 | [0.20] |
| Year of birth == 1977 X GER at 1996 | -0.12 | [0.19] | -0.14 | [0.20] | -0.19 | [0.18] | -0.19 | [0.19] |
| Year of birth == 1978 X GER at 1996 | -0.46** | [0.19] | -0.47** | [0.20] | -0.56*** | [0.21] | -0.56*** | [0.21] |
| Year of birth == 1979 X GER at 1996 | -0.09 | [0.16] | -0.09 | [0.17] | -0.17 | [0.16] | -0.17 | [0.16] |
| Year of birth == 1980 X GER at 1996 | -0.08 | [0.18] | -0.09 | [0.19] | -0.21 | [0.18] | -0.21 | [0.18] |
| Year of birth == 1981 X GER at 1996 | -0.04 | [0.15] | -0.13 | [0.21] | -0.13 | [0.17] | -0.22 | [0.21] |
| Year of birth == 1982 X GER at 1996 | 0.03 | [0.17] | 0.03 | [0.17] | -0.01 | [0.16] | -0.00 | [0.16] |
| Year of birth == 1983 X GER at 1996 | -0.04 | [0.17] | -0.05 | [0.17] | -0.04 | [0.17] | -0.04 | [0.17] |
| Year of birth == 1984 X GER at 1996 | -0.03 | [0.15] | -0.04 | [0.15] | -0.11 | [0.18] | -0.11 | [0.17] |
| Year of birth == 1985 X GER at 1996 | -0.00 | [0.15] | -0.01 | [0.15] | -0.13 | [0.14] | -0.13 | [0.14] |
| Year of birth == 1986 X GER at 1996 | -0.28 | [0.20] | | | -0.33** | [0.17] | | |
| Year of birth == 1987 X GER at 1996 | 0.16 | [0.20] | 0.15 | [0.20] | 0.03 | [0.17] | 0.03 | [0.17] |
| Year of birth == 1988 X GER at 1996 | -0.07 | [0.15] | -0.07 | [0.16] | -0.12 | [0.16] | -0.12 | [0.16] |
| Year of birth == 1989 X GER at 1996 | 0.07 | [0.14] | 0.07 | [0.14] | -0.05 | [0.14] | -0.05 | [0.13] |
| TPC | -1.97 | [3.41] | -1.42 | [3.48] | -2.72 | [2.46] | -2.41 | [2.45] |
| Young X TPC | 0.62 | [1.19] | 0.30 | [1.35] | 0.04 | [1.05] | -0.00 | [1.35] |
| Age == 18 | -0.04 | [0.22] | -0.07 | [0.23] | 0.07 | [0.20] | 0.07 | [0.22] |
| Age == 19 | -0.11 | [0.26] | -0.14 | [0.27] | 0.10 | [0.25] | 0.10 | [0.26] |
| Age == 20 | 0.04 | [0.20] | 0.02 | [0.20] | 0.17 | [0.20] | 0.17 | [0.20] |
| Age == 21 | -0.16 | [0.26] | -0.18 | [0.26] | 0.05 | [0.23] | 0.05 | [0.23] |
| Age == 22 | 0.21 | [0.26] | | | 0.35 | [0.22] | | |
| Age == 23 | -0.01 | [0.25] | -0.04 | [0.28] | 0.10 | [0.24] | 0.10 | [0.27] |
| Age == 24 | -0.10 | [0.28] | -0.14 | [0.30] | 0.09 | [0.27] | 0.09 | [0.30] |
| Age == 25 | 0.07 | [0.22] | 0.04 | [0.23] | 0.17 | [0.21] | 0.17 | [0.23] |
| Age == 26 | -0.11 | [0.26] | -0.14 | [0.27] | 0.08 | [0.23] | 0.08 | [0.25] |
| Age == 27 | 0.19 | [0.27] | 0.21 | [0.21] | 0.33 | [0.24] | 0.35** | [0.16] |
| Age == 28 | 0.02 | [0.24] | -0.01 | [0.26] | 0.11 | [0.23] | 0.11 | [0.26] |
| Age == 29 | -0.08 | [0.28] | -0.12 | [0.29] | 0.11 | [0.26] | 0.11 | [0.29] |
| Year of birth == 1974 | 0.41*** | [0.13] | 0.42*** | [0.13] | 0.26*** | [0.09] | 0.26** | [0.11] |
| Year of birth == 1975 | 0.20 | [0.19] | 0.21 | [0.20] | 0.33** | [0.16] | 0.33** | [0.17] |
| Year of birth == 1976 | 0.04 | [0.21] | | | 0.02 | [0.13] | | |
| Year of birth == 1977 | 0.26* | [0.15] | 0.27* | [0.16] | 0.20 | [0.12] | 0.20 | [0.13] |
| Year of birth == 1978 | 0.36*** | [0.10] | 0.36*** | [0.10] | 0.40*** | [0.13] | 0.39*** | [0.13] |
| Year of birth == 1979 | 0.19* | [0.11] | 0.20* | [0.12] | 0.13 | [0.11] | 0.12 | [0.13] |
| Year of birth == 1980 | 0.09 | [0.18] | 0.10 | [0.19] | 0.16 | [0.18] | 0.16 | [0.19] |
| Year of birth == 1981 | -0.15 | [0.14] | -0.13 | [0.21] | -0.14 | [0.12] | -0.08 | [0.18] |
| Year of birth == 1982 | 0.09 | [0.13] | 0.09 | [0.13] | 0.01 | [0.10] | 0.00 | [0.11] |
| Year of birth == 1983 | -0.02 | [0.06] | -0.01 | [0.06] | -0.05 | [0.08] | -0.05 | [0.08] |
| Year of birth == 1984 | 0.14 | [0.10] | 0.16 | [0.10] | 0.08 | [0.13] | 0.08 | [0.14] |
| Year of birth == 1985 | 0.01 | [0.14] | 0.02 | [0.15] | 0.10 | [0.14] | 0.10 | [0.14] |
| Region of birth == TR2 | 0.12 | [0.08] | 0.11 | [0.08] | 0.10 | [0.06] | 0.09 | [0.07] |
| Region of birth == TR3 | 0.09* | [0.05] | 0.09* | [0.05] | 0.06 | [0.04] | 0.06 | [0.04] |
| Region of birth == TR4 | 0.06 | [0.05] | 0.07 | [0.05] | 0.04 | [0.04] | 0.04 | [0.05] |
| Region of birth == TR5 | 0.07*** | [0.02] | 0.07*** | [0.02] | 0.06*** | [0.02] | 0.06*** | [0.02] |
| Region of birth == TR6 | 0.08 | [0.05] | 0.08 | [0.05] | 0.04 | [0.04] | 0.04 | [0.05] |
| Region of birth == TR7 | 0.09** | [0.05] | 0.09* | [0.05] | 0.05 | [0.04] | 0.05 | [0.04] |
| Region of birth == TR8 | 0.07 | [0.05] | 0.06 | [0.05] | 0.04 | [0.04] | 0.03 | [0.04] |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Region of birth == TR9 | 0.05 | [0.06] | 0.06 | [0.06] | 0.01 | [0.05] | 0.02 | [0.05] |
| Region of birth == TRA | 0.09 | [0.08] | 0.08 | [0.08] | 0.02 | [0.07] | 0.01 | [0.08] |
| Region of birth == TRB | 0.12 | [0.11] | 0.13 | [0.12] | 0.04 | [0.10] | 0.04 | [0.11] |
| Region of birth == TRC | 0.15 | [0.10] | 0.16 | [0.11] | 0.07 | [0.10] | 0.06 | [0.10] |
| Observations | 9,790 | | 8,874 | | 9,790 | | 8,874 | |

Robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

# CHAPTER 5. CONCLUSIONS AND IMPLICATIONS

## I. Concluding remarks and policy implications

Since the mid-1990s, public education provision in Turkey has been in constant transformation, parallel to modernization efforts that have been closely linked to the political determination of governments to complete Turkey's accession to the European Union. During this period two nation-wide interventions stand out due to their dramatic impact on children, students, teachers and the education system as a whole. First, the Compulsory Education Law enacted in 1997 required that all the children enrolled in grade 4 or lower must stay in school until the completion of the eighth grade. Second, the introduction of tests to be taken by teachers in order to be evaluated for employment (the KPSS) in 2002 changed the teacher selection regime fundamentally. With this new regulation, the MONE abandoned recruiting teachers based on lottery and started to use an objective measure, i.e. test scores of teachers. This dissertation provides an econometric evaluation of the impacts of these interventions on different aspects of human development.

In Chapter 3, the dissertation establishes a causal link between the enactment of KPSS and student achievement and presents evidence indicating that teacher recruitment via the more meritocratic and objective assessment instead of the lottery may have had a positive impact on student achievement. It is also shown that the increase in the average student achievement in Turkey as measured in international assessments such as PISA and TIMSS may be partially explained by the inception of tests concerning the assignments of public servant candidates. These findings are consistently obtained under various model specifications and sub-sample analyses.

The findings presented in Chapter 3 have direct policy implications for Turkey. Given the excess supply of teacher candidates, the centralized testing system implemented in 2002 may have been a useful tool to distinguish effective and ineffective candidates. The evidence thus suggests that the current teacher selection model should be preserved. However, there are also several shortcomings of this teacher selection regime. First, centralized test does not vary by subject. This means that teacher candidates for all subjects are selected by answering the same set of questions. Thus the examination is not capable of distinguishing different qualities necessary to be an effective mathematics, science or art teacher. It only provides a generic measure of the knowledge on general culture and educational sciences of teacher candidates. Subject-matter knowledge and knowledge on subject-matter teaching are not measured with the examination. On the other hand the relevant literature provides ample evidence of a positive relationship between subject-matter knowledge and teacher effectiveness (Darling-Hammond, 2000; Metzler & Woessmann, 2012).

In 2007, the MONE attempted to address this problem by introducing a second stage of centralized testing. The proposed second stage was specifically designed for the measurement of subject-matter knowledge and knowledge on subject-matter teaching. Thus the tests of the second stage were also planned to be specific to each subject. Then, it was proposed that the final score was to be computed as a weighted sum of test scores obtained in the first and second stage. However, teacher unions resisted the introduction of another stage of examinations and applied to Council of State for the cancellation of the proposed bylaw. The Council of State cancelled the bylaw. Nevertheless the need for an additional stage of testing for the measurement of subject-matter knowledge and knowledge on teaching subject-matter is still a significant part of education policy agenda and it is likely that the MONE will go on with its attempts to establish

such a testing mechanism and this will likely lead to another round of legal battles between the MONE and teacher unions.

Another critical issue with the teacher testing regime is that currently teacher testing is tightly connected to an excess supply of teacher candidates. However, maintaining a large body of unemployed teacher candidates is unlikely to be politically sustainable and the chronic excess supply of teachers is likely to harm the teaching profession and this may lead to an overall decrease in teacher quality over the long term. Currently, the MONE and Council of Higher Education are trying to solve this problem by shutting down evening education pre-service teacher training and pedagogic formation programs (master level programs which grants teacher certification upon successful completion without a four-year degree from education faculties). Additionally the MONE and Council of Higher Education are also considering reducing the quotas of education faculties. Obviously these initiatives may cause a significant reduction in the size of the pool of teacher candidates and this reduction in the pool of potential teachers, in turn, may cause a decrease in the overall teacher quality. Therefore, another policy option may be to change the timing of selection. In addition to reducing the quotas of educational faculties, student selection procedures to education faculties may be strengthened and the course of selection may go on within the four-year training in education faculties. Students not suitable for teaching profession may be directed to other programs during their university education. Such a comprehensive selection mechanism may be better in identifying effective teachers as well as it may shrink the excess teacher supply. Indeed this is exactly how teachers are selected in Singapore and Finland, among the top performing school systems of the world (Barber & Mourshed, 2007).

In Chapter 4, the dissertation established a causal link between the enactment of the 1997 Compulsory Education Law and years of schooling and the probability of completing eight years of schooling of women. The findings also indicate that the Compulsory Education Law increased high school completion, i.e. eleven years of schooling. The econometric analysis is robust to the inclusion of additional control variables and the instrumental variable passes the tests of weak identification.

The findings exhibited in Chapter 4 also have direct policy implications. First, extending compulsory education and supporting this legal change with necessary resources and political commitment may have an impact on completed years of schooling. This is an important inference because implementing compulsory schooling laws and ensuring compliance to compulsory schooling laws in developing countries are indeed very challenging. Krueger (1996), analyzing school leaving age for birth cohorts between 1959 and 1974, concludes that 80 percent of children in Brazil, 40 percent of children in India and 25 percent of children in Mexico and Portugal left school before reaching the minimum schooling age. Weiner (1991) claims that the lack of national commitment regarding the implementation of compulsory schooling law in India is one of the major factors related with the low compliance rates. Within this context, the implementation of --and compliance with-- the Compulsory Education Law in Turkey stands out as a policy intervention which can be considered as successful. Even for the first three cohorts that were subjected to the Compulsory Education Law, the rate of completing eight years of schooling was above 70 percent. It also has to be underlined that the compliance rate exceeded 90 percent in early 2000s and reached almost 100 percent during mid-2000s.

This achievement may be partially explained by the strong and consistent political commitment behind the implementation of the Compulsory Education Law and its egalitarian goals. As

discussed in detail in previous chapters, total annual public resources devoted to the implementation were around USD 3 billion and total resources devoted to the implementation exceeded USD 11 billion. However it is likely that even this figure is an underestimation because it does not contain donations from private sources. Additionally, during the implementation of the Compulsory Education Law, the budget of the MONE consistently grew and its share in the total central budget increased. The share of investment spending in the budget of the MONE remained around 20 percent until 2001 and peaked to 30 percent in 1998, the first year of the implementation of the Compulsory Education Law.

These findings regarding the effective implementation of the Compulsory Education Law are also very informative for the current transformation of basic education in Turkey. In 2012, compulsory years of schooling have been increased from eight to twelve. However a basic investigation of the budget allocated to the MONE as well as the share of investment spending in the budget of the MONE for 2013, 2014 and 2015 highlights that there is only a modest increase in the resources devoted to the MONE and the share of investment spending in the budget of the MONE is projected to remain around 10 percent until 2015. These facts raise concerns regarding the effective implementation of the twelve years of compulsory schooling law and may signify a lack of political commitment.

The analysis regarding the causal impact of increased education on fertility did not provide any statistically significant results. In contrast with available research on Turkey, the two stage least square estimations did not supply any evidence in favor of the presence of a causal link between completing eight years of schooling and on teenage marriage and fertility.

The impact of completing eight years of schooling on teenage marriage and fertility is likely to be much lower than estimated in earlier studies (Kırdar, et al., 2009; Kırdar, et al., 2011). It is very likely that previous estimates of the impact of the Compulsory Education Law on teenage marriage and fertility is confounded by the impact of the economic crisis of 2001 on the marriage market as well as the change of the Civil Code in 2002. It should be noted that patterns regarding the timing of marriage and fertility may not be very sensitive to an increase in years of schooling from five to eight because getting married at age 13 or 14 may not be the individual decision of the women and this decision may be much more tightly connected to local characteristics such as prevalence of bride's dowry as well as other local customs and culture. It is hard to claim that the Compulsory Education Law affected these characteristics in the short run.

To summarize, this dissertation provides evidence suggesting that the Compulsory Education Law and the policy changes on teacher selection linked to KPSS had important effects on the quantity and quality of public education provision in Turkey. Nevertheless, regarding the Compulsory Education Law, it may be too early to detect its impact on other domains of human development such as teenage marriage and fertility.

## II. Shortcomings and future research

However, the findings and inferences presented in this dissertation are far from definitive and these findings can only be considered as suggestive. There are several reasons to be cautious.

The analysis on the impact of KPSS on student achievement has some key limitations: First, the identification strategy only exploits variation in time. Thus, the estimates may be confounded by simultaneous unobserved events. One possibility is the reform of pre-service teacher training programs in 1997.

Second, possible student-teacher sorting based on within-student between-subject ability variation is a serious issue. These problems have been discussed in detail in Chapter 3 and several sensitivity and robustness checks were performed within the restrictions of data availability. Although the estimates appear to be insensitive to these checks there may be other simultaneous unobserved events and student-teacher sorting may be based on an unobserved criteria other than within-student between-subject ability variation. Shadow education in the form of private tutoring is a widespread practice in Turkey and principals may be matching students and teacher based on within-student between-subject variation in private tutoring consumption. Similarly, parents may choose to buy more private tutoring in response to within-student between-subject variation in teacher effectiveness.

Third, the treatment and control groups are constructed based on years of experience of teachers. Thus, the data does not allow identifying whether teachers were assigned by centralized testing or otherwise. However, the misclassification should be very limited given that leaving and re-gaining public servant status is a very rare event in Turkey and there is no reason to assume that measurement error due to this misclassification is non-random. In sum, despite substantial efforts to correct for potential sources of bias, there remain some limitations that cannot be addressed in the absence of additional observational data or experimental data.

The analysis on the impact of Compulsory Education on increased schooling and on the timing of teenage marriage and fertility has also some key limitations. First, the identification strategy is based on the assumption that the measure of treatment of intensity variable is exogenous. This is likely to be a valid assumption given the very high correlation between pre-treatment regional gross enrollment rates and regional change in teachers per children. Therefore it appears to be safe to claim that the intensity of the treatment was almost solely determined by pre-treatment

gross enrollment rates which are controlled for. However this assumption does not have to be necessarily valid. More specifically, the measure of the treatment may be correlated with other changes, such as the regional intensity of utilization of contraception methods allowed in 1983 and the regional intensity of the economic crisis in 2001. Both of these unobserved factors may have affected completed years of schooling as well as the timing of marriage and fertility.

Second, exclusion restrictions may be problematic. Teachers in Turkey, especially in rural areas, are also considered to be community leaders. Thus it may be risky to assume that additional teachers only had an impact on completed years of schooling. Families, women and men may have consulted teachers before getting married. The knowledge and practice of family planning methods may have been affected by the presence of teachers. Therefore, additional teachers may have impacted women's completed years of schooling as well as the timing of marriage and fertility. Surprisingly, the literature on developing countries summarized in Chapter 3 does not provide any discussion on teachers' impact beyond completed years of schooling. The same doubts may be raised in the cases of Indonesia and Nigeria (Breierova & Duflo, 2004; Osili & Long, 2008).

Third, the TDHS 2008 and 2003 do not allow identifying whether individuals were at the fourth grade in the 1996-1997 school year. Thus the analysis above also suffers from potential misclassification. However it may be claimed that the extent of this misclassification does not appear to be dramatic based on inferences drawn from administrative and supplementary survey data. In sum, these are critical shortcomings of this analysis and cannot be addressed in the absence of additional observational data or experimental data.

The analysis on the impact of KPSS on student achievement can be extended with the release of TIMSS 2011 data. Moreover, the human resources department of the MONE also started to publish administrative data on teacher assignments at the provincial level. Therefore, an extended analysis could be carried out in the future without relying solely on variation in time. Nevertheless, this analysis should be conducted with a larger student-teacher matched panel data set which contains KPSS test scores for teachers. In Turkey, students are subject to centralized testing in order to proceed from primary to secondary and from secondary to tertiary institutions. These students' test scores and teachers' KPSS test scores are available in ÖSYM and students and teachers can be matched with the help of the personnel database (İLSİS) of MONE.

The analysis on the Compulsory Education Law can be extended in the future by making use of another data set, the Turkey Population and Building Study of 2011, which is expected to be released in the coming months.[24] Data from 2.4 million households were collected for this study and this data set includes individual level information on level of education, type of place of birth (urban/rural), province of birth, marriage and birth history of women in additional to usual demographic indicators. Future studies can use these new data sets to improve upon the analysis in this dissertation.

[24] http://www.tuik.gov.tr/arastirmaveprojeler/NKA/nufus.html

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