Higher education expansion and college wage premium: Evidence from Turkey

Asena Caner* Merve Demirel-Derebasoglu† Cagla Okten‡

October 16, 2022

Abstract

Studies from advanced countries document that the college wage premium increased (Bound and Johnson, 1995; Katz and Murphy, 1992) or remained flat (Crivellaro, 2014) as the supply of college graduates expanded over time. The literature pointed out the important role of increasing demand for skilled workers due to skill-biased technological change and labor market policies such as stagnant minimum wages for this phenomenon. However, the contribution of supply variations in college graduates in determining wage differentials got very little attention partly because it is not easy to establish a causal link between the supply of college graduates and education wage differentials. This paper examines the causal impact of a large-scale expansion in higher education on college wage premium in Turkey, where new universities opened across the country and slots in new and established universities increased over a short period. We show that expansion has decreased the college wage premium by 9% for young men exposed to the policy. We explore two channels that might lead to this decline: First is the sudden and large supply increase of university graduates, and second is the lower productivity of young college graduates, due to lower value-added by the new universities and lower ability of graduates as admittance to university became less selective. Our findings provide suggestive evidence that the lower productivity of young workers is a driving force for the recent fall in the wage advantage of college graduates relative to their older peers.

Keywords: College wage premium, higher education expansion, supply of skilled workers, Turkey.
Jel Codes: I23, I26, J24, J31.

1 Introduction

A striking feature of the last hundred years has been the enormous expansion in tertiary education. In 1900, only about one in a hundred young people in the world were enrolled in universities, but over the course of the twentieth century, this rose to about one in five (Schofer and Meyer, 2005). The large increase in tertiary education attainment occurred at different times in different countries. While the US experienced a vast increase in the number of college graduates in the 1960s and 1970s, the same phenomenon occurred in other advanced countries, such as Canada, France, Spain, and Nordic countries in the 1990s. Many developing countries, seeking higher growth through increased human capital (Lucas,

*Asena Caner is a professor at TOBB University of Economics and Technology, Ankara, Turkey, and a Research Fellow of Economic Research Forum (ERF); her e-mail address is acaner@etu.edu.tr.

†Merve Demirel-Derebasoglu is an instructor in Baskent University and consultant in the World Bank, Ankara, Turkey; her e-mail address is merve.demirel@bilkent.edu.tr.

‡Cagla Okten is an associate professor at Bilkent University, Ankara, Turkey, and a Research Fellow of IZA (Institute of Labor Economics); her e-mail address is cokten@bilkent.edu.tr.

1989; Mankiw, Romer, and Weil, 1992), experienced similar inflation of college graduates in the last two decades. Specifically, in Turkey, Slovakia, Czechia, Poland, Latvia, Slovenia, Portugal, and Hungary, the higher education attainment rate of 25-34-year-olds increased by more than 100% between 2002 and 2017 (OECD, 2020). This transformation in tertiary education attainment is bound to have an impact on the structure of wage differentials.

Many contributions in the literature have linked the demand for skilled labor and labor market institutions with the evolution of the educational wage differentials of the tertiary-educated labor force. Several studies analyzing the educational wage differentials in the US labor market provide evidence on the growing college wage premium in the 1960s and 70s parallel to the increase in the supply of college graduates. One prominent view on the underlying causes for the rising college wage premium is the skill-biased technological change (SBTC). Bound and Johnson (1995), Katz and Murphy (1992), and Taber (2001), in addition to many others, argue that the increase in demand for skilled workers due to recent technological changes explains the increasing wage premiums of college-educated. On the other hand, Card and DiNardo (2002) and Lee (1999) argue that the changes in the labor market institutions, such as a decline in unionization and stagnant minimum wages, explain a substantial part of the wage differentials by educational attainment. In the UK (Walker and Zhu, 2008) and several other European countries (Crivellaro, 2014), the wage differential of college to high school graduates followed a flat path along with the increase in college graduates. The different findings between the US and European countries have been attributed to the different labor market institutions and policies (Crivellaro, 2014). Even with a higher demand for skilled workers, compressed and regulated labor markets in Europe have led to lower educational wage inequality.

Even though these studies focus on the educational wage differentials at a time of relative supply increase of college graduates, the role of the supply in determining the wage differentials did not receive much attention. Fortin (2006) explores the impact of supply by exploiting interstate variation in the college graduates and shows the faster growth of college graduates suppresses the growth of college wage premium in states that experienced a higher growth. Card and Lemieux (2001) explore the role of supply in a period of college graduate stagnation and identifies the supply as an essential determinant of college wage premium by associating the rise in the premia of younger workers with the stagnated growth of college graduates. However, both of these studies fall short on identifying the impact of the supply increase since their analysis overlaps with the evolution of labor demand due to skill-biased technological change, and hence increase in demand for skilled workers is a confounding factor in their analysis. Kawaguchi and Mori (2016) compare the college wage premium in two developed countries, the US and Japan, where demand for skills due to recent technological progress have followed similar paths, while the supply of college graduates followed different trends as the supply of graduates grew substantially faster in Japan than in the US. They find that Japan and the US's contrasting wage premia trends can partly be explained by the faster-growing supply of college graduates in Japan than in the US in the same time period.

Though the association between supply and the educational wage differentials has been an important feature in many theoretical models[1], the empirical evidence on the causal relationship between the supply on the wage inequality is absent. It has been a challenge to examine the causal link between the supply of college graduates and educational wage differentials as demand for skills due to skill-biased technological change and supply of skilled workers increased and evolved in advanced countries. Turkey's recent higher education expansion policy, an exogenous reform that leads to a large increase in the supply of college graduates over a short period of time, offers an excellent case to identify the role of supply increase in the wage differentials.

[1]The pioneering work by C. D. Goldin and Katz (2009) forms the basis of many of these studies.

In Turkey, the number of universities increased from 77 in 2005 to 138 in 2009. The number of available slots increased by 60% during the same period. By 2012, there were 158 universities in the country, and the number of available slots was two-fold of its 2005 level. The timing and spatial distribution of the policy were driven by political concerns, particularly by the requests of the members of the parliament seeking re-election in the 2007 general elections. Moreover, the implementation of the reform took place over a short period of time and was unanticipated from the perspective of university candidates.

Due to the expansion policy, the share of college graduates among young adults tripled (OECD, 2020), and the characteristics and skill accumulation of Turkish youth with higher education have also changed over this same period of time. As opposed to the existing trends in advanced economies, in Turkey, an emerging country with less rigid labor market institutions than EU member countries, the college wage gap has substantially narrowed down in the last 15 years (Eren et al., 2018). In this paper, we aim to investigate the role of the supply of college graduates on the evolution of the educational wage differentials in Turkey by exploiting a large-scale expansion policy, which was exogenous to the labor market and macroeconomic conditions. This question has wide relevance for other countries that have recently increased or are planning to expand higher education, especially for those where labor demand for skilled workers remains relatively stable along with the pace of technological change.

We identify the causal impact of the increase in supply of college graduates induced by higher education expansion on the additional wages earned by young college graduates using the difference-in-differences methodology. Since the expansion reform started in all regions simultaneously and increased gradually over time, we use region and year variations in the level of exposure to capture the causal relationship between the additional slots introduced in the expansion period and the changes in the college wage premium. Two-way variation in the exposure measure allows us to control for both region and year fixed effects. Hence our estimates disentangle the effect of the expansion from country-level time trends and time-invariant regional differences in the educational wage differentials.

We find that the expansion in tertiary education has significantly reduced the additional wages enjoyed by the 25-29-year-old college graduate men over their high school graduate peers in the same age group. Our results indicate that the average fall in the college wage premium due to reform was 9% that varies in 3-57% in the last year of our sample. This can be due to the labor market equilibrium effect of the expansion as the supply of college graduates increased while demand remained constant. It can also be due to lower productivity of new graduates as the expansion happened over a short period, at a large scale when resources in terms of faculty and infrastructure were limited and the sorting power of the university entrance exam according to ability has decreased.

To disentangle the productivity channel from labor market equilibrium effects, we examine the additional wage that college graduates earn compared to their high school graduate peers at different quantiles of the wage distribution. We find that college wage premium decreases more in the lower quantiles than upper quantiles that provide suggestive evidence that the lower productivity of young college graduates contributed to the decline in the college wage premium.

To explore whether the channel of the supply increase in skilled workers is at work, we further explore the causal impact of the expansion on the wage premiums of the older age groups, who were not subject to the policy when they were most likely to make their college entry decision. These workers were not exposed to quality issues related to newly established universities or lower selectivity of the university admission process that younger cohorts were exposed to. Therefore, we expect only labor market equilibrium effects for these cohorts; moreover, such effects are likely to be limited since younger and older graduates are not close substitutes due to their different experience profiles in the labor market. Contrary to our results on young graduates, we do not find a negative effect of the expansion policy on the college wage premium of older graduates. The finding that older cohorts who were exposed to an increase in

the supply of young graduates did not experience any fall in their college wage premium suggests that younger graduates' lower productivity may be an important factor in explaining the decline in their college wage premium. Such a finding without further information on the substitutability between older and younger graduates, however, neither supports nor rules out the explanation that the sudden increase in the supply of college graduates beyond demand is a driving force in the falling college wage premium of young adults.

Our paper makes an important contribution to the literature on the effects of education policies on labor market outcomes. Studies in the literature are mostly on the extension of compulsory schooling at lower levels of education (Angrist and Keueger, 1991; Harmon and Walker, 1995; Oreopoulos, 2006; Devereux and Hart, 2010; Pischke and Von Wachter, 2008; Aydemir and M. G. Kirdar, 2017). Few studies examine the effect of higher education expansion on returns to education (Devereux and Fan, 2011; Kyui, 2016) or labor market advantages of young graduates (Walker and Zhu, 2008; S. Li, Whalley, and Xing, 2014; Xing, Yang, and Z. Li, 2018). Our paper differs from existing studies in two ways: First, as opposed to the studies estimating the local average treatment effect of the expansion policy, as in Devereux and Fan (2011) and Kyui (2016), our study examines the impact of a large-scale expansion on all labor market participants and hence identifies how it bounds to structure the labor market over time. Second, the identification strategy that relies on the regional exogenous variation in the supply of skilled labor distinguishes our study from those who rely on the variations in the educational attainment of different birth cohorts that has limited power on excluding demand-driven variations, as in Devereux and Fan (2011), Walker and Zhu (2008).

Second, our paper contributes to the literature on productivity in education (Hendricks and Schoellman, 2014). Productivity in higher education depends on a number of factors, including resources such as faculty and infrastructure and the ability profiles of students. Especially middle- and low-income countries, while the transition from elite to mass higher education, face severe challenges in maintaining education quality since resources tend to be limited at all levels of education. Even in advanced countries, productivity in higher education has come into question recently. Oppedisano (2011) shows that due to the expansion of regional higher education institutions in Italy, many middle-ability individuals from less favorable backgrounds have enrolled in education. However, the higher drop-outs and decline in passed exams of newly enrolled individuals cast doubt on recent college students' ability profiles. Similarly, Bound, Lovenheim, and Turner (2010) document a decline in college completion in the US with a rise in college enrollment. The college preparedness of recently enrolled students contributes to this observed fall. We contribute to the literature by providing suggestive evidence on both differences in the ability profiles, and the added value in the new higher education institutions lowers the productivity of skilled labor as quantity expands. Hence the lower productivity may give rise to lower than expected returns to education in the labor market.

The next section provides background information on the higher education expansion in Turkey. This is followed by a section that introduces the conceptual framework. Section 4 describes the data used in the analysis. Section 5 and 6 explain the empirical strategy and identification to analyze the causal impact of the reform on college wage premium. Section 8 and 9 present the results and the robustness of our results. Finally, section 9 states the concluding remarks.

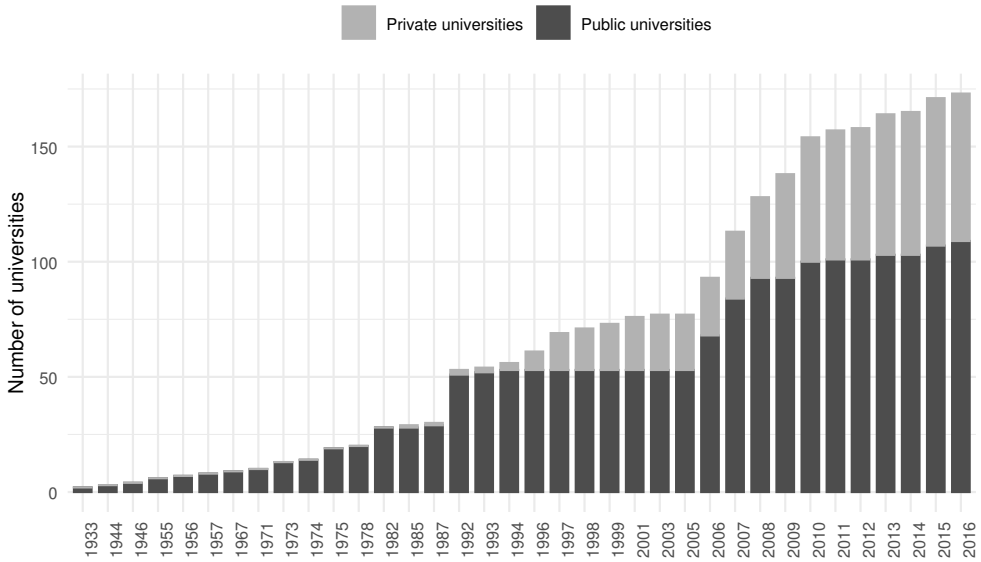
2 Higher education expansion

Higher education is offered by two types of universities in Turkey, namely public and private (non-profit foundation) universities. Since 1981, all universities are affiliated with the Council of Higher Education (COHE), an independent entity of the central government, and COHE is responsible for the strategic plan-

ning of higher education, in addition to establishing and maintaining quality assurance mechanisms. Public and private universities offer three forms of training: normal education, evening education, and open (distance) education. Students who study in normal or evening education receive education at the university, whereas those who attain an open education program are only obliged to pass centralized exams. Normal and evening education programs have limited quotas determined by the COHE, but many open education programs do not have quota restrictions.

Higher education in Turkey includes vocational colleges, undergraduate programs[2], in addition to post-graduate level education. In this study, we are primarily interested in completing an undergraduate program. Demand for undergraduate education has been greater than supply in Turkey parencite-cohe2004, cohe2007. Therefore, a centralized competitive examination is applied to ration excess demand since 1974. Although the university exam structure may change over time, it is mainly composed of the four main subjects students study during their high school education: mathematics, Turkish, science, and social sciences.

Figure 1: The number of universities across years.



Source: Council of Higher Education, Higher Education Statistics.

The first university in the country was introduced in 1933, and there was a gradual increase in the number of public universities until 1987. Turkish government introduced the first wave of higher education expansion in 1992-1993. During the two years of the expansion, 24 new public universities were established in 23 cities that did not have a university before. Between 1992 and 2005, the number of public universities remained relatively constant, and the number of private universities slightly increased, as shown in Figure 1. In the second wave of the higher education expansion, 50 universities (40 public and 10 private) were established between 2006 and 2008. As a result, the number of universities increased from 97 in 2005 to 138 by 2009 and 168 by 2012, and the number of available slots increased by around 60% by 2009 and 105% by 2012 compared to the slots in 2005. This second wave of higher education expansion is the focus of our study.

[2]Vocational colleges generally take two years, while the overwhelming majority of undergraduate programs take four years. There are only a few exceptions that take longer: Schools of Dentistry, Pharmacy, and Veterinary take 5 years; School of Medicine takes 6 years of education. These are also classified as undergraduate programs.

Table 1: Higher education statistics

Higher education enrollment of 18-20-year-olds			Higher education graduation of 23-25-year-olds		
Year	Men	Women	Year	Men	Women
2004	15.6	10.6	2009	15.7	15.7
2005	17.5	11.6	2010	16.8	17.7
2006	20.1	12.6	2011	18.3	19.8
2007	20.9	13.5	2012	21.4	23.3
2008	21.2	15.8	2013	22.6	26.1
2009	23.2	19.1	2014	24.3	27.5
2010	25.0	21.1	2015	25.1	30.3
2011	26.4	23.0	2016	27.1	32.2
2012	28.8	26.8	2017	28.1	35.0
2013	30.3	28.0	2018	28.3	36.9

Source: HLFS, 2004-2018.
Notes: Authors' calculations. HLFS only provides information on the educational attainment, but not on where the education had been attained (open education, public or private institutions, etc.). On the other hand, in the 2004-2013 waves of HLFS, the information on the enrollment into open and regular education is provided separately. Even though the focus of our paper is the four-year higher education in regular higher education institutions, to have comparable statistics, we calculate the mean enrollment rates as the mean enrollment into both regular and open education institutions at the higher education level.

According to education statistics derived from Turkish Household Labor Force Surveys, presented in Table 1 in the Appendix, the rise in enrollment in higher education started in 2006, the first year of the expansion, and continued even after 2008. The enrollment rates of young men and women of age 18-20 increased from 20% and 13% in 2006 to 29% and 27% in 2012, respectively. The individuals enrolled in higher education are assumed to graduate in about five years (Valero and Van Reenen, 2019). Hence, to examine whether the enrolled students translated into graduates in five years, we also examine the higher education graduation rates of the same birth cohorts whose enrollment rates are given. To that end, we also present the higher education graduation rates of 23-25-year olds (individuals five years older than 18-20-year-olds) in the waves 2009-2018 (five years later than waves 2006-2013) in Table 1. The increase in the higher education attainment of 23-25-year-olds, same birth cohorts whose enrollment statistics are given in 2006 and 2012, from 18% and 20% in 2011 to 28% and 35% in 2017 supports this argument by Valero and Van Reenen (2019).[3]

The higher education expansion was politically motivated and driven by requests from members of the parliament to establish universities in their cities (Arap, 2010). The Turkish general election was to be held in 2007 to elect 550 members of parliament. Before this, in 2005, 25 new public universities were planned to open with the primary purpose of providing economic benefits to the regions where they were established. When the central government adopted the reform at the end of 2005, the Council of Higher Education (COHE) opposed the draft by saying that there were insufficient human resources and infrastructure to establish the new universities. However, due to pressures from members of the parliament who represented different cities and sought re-election, by 2008, 15 more public universities were opened in addition to those 25 universities initially planned.

3 Conceptual Framework

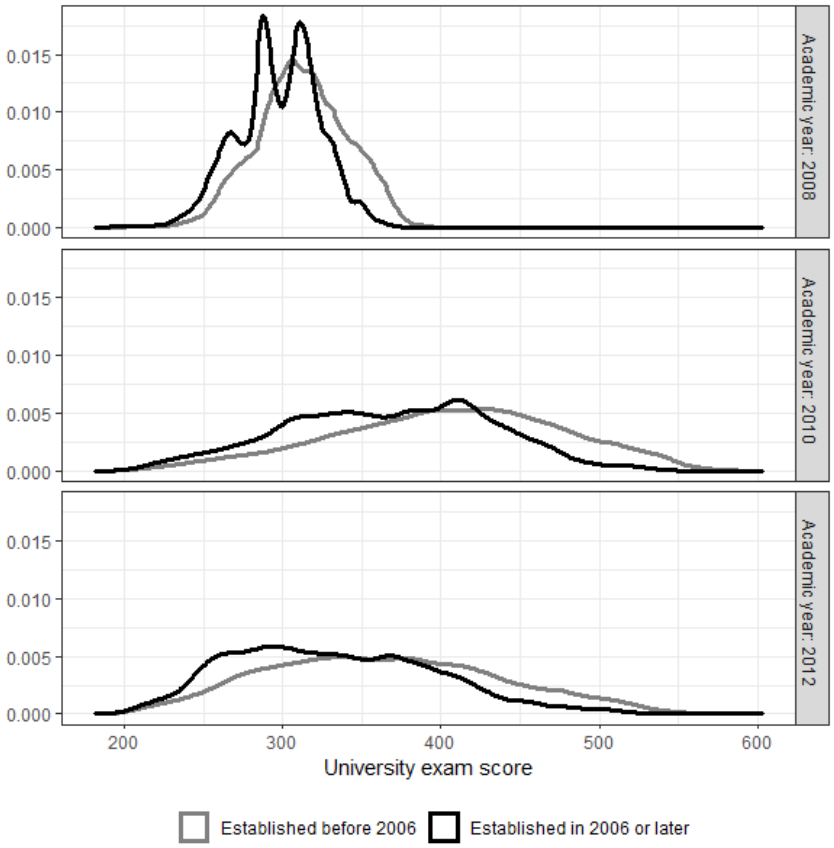
Following the conventional approach introduced by C. Goldin and Katz (2007), we conceptualize the changes in educational wage differentials first by using a framework of the interaction of the supply of skills (driven by changes in the educational attainment of the workforce) and the demand for skills (driven by skill-biased technological change). If we assume a CES aggregate production function with two labor inputs, namely high (college graduate) and low (high school graduate) skilled workers, with a fixed elasticity of substitution between two types of labors, then in the canonical model, the evolution of the

[3]HLFS does not cover students living in dormitories. The systematically lower enrollment of women compared to their graduation rates is most probably due to a high share of women living in dormitories while studying in college.

wage differential depends on the balance between relative demand for and supply of high skilled and low skilled workers. Hence, in the absence of institutional constraints, the relative wage, called college wage premium, goes up or down depending on whether demand grows faster than supply or vice versa.

In our case, the expansion in the supply of college graduates happened in a short period. Hence, during this period, the demand for high skilled workers can be assumed to have been relatively stable. Under this assumption, we would expect the increase in labor supply beyond demand to result in a decrease in the market wage of graduates in about five years after the educational expansion based on the assumption that the students graduate and participate in the local labor market five years later than their enrollment (Valero and Van Reenen, 2019).

Figure 2: Kernel density estimates of university entrance exam scores



Source: OSYM Almanacs.
Notes: Authors' calculations. OSYM Almanacs provide the number of students admitted to all programs and the lowest and highest scores of the students for each program in all universities. The score distributions are generated by assuming that scores are uniformly distributed between the lowest and highest scores within each program.

Another possible effect of the expansion is the decline in the productivity of graduates via two channels. First, the expansion reduced the selectivity of the university entrance exam and allowed lower ability individuals to have access to higher education. Hence, the innate ability distribution of college graduates might have changed in the post-expansion period compared to the earlier years. In particular, the ability distribution of post-expansion graduates may have a lower mean and a higher variance with more observations at the low end of the distribution, compared to pre-expansion graduates. Such a change would lower the signaling value of higher education attainment, as the expected productivity of a university graduate is now lower, resulting in a lower average wage for a university graduate. To provide empirical evidence for our claim, we compare the distributions of university entrance exam scores of students in

already existing and newly established universities using data on the lowest and highest exam scores in all programs in these universities (Figure 2). Here, we assume that the scores in a program are distributed uniformly between the lowest and highest scores. We observe that the score distribution in newly established universities falls slightly to the left of the distribution in the existing universities (established before the reform). Hence, employers may perceive the newly established universities as less selective and pay lower wages to their graduates.

Table 2: Average faculty member per student over years

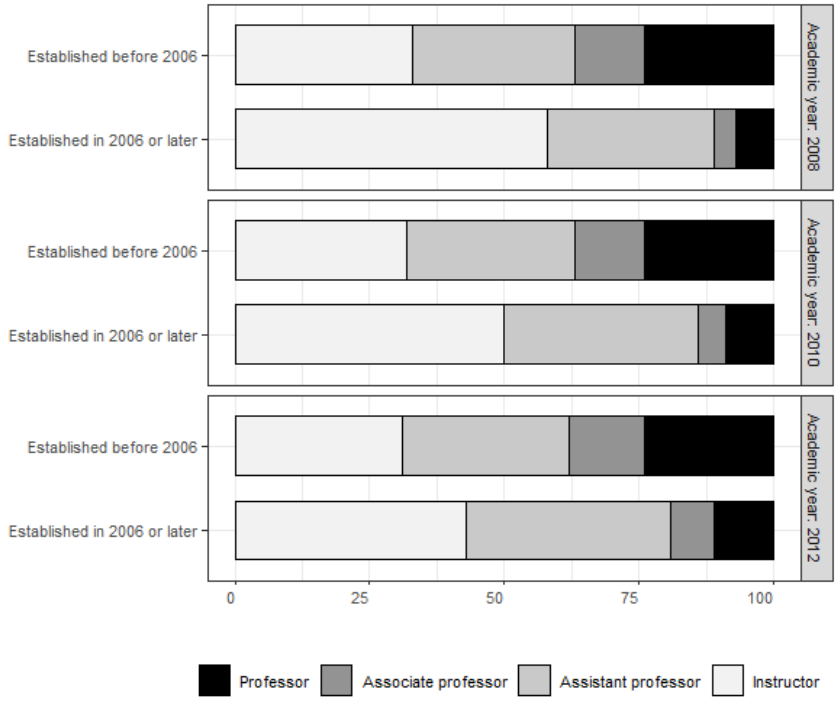
Year	Established before 2006	Established in 2006 or later
2001	0.037	-
2002	0.036	-
2003	0.036	-
2004	0.036	-
2005	0.034	-
2006	0.035	0.019
2007	0.038	0.021
2008	0.037	0.020
2009	0.035	0.021
2010	0.034	0.027
2011	0.032	0.031
2012	0.030	0.034

Source: Council of Higher Education statistics.
Notes: Authors' calculations. The faculty members include professors, associate professors, assistant professors and instructors. Research assistant are excluded from the faculty members since they are not allowed to teach in Turkish higher education system. The universities with more than 500,000 students are also excluded since the numbers include students having open education.

Second, the value-added of education could be lower in the universities established in the post-expansion period. With these universities, there are concerns that resources in terms of faculty (size and experience) and infrastructure fail to meet the demands of increasing number of available slots. Indeed, according to the Council of Higher Education statistics presented in Table 2, the average number of faculty per student is significantly lower in the newly established universities in the early years of the expansion (2006-2009) compared to the same statistic in the universities established prior to the expansion. The average number of faculty per student increased in the later years of the expansion (2010-2012), and even exceeded the rate in the pre-expansion group. Yet, in these later years, the distribution of faculty members by rank in the newly established universities is quite different from the distribution in the already existing universities. Figure 3 shows that instructors (the faculty members who do not necessarily hold a doctoral degree) constitute more than half of the faculty members in the universities established in 2006 and later, in the early years of the expansion. Over time, the shares of professors and associate professors have increased. However, even in the latest year shown in the figure, the combined share of professors and associate professors is less than one-quarter of faculty in the new universities, while their share in the already existing universities is around one-third of the instructing faculty. Hence, the quality concerns about the newly established universities could limit the college wage premium enjoyed by recent graduates. In other words, the expected value added (skills gained) from a university degree may have been reduced. Moreover, the dispersion of value-added among college graduates may have increased. In this conceptual framework, we would expect a lower average wage and a higher wage dispersion among younger graduates.

Ideally, to identify a decline in the innate ability of graduates and to measure the value-added by higher education, we would require data on the ability of students —such as the university entrance exam scores— as well as data that match students to the university they studied at. Since such detailed data do not exist, we examine the impact of the quality channel indirectly by analyzing the effect of expanding educational opportunities on the heterogeneity in the wage premiums. We claim that the productivity channel at work is less relevant for individuals belonging to the upper tail of the wage distribution. In other words, wages of those who attained education in more prestigious existing universities that are more selective

Figure 3: Distribution of faculty members



Source: Council of Higher Education statistics.
Notes: Authors' calculations. The faculty members include professors, associate professors, assistant professors and instructors. Research assistant are excluded from the faculty members. The universities with more than 500,000 students are also excluded since the numbers include students having open education.

in the university exam and have a higher quality of academics and infrastructure remained considerably stable over time. In comparison, the channels described above reduced the relative wage advantage of individuals in the lower tail, those who received education in new universities only thanks to the higher education reform. Hence the impact of the reform might have been smaller in the upper tail of the ability distribution, but larger in the lower tail of the ability distribution.

4 Data

The micro dataset used in this study comes from the Turkish Household Labor Force Surveys (HLFS). The HLFS is one of the largest household surveys available in Turkey, and it is carried out annually by the Turkish Statistical Institute (Turkstat). It collects demographic, education, and labor market data from roughly 400,000 individuals living in 150,000 households each year. For each individual, the region of residence is available at the NUTS-2 level.[4] The survey has data on age, gender, and marital status among the demographics; enrollment into education, highest educational degree, and the field of study in higher education among education outcomes; employment status, the type of employment, occupation, earnings, working hours, and the industry of the workplace among the labor market outcomes.

Our analysis using individual-level data from HLFS builds on the extensive literature that estimates the returns to schooling, beginning with the seminal work of Mincer (1974), what has become known as the Mincer model. This model estimates the rate of return by the coefficient on schooling in a log wage equation that controls for a quadratic polynomial of potential experience. Earlier literature points out that

[4]There are 26 NUTS-2 regions in Turkey.

allowing for non-linearities associated with degree completion, known as the sheepskin effect, instead of assuming the same increase in earnings with each year of schooling, is essential to estimate the returns to schooling accurately (Hungerford and Solon, 1987; Jaeger and Page, 1996). By following these insights, we restrict our HLFS sample to at least high school graduates and introduce a binary higher education variable that indicates whether a high school graduate had also attained higher education or not, based on the highest educational degree information available at the individual-level. We focus on the additional wage enjoyed by college graduates compared to the high-school graduates, known as college wage premium in the literature, as our variable of interest. We estimate the premium of a college degree by the coefficient of the higher education dummy in a statistical analysis of regressing logarithm of earnings onto higher education dummy and a non-linear function of potential experience.

HLFS collects data on monthly income and weekly hours of work. By using this information, we measure earnings by hourly wages. The idea behind such a measure is as follows: The variations in the monthly income may originate from the differences in both the hours of work and the hourly wages. Since the hours worked in a given month could differ across educational groups, we use hourly wages as the measure of earnings. We compute the nominal hourly wages by dividing monthly income by monthly hours of work (4.3$\times$weekly hours of work). Further, we adjust the nominal figures by the annual regional (NUTS-2 level) consumer price index.[5][6] We further winsorize hourly wages of the top and bottom 1% of the wage distribution for each wave to exclude outlier observations. We use the log of hourly wages as our main dependent variable.

To account for the effect of experience in our estimates, we add age and age-squared variables in our regressions and capture the effect of potential experience (data on labor market experience is not available in the HLFS). The years of tenure with the current employer is introduced as an additional control for potential experience. Hence, we control for both firm tenure and the second-order polynomial of age (age and age-squared) to account for potential experience.

We further introduce occupation, industry, and sector dummies using the categorical information available in HLFS on occupation (ISCO-88 until 2013, ISCO-08 in 2014 and later[7]), industry (Nace Rev.2), and sector (available only in 2009 and later waves) in some specifications to control for the wage differentials across occupations and workplace characteristics.

Figure 4 displays the evolution of the college wage premium over time captured by the ratio of average hourly wages for university graduates to high school graduates. The lines show the local linear fits to capture the time trend of the wage premium. Our figure documents an increasing trend in the first decade of the twenty-first century in the college wage premium of all age-groups of 25-49. Many developed and developing countries experienced a similar increase, mostly associated with the skill biased technological change. However, around 2010s we observe a decline in the wage advantage enjoyed by college graduates. Moreover, the decline is steeper for younger adults in the labor market. To associate the recent decline in the college wage premium, especially for young adults, with the reform that increased access to higher education, we use data on both supply and demand-side variations in higher education, as described next.

Table 3 additionally provides information on the wage dispersion separately for high school and college graduates observed before and after 2011. Consistent with our observations in Figure 4, the ratios of both mean and median wages of university graduates to high school graduates fall for younger age groups after 2011, parallel to the increase in their supply. On the other hand, the same wage ratios remain flat or slightly increases for older age groups. The last two columns show the q90/q10 and q75/q25 ratios separately for

[5] We use data on regional consumer price indices, published by the Central Bank of Turkey (2020) to deflate the earnings to account for the price variations across regions in addition to across years.

[6] Moretti (2013) points out that the nominal wage differentials by educational attainment significantly exceed the real wage inequality due to the geographical concentration of skilled workers into high-cost locations.

[7] We convert ISCO-08 classification to ISCO-88 and use ISCO-88 classification to construct occupation dummies

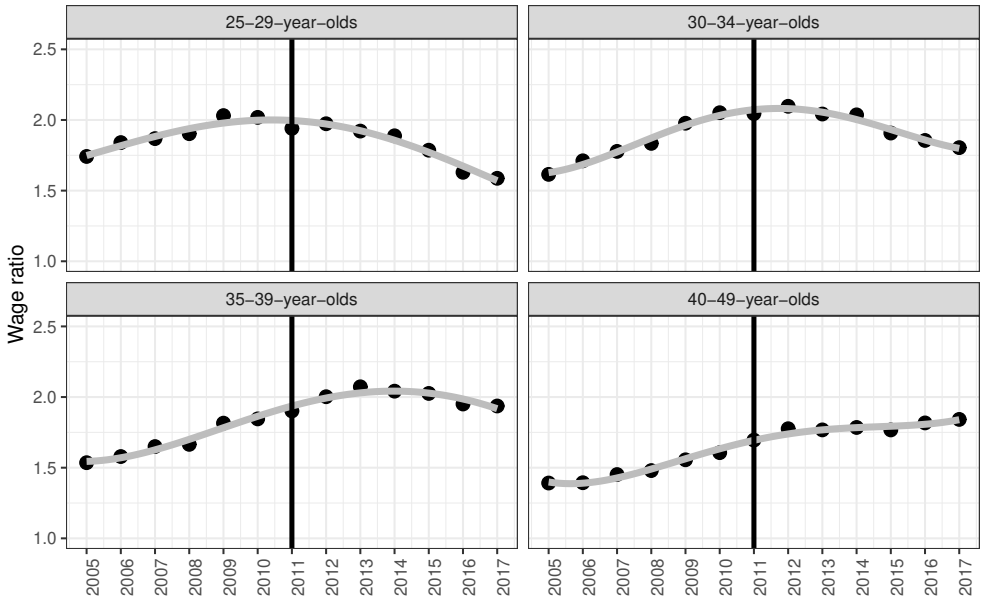


Figure 4: Evolution of college wage premium

Source: Authors' estimations using HLFS 2005-2017.
Notes: The wage ratio for each year gives the ratio of average hourly wages for university graduates to high school graduates for the age group given in each panel.The sample includes full-time paid employees with at least a high school degree observed in HLFS 2005-2017. The gray curves are the local linear fits to capture the time trend in the wage differentials.

high school and college graduates from pre and post-2011 waves. We observe that the spread of the real wages remains relatively the same or slightly widens for college graduates, while it significantly narrows down for high school graduates in post-2011 for all age groups.

Table 3: Distributional evolution of wages by age group and educational attainment

Age group	Educational attainment	Time period	Mean	Median	q90/q10	q75/q25
25-29-year-olds	High school	Pre-expansion	2.041	1.771	3.028	1.717
		Post-expansion	2.397	2.173	2.562	1.584
	University	Pre-expansion	3.922	3.641	4.415	2.390
		Post-expansion	4.318	3.857	4.159	2.422
30-34-year-olds	High school	Pre-expansion	2.529	2.124	3.649	2.013
		Post-expansion	2.682	2.370	2.827	1.675
	University	Pre-expansion	4.748	4.641	3.640	1.908
		Post-expansion	5.254	5.119	3.854	2.118
35-39-year-olds	High school	Pre-expansion	3.052	2.693	3.929	2.295
		Post-expansion	2.981	2.582	3.197	1.821
	University	Pre-expansion	5.305	5.190	2.909	1.679
		Post-expansion	5.905	6.495	3.339	
40-49-year-olds	High school	Pre-expansion	3.622	3.544	3.931	2.091
		Post-expansion	3.663	3.261	3.644	2.288
	University	Pre-expansion	5.550	5.341	2.477	1.576
		Post-expansion	6.567	6.448	2.706	1.571

Notes: Authors' calculations using 2005-2017 HLFS.

To construct our key variable, the measure of exposure to expansion policy in a given region and year, we collect data on the number of available slots in four-year higher education programs and the population of 18-year-olds. We define the measure of exposure as the increase in available slots divided by the 18-year-old population where the former captures the supply-side variations and the latter represent the demand changes in higher education. We use the online almanacs of the OSYM to obtain the data on the

available slots. Each year OSYM publishes data on the number of available slots in all programs (majors) in all universities. We collected and digitalized the data for the 2005-2012 period. The location identifiers (Province (NUTS-3), and NUTS-2 regions) of each university are also known. We aggregate the available slots at the NUTS-2 level to merge with our HLFS data and for each year we subtract the base number of slots in 2005 (before the expansion policy) to define the increase in the stock of educational opportunities with the intervention.

We obtain the population data of 18-year-olds at the province level from the Address Based Population Registry System of Turkstat, available since 2007. We aggregate the 18-year-old population information in 2007-2012, at the NUTS-2 level to merge with our available slots data. The number of 18-year-olds represents the size of the population that benefits from the higher education opportunities in a particular region since an individual is typically 18-year-old when he graduates from high school. We use the number of 18-year-olds to normalize the available slots in order to control for any scale differences across regions.

Our final variable to measure the level of exposure to the reform is the increase in the available slots (compared to the base year 2005) per 18-year-old population. Since the reform was initiated in 2006, exposure is zero in the earlier years, as done in the earlier studies in the literature (Duflo, 2001; Berlinski, Galiani, and Gertler, 2009). We refer to these years as the pre-expansion years in the rest of the paper.

The individuals enrolled in higher education programs are expected to participate in the labor market five years later than their enrollment (Valero and Van Reenen, 2019). Hence, we measure the level of exposure of an individual who participates in a local labor market by the increase in available slots relative to the number of slots in 2005 (before expansion), normalized by the 18-year-old population in the same region, five years before the year that the individual is observed in the HLFS. In other words, we lag our exposure measure by five years to evaluate its impact on the labor market when the students who benefit from the exposure actually enter the labor market. This approach, similar to Fortin (2006), allows us to exclude the concerns on the migration of skilled labor to the region to benefit from higher returns to education. Our exposure measure is calculated using data on the number of slots from 2007-2012, associated with the labor markets in 2012-2017. As discussed above, in the definition of *exposure*, the increase in slots is normalized by the population of 18-year-olds to control for the scale differences across regions. Thus, for example, for an individual observed in the 2015 survey living in Konya region, exposure is measured as the increase in available slots from 2005 (the year that the expansion policy was initiated) to 2010 in Konya region, divided by the number of 18-year-olds in 2010 in Konya region.

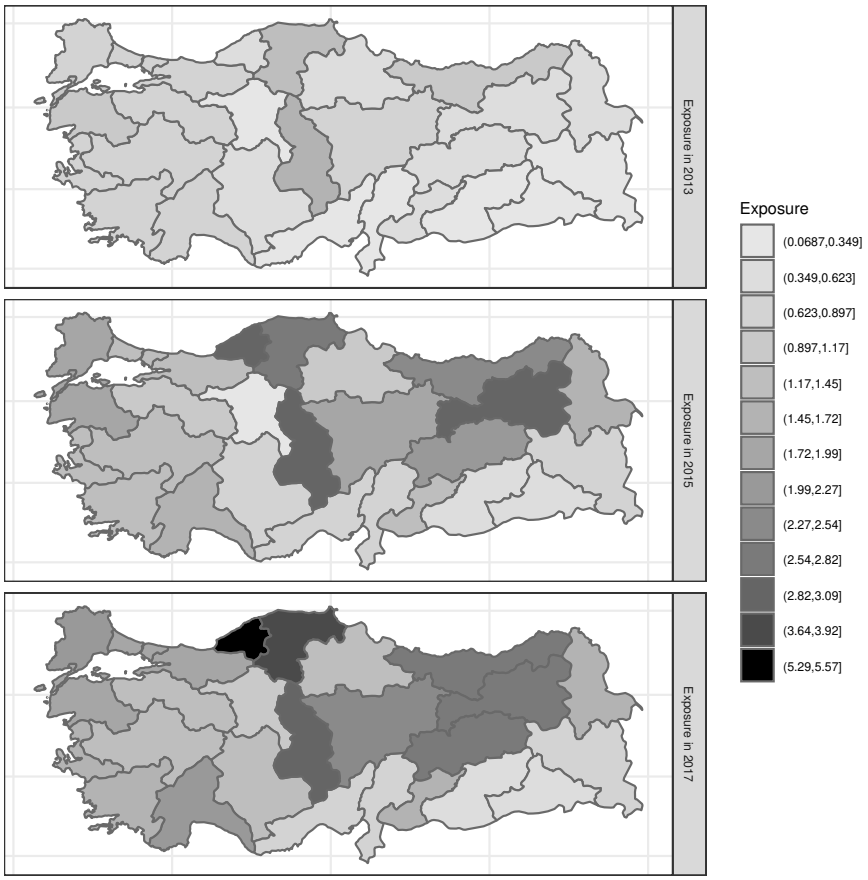
Figure 5 depicts a detailed demonstration of the evolution of the expansion's spatial distribution over time in 2013, 2015, and 2017 (5 years lagged) and provides evidence on the idiosyncratic nature of the expansion policy. Figure shows that exposure has significantly varied over time, as well as across regions. Some regions started with a much higher exposure than others in the early years of the expansion. There are several regions with low exposure at the beginning of the expansion, but reached the highest exposure in the later years of the expansion, and vice versa. In other words, the expansion did not proceed at a uniform pace across regions.

We use the 2005-2017 waves of HLFS to estimate our main regressions. We also make use the 2005 wave of the HLFS (2005) to show that the intervention to higher education is exogenous to pre-existing trends in the labor market.

5 Empirical strategy

Our main aim is to identify how the expansion policy affects the additional wage enjoyed by college graduates compared to high school graduates in the local labor markets. The local labor market is determined

Figure 5: The spatial distribution of exposure across years.



Source: OSYM Almanacs and TurkStat Adress Based Population Registry System.
Notes: Authors' calculations. Exposure for the year t is measured by the increase in available slots per 18-year-olds in the year $t-5$.

by the region of residence of the individual in the year an individual is observed with a wage. In other words, year and region jointly determine the local labor market that an individual participates in and also the level of exposure to the expansion policy.

We identify the causal impact of the reform by exploiting the spatial and temporal variations in the exposure level. Our empirical approach is similar to Card (1992), Duflo (2001), Berlinski, Galiani, and Gertler (2009), and Müller and Wrohlich (2020).

We introduce a generalized regression framework of the identification with the following equation:

$$log(w_{irt}) = \beta_1 h_{irt} + \beta_2 s_{rt} + \beta_3 h_{irt} \times s_{rt} + \alpha_0 + X_{irt}\alpha_1 + \gamma_r + \mu_t + \epsilon_{irt} \tag{1}$$

where w_{irt} represents our dependent variable, wage rate of individual i living in region r and observed in year t, and s_{rt} represents our explanatory variable of interest, exposure to treatment in region r and year t, defined as the increase in the higher education slots in region r and year t-5 compared to the pre-expansion year 2005. The variable h_{irt} is a binary indicator whether the individual is a college graduate or not. The interaction of h_{irt} and s_{rt} aims to account for possible differential effect of the expansion on high school versus college graduates. X_{irt} represents individual-level controls introduced in a classical Mincer Model. The inclusion of region effects, γ_r control for time-invariant unobserved regional differences which could impact our dependent variable. The year fixed effects, μ_t capture any time-related differences observed

in the dependent variable at the country-level. By the inclusion of two-way fixed effects, our parameter of interest β_3 captures the correlation between the exposure to reform and within region variations over time in the differential wage of college graduates. Therefore, our estimates for β_3 can be interpreted as the causal effect of the expansion policy on the returns to a college education.

The vector of individual controls consists of potential experience, captured by age, age squared and firm tenure. In some specifications we additionally control the occupation and workplace characteristics to check the robustness of our results.

We estimate the equation (1) separately for the age groups 25-29, 30-34, 35-39, and 40-49. The error term ϵ_{irt} captures the impact of individual-specific idiosyncrasies that influence the dependent variable. We calculate standard errors in three ways, following different strands in the literature. First, we cluster errors at the region level by following Abadie et al. (2017), that suggest the standard errors should be clustered at the level that treatment is clustered. In our study, the expansion policy (i.e., our treatment variable) is determined at the region level. Hence, we first estimate the standard errors by allowing within-region correlation. Second, we cluster errors at the year of birth level following Bertrand, Duflo, and Mullainathan (2004), who suggest that clustering should be performed to capture time-trend related autocorrelation in the sample. Since consecutive waves of the HLFS include individuals born in the same year who were probably observed in the labor market in the same year, their wages may be correlated, leading to serial autocorrelation in the data. To account for that, we allow the errors to be correlated among those born in the same year. Finally, we combine these two approaches and cluster standard errors at the region$\times$year of birth level. In the rest of the paper, we only report the standard errors clustered at the region level since it gives the largest standard errors.

5.1 Sample

We use micro-data from the 2005-2017 waves of HLFS to construct our sample. The year 2006 is considered to be the transition year to the expansion policy. Hence, we exclude five years posterior to this transition year, i.e., year 2011, from the sample to reduce the fuzziness in the treatment status. Therefore, our sample includes individuals observed in the six waves (2005-2010) that belong to the pre-expansion period and six waves (2012-2017) in the post-expansion period. We avoid extending the time window around the transition years beyond six years with the concern of maintaining exogeneity of the reform to demand and also to exclude the impact of longer-term macroeconomic fluctuations[8] on the labor market. We trim down the time window and construct narrower alternative samples with 4 and 3 years around the policy transition years, to control the robustness of our results by excluding possible impacts of the political events[9] and other policy interventions occurred in 2016 on the labor market[10]

We further restrict the sample to those working full-time, i.e., working at least 30 hours a week by following the earlier literature (Aydemir and M. Kirdar, 2017; Kawaguchi and Mori, 2016), with a wage, since the wage information is not available for employers, or self-employed.

Next, we restrict our sample to those who completed at least secondary education (graduated from high school) for two reasons: First, secondary education graduates are the ones who have the minimum qualification to attend higher education and so they are the primary target of the expansion policy. Second, we aim to compare college graduates with high school graduates instead of with all individuals who may have many different educational qualifications C. Goldin and Katz (2007). Still, we control the robustness

[8] Turkey went into recession at the end of 2018 according to official statistics published by Turkstat (2019).

[9] Due to the coup attempt in 2016, a state of emergency was declared in the country. Many people with the suspicion of being related to the parties organizing the failing coup attempt were dismissed from their jobs with a series of decree laws.

[10] At the end of 2015, the governing party has increased the minimum wage by around 30% as a part of their general election promises. The result of such a large increase in the minimum wage on the wage differentials is not very clear since most high school graduates are paid with minimum wage according to statistics derived from 2015 HLFS.

of our results by focusing on the sample of all education levels and comparing the wage differentials of college graduates to the rest of the labor market. Our results on the larger sample, though not presented here, are available upon request.

We further restrict our sample to males aged 25-49. Females are excluded to avoid bias in the sample due to the self-selection of women into employment.[11]. Individuals younger than 25 are excluded to avoid selection due to those who did not complete their educational attainment yet, and those who are 50 and above are excluded to avoid sample selection due to those who retire early, especially in the early years of our sample.

Finally, we divide our sample into several subsamples by the age-group since, first, individuals from distinct age profiles may not be close substitutes of each other in the labor market (Card and Lemieux, 2001), and second, the channels at work might differ across our subsamples. The experiences of older and younger workers may exhibit large differences, especially as the age-gap increases, that could lead to heterogeneous impacts of the expansion policy on different age-groups. Moreover, as explained in the conceptual framework, younger workers are affected by the reform via two possible channels (productivity and labor market equilibrium channel), whereas older workers are affected only through the higher number of younger graduates in the labor market (labor market equilibrium channel). Although we separately analyze several age groups, our primary sample of interest is 25-29-year-old men in this study. Similar to our sample of interest, we explore the impact on the other age groups to provide evidence on the full picture of how the expansion alters the labor market outcomes of college graduates in the labor market.

6 Identification

In this section, we first verify the validity of our identification strategy by providing evidence on exogeneity of the expansion policy to the education and labor market outcomes prior to the reform. Then, we conduct a regression analysis to show the impact of the expansion policy on the share of college graduates.

6.1 Exogeneity of expansion

In estimating the impact of an expansion policy on labor market outcomes, researchers face the problem of identifying the effects of a compensatory intervention or an intervention that targets the areas that are already improving their labor market outcomes. To address this concern, we investigate whether the expansion is correlated with the average education and labor market outcomes of individuals in ages 25-64 with at least secondary education attainment, i.e., our sample of interest at the regional level prior to the expansion. First, we calculate the higher education attainment among those with at least high school education in 2005 Turkish HLFS across regions. Next, we introduce mean employment, unemployment, informal employment, and average hourly wages in the same sample. Finally, we introduce the gross domestic product (GDP) per capita in 2005, using the data published by Turkstat, across regions. We show in Table 4 that the increase in available slots per 18-year-olds (exposure) in 2013, 2015, and 2017 is not correlated with any of these variables observed in the pre-expansion year 2005[12].

[11] Female labor force participation rate in Turkey, at 28.9 percent, is the lowest among OECD countries and the 22^{nd} lowest in the world (Bank, 2020)

[12] We also experiment with the same explanatory variables calculated for ages 25-34, 25-39, and 25-49 and confirm that the results are similar to the ones presented in Table 4

Table 4: The exogeneity of expansion policy

Dependent variable:	Exposure in 2012	Exposure in 2013	Exposure in 2014	Exposure in 2015	Exposure in 2016	Exposure in 2017
Higher education attainment of aged 25-34	1.227	5.424**	5.365	3.473	3.663	6.909
	(1.876)	(2.172)	(3.519)	(5.725)	(6.422)	7.947
Higher education attainment of aged 25-44	1.074	6.431**	6.841	4.967	5.278	9.422
	(2.148)	(2.452)	(3.965)	(6.502)	(7.296)	9.004
Higher education attainment of aged 25-64	0.766	4.809*	4.098	0.832	0.638	4.590
	(2.196)	(2.66)	(4.204)	(6.707)	(7.519)	9.341
Number of universities per 18-year-old	-3.885	2.929	6.205	7.581	11.064	9.535
	(2.23)	(2.99)	(4.431)	(7.046)	(7.764)	9.905
Number of public universities per 18-year-old	-2.337	0.63	1.209	-1.485	0.252	0.821
	(1.514)	(2.04)	(3.08)	(4.827)	(5.421)	6.766
Number of available slots per 18-year-old	-1.933***	0.285	1.416	1.199	1.507	1.393
	(0.467)	(0.786)	(1.156)	(1.848)	(2.067)	2.593
Number of available public slots per 18-year-old	-1.687***	0.148	0.991	0.438	0.715	0.785
	(0.436)	(0.715)	(1.063)	(1.692)	(1.893)	2.365
Gross domestic product per capita	3.051	20.637	10.098	-28.27	-21.062	-5.280
	(15.426)	(19.437)	(29.991)	(46.698)	(52.564)	65.831
Unemployment among working age population	-0.121	-2.19	-4.436	-7.267*	-7.883	-8.410
	(1.434)	(1.792)	(2.641)	(4.111)	(4.627)	(5.870)
Unemployment among aged 25-34	0.028	-1.721	-3.222	-4.61	-5.32	-5.323
	(1.354)	(1.708)	(2.553)	(4.018)	(4.496)	(5.671)
Unemployment among at least high school graduates	0.215	-0.505	-1.673	-2.689	-2.532	-1.907
	(1.512)	(1.946)	(2.925)	(4.577)	(5.141)	(6.439)
Unemployment among at least college graduates	-0.206	-1.134	-2.421	-3.788	-2.603	-1.028
	(1.936)	(2.484)	(3.739)	(5.852)	(6.595)	(8.258)
Labor productivity in industry sector	-19.135	5.056	12.402	-15.907	-21.933	-24.397
	(12.555)	(16.907)	(25.478)	(39.943)	(44.694)	(55.854)
Labor productivity in all sectors	4.81	13.824	8.251	-7.666	-10.017	-5.415
	(7.455)	(9.266)	(14.544)	(22.864)	(25.605)	(32.048)

Notes: A constant is included as a control variable. The standard errors are given in parentheses.*p<0.1 **p<0.05 ***p<0.01.

6.2 The expansion policy on the share of college graduates

The increase in the share of college graduates observed in the recent years is associated with the large-scale expansion policy. In Turkey, the share of individuals in ages 25-29 with a higher education degree was 15 percent in 2008, varying substantially across regions from 8 to 24 percent. After the expansion, the percentage of college graduates among 25-29-year-olds rose to 25 in 2013 and 36 in 2017. When we compare year 2010, five years into the expansion, with the final year of our sample, 2017, we observe that the increase in the share of college graduates among 25-29-year-olds is around 17-24 percentage points in all regions.

In our empirical strategy, we assume that the slots introduced in higher education shaped the local labor market five years later. This assumption would not be valid if, first, the additional slots did not translate into college graduates, or second, if the increase in the share of college graduates were not a result of the reform. Here, we check the validity of this assumption by identifying the impact of the expansion on the share of college graduates.

We conduct a regression analysis by exploiting the variations in the level of exposure across regions and years using the following equation:

$$c_{rt} = \theta_1 s_{rt} + \theta_2 x_{rt} + \gamma_r + \mu_t + \nu_{rt} \tag{2}$$

where c_{rt} is the share of college graduates in region r and year t, s_{rt} is the exposure, the increase in available slots per 18-year-old five years before t, and x_{rt} is the vector of control variables that includes a constant and the number of 18-year-olds. The inclusion of region fixed effects allows us to control for time-invariant regional differences correlated with the share of college graduates. Year fixed effects capture any time-related differences observed in the dependent variable at the country-level. Hence the coefficient θ_1 of the

exposure variable captures the correlation between the share of college graduates and the exposure to the reform, which varies by region and year; and can be interpreted as the causal impact of the expansion policy.

Table 5 present the estimation results of the equation (2) where the dependent variable is the share of college graduates among 25-29-year-olds in column (1), 30-34-year-olds in column (2),35-39-year-olds in column (3), and 40-49-year-olds in column (4). Our results suggest that a one-unit increase in the exposure significantly increases the share of college graduates by around 12 percentage points among 25-29-year-olds.

Table 5: The effect of expansion policy on the share of college graduates

Dependent var: Share of college grad. among	*22-24-year-olds*	*25-29-year-olds*	*30-34-year-olds*	*35-39-year-olds*	*40-49-year-olds*
Exposure	0.009*	0.012***	0.005	0.004	0.003
	(0.004)	(0.003)	(0.003)	(0.003)	(0.002)
Observations	234	234	234	234	234
Control for:					
18-year-old population	✓	✓	✓	✓	✓
Region effects	✓	✓	✓	✓	✓
Year effects	✓	✓	✓	✓	✓

Notes: The standard errors clustered at region level are given in parentheses.*p<0.1 **p<0.05 ***p<0.01.

Our findings indicate that older age groups are not likely to have benefited from the expansion. The increase in the share of college graduates in these groups, although estimated to be positive, is very small and not statistically significant. Note that the slight increase in the share of college graduates in the older age-groups in higher exposure regions might have resulted from the migration of high-skilled workers to the region to benefit from job creation in the region due to the establishment of new universities. To conclude, our results suggest that underlying regional trends in attaining a college degree that are systematically correlated with the expansion policy are not driving our results about the share of college graduates.

7 Results

7.1 The expansion policy on college wage premium

Prior to the expansion (2005-2010), the difference between the average earnings of high school and college graduates had been increasing over time so that by 2010 university graduates in ages 25-29 were paid about 109% more in an hour than high school graduates. This wage gap decreased in the post-expansion years (2012-2017) so that in 2017, young college graduates are paid only 63% more in hourly wages than high school graduates. In order to examine the impact of the expansion policy on wage differentials, we estimate the equation (1) and present our results in Table 6 for those aged 25-29, 30-34, 35-39, and 40-49.

The coefficient of the education dummy captures the mean college wage premium in the years where the exposure is zero, i.e., the pre-expansion years. Our baseline results given in the column (1) and (2) for the younger age group of 25-29 suggests that, after accounting for potential experience, time trend, region and year fixed effects, in the pre-expansion period, college graduate men earn about 61-62% more than their peers with at most high school degree, whereas this rate is 64-66% for aged 30-34, 58-59% for aged 35-39, and 45-47% for men aged 40-49.

The coefficient estimates of the interaction term *education*×*exposure* show the causal impact of the reform on college wage premium. The estimates are negative and strongly significant for men aged 25-29 in column (1), where we present our baseline results for the younger age group showed to be the compliers of the expansion policy. Specifically, the wage premium received by 25-29-year-olds decreased by 9% with a one-unit increase in the exposure. Since the mean exposure in the post expansion years was 1.00

Table 6: The effect of expansion policy on hourly wages

Ages:	**25-29**		**30-34**		**35-39**		**40-49**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Education	0.607***	0.619***	0.639***	0.661***	0.579***	0.589***	0.449***	0.470***
	(0.028)	(0.029)	(0.022)	(0.024)	(0.017)	(0.018)	(0.016)	(0.016)
Education×exposure	-0.087***	-0.078***	-0.039***	-0.030*	0.013	0.041***	0.022*	0.013
	(0.015)	(0.017)	(0.013)	(0.017)	(0.010)	(0.011)	(0.012)	(0.012)
Observations	60,202	41,409	62,768	43,158	52,612	35,422	75,325	50,171
Mean exposure in the post expansion years	1.000	0.739	1.028	0.746	1.074	0.773	1.071	0.768
Sample:	2005-2017	2007-2015	2005-2017	2007-2015	2005-2017	2007-2015	2005-2017	2007-2015

Notes: The dependent variable is the log of hourly wages. All regressions include controls for a constant, age and age squared, firm tenure, linear pre-trend, education dummy, continuous exposure variable, region fixed effects, and year fixed effects. The sample restricted to full-time paid employees with at least a high school degree observed in the sample of years given each column. The observations from year 2011 are excluded from all regressions. The standard errors clustered at region level are given in round parentheses with the patterns of p-values denoted by * for $p<0.1$, ** for $p<0.05$, and *** for $p<0.01$.

on average, the reform resulted in 9% fall in the college wage premium of 25-29-year-old men observed in post-expansion years. The exposure to the expansion varied between 0.37 and 5.56 across 26 NUTS-2 regions in the final year of our sample, 2017. Hence, our findings indicate that the wage advantage of 25-29-year-old college graduates fell by around 3-57% due to government's expanding educational opportunities. Narrowing down the sample to four years around the policy cutoff only slightly changes the estimates for our parameters of interest and keep the level of statistical significance the same.

Our estimates on the interaction term on the sample of older age groups show that the adverse effects of increasing the supply of skilled workers on wages are statistically significant only for men aged 30-34. On the other hand, the causal effect is statistically equivalent to zero for men aged 35-39, and we even observe a positive and weakly significant impact on 40-49-year-old men. Hence, the only negative impact on the relative wage advantage of college graduate men is shown for 30-34-year-olds, a sample that might include individuals exposed to the reform by starting their higher education in the transition years, or more close substitute to the younger skilled workers observed to be compliers of the policy. Even this impact is quite lower in magnitude than our results for 25-29-year-olds presented in the first two columns.

The older employees whose results are presented in columns (3)-(8) are expected to have started their higher education in 2007 or earlier, and therefore mostly not expected to be exposed to the expansion policy. Our findings on the statistically significant impact of the exposure on the wage advantages of college graduates aged 30-34, presented in Table 6, provide suggestive evidence that the labor market equilibrium channel is at work, and, therefore, increasing the supply of skilled workers slight diminishes the college wage premium of older workers not exposed to the policy.

Our findings on the higher negative impact of the expanding educational opportunities on the labor market advantage of younger college graduates compared to their high school graduate peers of the same age suggest that supply increase may not be the only driving mechanism for the fall in the college wage premium and the lower productivity of young college graduates might be another mechanism of lower premium for that age group. On the other hand, the channel of the supply increase is expected to lower the wages of all college graduates to varying degrees. However, one can also argue that since younger college graduates are not close substitutes for older college graduates and wage levels at entry to the labor market affect earnings over the life cycle, it is expected that that wages of older workers are not affected via the labor supply of young college graduates and thereby this finding does not entirely rule out the hypothesis that increase in labor supply may indeed decrease the college wage premium of young graduates.

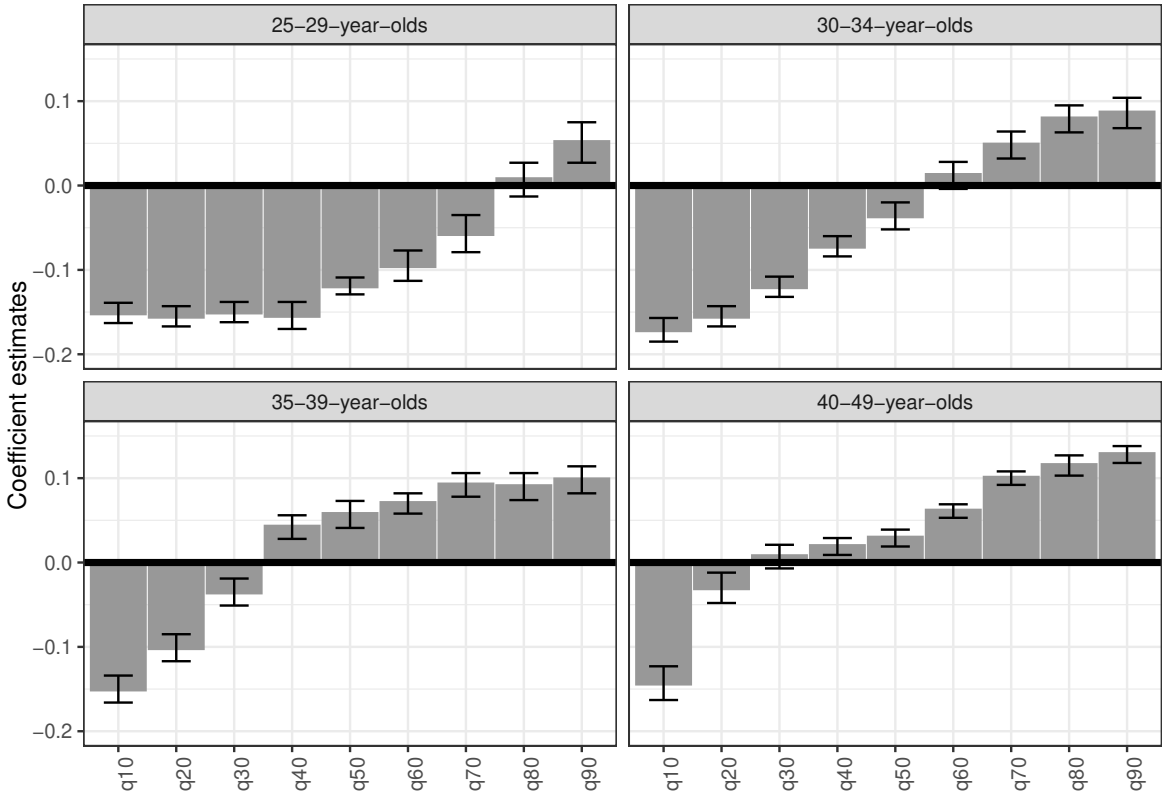
Hence, though our findings presented in this section confirms the existence of the labor market equilibrium channel, does not entirely confirm or rule out the hypothesis that expanding the educational oppor-

tunities with a sudden and not well-prepared policy leads to lower productivity for those benefited from these additional opportunities.

7.2 The effect of the expansion policy by quantile regression

In our conceptual framework, we conjecture that the fall in the college wage premium might result from either the increase in the supply of high-skilled labor beyond demand or the fall in the ability structure/value-added in higher education, or both. The lower productivity channel mostly affects the wages of those who attained education due to the additional educational opportunities. However, the effect of the expansion on the earnings of those who attained education in more prestigious universities is expected to be limited. Our sample consists of workers who attained education in well-established prestigious universities as well as those who studied in newly established universities with fewer educational resources. For this reason, we would expect a higher wage dispersion among younger college graduates if it is mainly the productivity channel that is driving our results (in Table 6). Here, we use quantile regression analysis to investigate whether the impact of the reform significantly varies along with the wage/ability distribution.

Figure 6: Distributional effects of expansion policy by unconditional quantile regression analysis



Source: HLFS 2005-2017, OSYM Almanacs and TurkStat Adress Based Population Registry System.
Notes: The dependent variable is the log of hourly wages. The points shows the coefficient estimate for the interaction of exposure with the binary education variable. All regressions include controls for a constant, age and age squared, firm tenure, linear pre-trend, education dummy, continuous exposure variable, region fixed effects, and year fixed effects. The sample restricted to full-time paid employees with at least a high school degree of aged given in each panel. The sample includes observations from 2005-2010 and 2012-2017 HLFS. The standard errors are bootstrapped and error bars shows the 95% confidence intervals of the coefficients.

We estimate the impact of the expansion policy on the wages of workers at different quantiles, by similarly controlling for potential experience, captured by age, age squared, and firm tenure variables, in

addition to region and year fixed effects. Figure 6 gives the coefficient estimates for the interaction term separately for each age group. Our findings indicate that the wage premium decreased significantly in all but the highest quantiles for the youngest age group exposed to the expansion policy. The impact of the reform is significantly less for higher ability individuals than lower abilities suggested by the lower coefficients in the lower tail of the wage distribution. However, the decline is slightly smaller than those in the lower tail. These findings provide suggestive evidence on that the fall in the ability of college entrants and lower value-added in the newly established universities are a driving force for the fall in the college wage premium.

Under the assumption that well-established universities do not suffer from quality of students and teaching faculty, if lower productivity is the only driving channel for the fall in the college wage premium, then we would not observe any fall in the highest quantiles, which consists of higher ability individuals who are more likely to attain their education in these universities. Hence, our finding that the exposure reduces the relative wage advantage of college graduate men in almost all quantiles of the wage distribution leads to two possible explanations: First, the lower productivity is the result of the expansion in all types of higher education institutions, i.e., there exists a fall in the ability structure of college entrants and/or quality of education even in the most prestigious universities. Second, the increase in the supply of high skilled workers beyond demand is the primary mechanism at work in reducing college wage premium. Even though we show that there is not any observable change, on average, in the teaching faculty in already existing universities (see Figure 2), it is not possible for us to detect whether the ability distribution of college students in these universities changed over time. (The university entrance exam results are not comparable across years since the score calculation rules and the difficulty of the questions may change from year to year.)

Our estimates on the youngest age group not exposed to the expansion policy (30-34) similarly show the adverse effects of expanding the supply of skilled workers on the relative wage advantage of college graduate men compared to their high school graduate peers at most quantiles. The adverse effects vanishes only on the upper tail of the wage distribution. Similarly, we find statistically significant negative impacts for the older age groups only on the lower tail of the wage distribution, and the effect of the expansion becomes positive and significant on the upper tail. A more striking feature deduced from our findings is that the magnitude of the negative impact we reported for the older groups in the lower tail is very close to our estimates on the impact on the youngest age group, suggesting that the compliers of the policy are only close substitutes to the workers in the lower tail of the wage distribution for the older age groups.

8 Robustness Checks

Here, we conduct three key robustness checks using different samples and specifications. In the first one, we explore the impact of the expansion policy by changing our definition of exposure. Next, we vary the time window around the policy cutoff, and then restrict the full sample to sub-samples by excluding the areas where the labor market might differ from the rest of the country. Finally, in the third one, we control for occupation and industry specifics of jobs to show whether the college wage premium can be partially explained by the segregation of workers by their level of education.

8.1 Alternative measure of exposure

Our measure of exposure relies on the increase in the available slots in both public and private universities. Here, to eliminate the concern that the available slots in private universities could be more demand-driven than those in public universities, we introduce an alternative measure of exposure, defined as the available

slots in public universities per 18-year-olds, called *public exposure*. We replicate our regression analysis by replacing the exposure variable with public exposure. Our results, given in the even columns of Table 7, show slightly smaller coefficient estimates (in magnitude) than our baseline results given in odd columns of Table 7, but with the same patterns of statistical significance.

Table 7: Robustness check with public exposure

Ages:	**25-29**		**30-34**		**35-39**		**40-49**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Education×exposure	-0.087***		-0.039***		0.013		0.022*	
	(0.015)		(0.013)		(0.010)		(0.012)	
Education×Public exposure		-0.083***		-0.037***		0.010		0.016
		(0.016)		(0.013)		(0.011)		(0.013)
Observations	60,202	60,202	62,768	62,768	52,612	52,612	75,325	75,325

Notes: The dependent variable is the log of hourly wages. All regressions include controls for a constant, age and age squared, firm tenure, linear pre-trend, education dummy, continuous exposure (public exposure) variable in odd columns (even columns), region fixed effects, and year fixed effects. The sample restricted to full-time paid employees with at least a high school degree observed in the waves 2005-2017. The observations from year 2011 are excluded from all regressions. The standard errors clustered at region level are given in round parentheses with the patterns of p-values denoted by * for p<0.1, ** for p<0.05, and *** for p<0.01. The p-values by wild-cluster bootstrapping are also given in the square brackets.

8.2 Alternative sample specifications

In Table 6 that presents our baseline results, we provide the estimates on the main sample that includes six years around the policy cutoff, and also on the narrower sample trimmed down the time window that includes four years around the policy year 2011 to exclude the possible impact of macroeconomic conditions and other policy interventions observed in the years that are of interest to us.

One possible concern one might consider is the effect of the coup attempt in 2016 on the labor market. Following the failing attempt, a state of emergency was declared in the country. Many people with the suspicion of being related to the parties organizing the coup attempt were dismissed from their jobs with a series of decree laws. To the best of the authors' knowledge, no study in the literature identifies the impact of the coup attempt on the labor market, if any. However, to eliminate the concern that it might shift the structure of our sample of interest, men, and women employed with an observable wage, we focus on the years prior to 2016, as an alternative sample specification.

On the other hand, one possible policy intervention that could deteriorate our results is the minimum wage hike in 2016. Turkey experienced a 33% increase in the minimum wage in January 2016, following the promise of the governing party in general election campaigns in 2015. Turkey has one of the highest minimum wage-to-average wage ratios among OECD countries (Işık, Orhangazi, and Tekgüç, 2020) making minimum wage an important determinant in the wage differentials. According to the findings of a recent study by Işık, Orhangazi, and Tekgüç (2020), there is no significant impact of the minimum wage hike on employment. However, a substantial positive impact on wages is identified that is also amplified with either education for the working-age population and age for the sample of all education levels. Even though their findings come short on answering whether the minimum wage jump increases or decreases the college wage premium of our sample of different age groups, it certainly signals some impact on the wage differentials. Hence, we aim to control whether our results remain the same in the sample of years prior to the government's minimum wage intervention beyond the current inflation rate.

Here, we focus on these two samples of interest, and further investigate whether our results are robust to restricting these sample geographically.

First, we consider the possible concern that our baseline results on the effect of the expansion policy on college wage premium would be different in the metropolitan areas than in the rest of the country. Between

2005 and 2010, referred to as pre-expansion years in our sample, among 25-29-year-olds with secondary education attainment, the share of college graduates was 50% in the three largest cities, namely Ankara, Istanbul, and Izmir, while it was 43% in the rest of the country. In addition to that, in the three largest cities, college graduates earned 98% more on average than high school graduates, while they only earned 80% more in the other cities. Hence, one could argue that the effects of the increase in the available slots would be stronger in the smaller cities due to lower college wage premium observed prior to the expansion. We exclude the three largest cities, restrict our sample to *smaller cities*, and examine the impact of the expansion in this sample.

Another concern about our baseline analysis may be that Turkey was the largest recipient of Syrian migrants displaced due to the Syrian civil war, hosting the highest number of refugees in the world since 2015. The number of registered Syrians rose to 2.5 million or 3.2% of the native population in 2015. The earlier literature examines the impact of this massive influx of Syrian migrants on the labor market outcomes of the natives by exploiting the variations in the share of migrants among the native population across NUTS-2 regions (Ceritoglu et al., 2017; Del Carpio and Wagner, 2015; Aksu, Erzan, and Kırdar, 2018a). Aksu, Erzan, and Kırdar (2018b), the study using the most recent datasets shows that the total employment of women decreased with the arrival of Syrian refugees. Hence, one could argue that this could affect our estimation results, especially for women, by changing the structure of our sample of full-time paid employees. On the other hand, due to the need for social assistance in the regions with higher share of Syrian migrants, the demand for high skilled workers might increase leading to a higher college wage premium in those regions. To avoid these concerns, we exclude the five regions with the highest share of Syrian refugees over time; in other words the regions that were identified as treated regions in Aksu, Erzan, and Kırdar (2018b)[13], and replicate our estimations for this sample, called *low refugee cities*.

Table 8: Robustness check with alternative sample specifications

Ages:	**25-29**		**30-34**		**35-39**		**40-49**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Full sample	-0.087***	-0.078***	-0.039***	-0.030*	0.013	0.041***	0.022*	0.013
	(0.015)	(0.017)	(0.013)	(0.017)	(0.010)	(0.011)	(0.012)	(0.012)
Observations	60,202	41,409	62,768	43,158	52,612	35,422	75,325	50,171
Smaller cities	-0.085***	-0.074***	-0.045***	-0.031	0.009	0.037***	0.023*	0.013
	(0.018)	(0.022)	(0.013)	(0.019)	(0.011)	(0.011)	(0.013)	(0.012)
Observations	42,841	29,242	45,241	30,855	39,001	25,961	56,592	50,171
Low refugee cities	-0.076***	-0.069***	-0.029**	-0.022	0.018	0.049***	0.022*	0.013
	(0.013)	(0.017)	(0.012)	(0.018)	(0.011)	(0.012)	(0.012)	(0.012)
Observations	52,223	35,983	54,715	37,626	45,858	30,896	65,744	50,171
Sample:	2005-2017	2007-2015	2005-2017	2007-2015	2005-2017	2007-2015	2005-2017	2007-2015

Notes: The dependent variable is the log of hourly wages. All regressions include controls for a constant, age and age squared, firm tenure, linear pre-trend, education dummy, continuous exposure variable, region fixed effects, and year fixed effects. The sample restricted to full-time paid employees with at least a high school degree observed in the waves 2005-2017. The observations from year 2011 are excluded from all regressions. The standard errors clustered at region level are given in round parentheses with the patterns of p-values denoted by * for p<0.1, ** for p<0.05, and *** for p<0.01.

Table 8 present our baseline results on the full sample in the first panel, on the smaller cities sample in the second panel, and finally on low refugee cities in the third panel.

First, we point out that the estimated effect of the reform on the college premium in men's wages is very similar in the samples including different time windows around the policy cutoff. The similar coefficients for men observed in years 2005-2017 and 2007-2015 suggest that the fall in the college wage premium of younger men cannot only be explained by the minimum wage increase. Therefore, we observe a reduced wage premium even in the absence of the minimum wage hike. The larger decline in the premium in the

[13]By Aksu, Erzan, and Kırdar (2018b), the regions with the highest share of Syrian refugees ranked by their share are Gaziantep (TRC1), Hatay (TR63), Sanliurfa (TRC2), Adana (TR62), and Mardin (TRC3).

wider time windows could be due to either the increasing effect of the expansion over the years or the effect of the minimum wage increase experienced in the later years.

In the second panel, where we present our results for the sample of smaller cities, we observe that the causal impact is statistically significant for younger men, with more mixed results for the older workers. Our main findings on the causal impact of the reform on college wage premium of aged 25-29 and 30-34 are robust to restricting the sample to smaller cities.

Finally, in the third panel, where we check the robustness of our results to restricting the sample to low refugee regions, we observe that the adverse effects are lower in the low refugee cities compared to our baseline results on the full sample.

8.3 Controlling for job and workplace characteristics

Skill biased technological change is described as the shift in the production technology that favors skilled over unskilled labor by increasing its relative productivity. This demand shift could lead to the polarization of college graduates into some occupations and industries. Here, we investigate whether our results change once we control for job and workplace characteristics, which could be closely related to the labor demand variations, by including first the occupation dummies in the second panel, next, the industry dummies in the third panel, and finally, both for occupation and industry dummies in the fourth panel of Table 9. We also present our baseline analysis in the first panel for easy reference. We observe that the coefficient estimates are relatively smaller than baseline analysis once we include the additional controls, which suggests that part of the wage differentials between college and high school graduates could result from the segregation of paid employees into occupations and industries by their level of education. The change induced by controlling for industries is more sizable. Notwithstanding, the fall in the college wage premium due to the reform is statistically significant for all age groups after controlling for job and workplace characteristics.

Table 9: Robustness check with occupation and workplace controls

Ages:	**25-29**		**30-34**		**35-39**		**40-49**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Baseline results	-0.087***	-0.078***	-0.039***	-0.030*	0.013	0.041***	0.022*	0.013
	(0.015)	(0.017)	(0.013)	(0.017)	(0.010)	(0.011)	(0.012)	(0.012)
Observations	60,202	41,409	62,768	43,158	52,612	35,422	75,325	50,171
Occupation controls	-0.058***	-0.052***	-0.020*	-0.013	-0.001	0.019*	0.023**	0.014
	(0.012)	(0.014)	(0.010)	(0.015)	(0.009)	(0.011)	(0.010)	(0.012)
Observations	60,202	41,409	62,768	43,158	52,612	35,422	75,325	50,171
Industry controls	-0.067***	-0.059***	-0.038***	-0.026*	-0.005	0.015	0.007	-0.003
	(0.010)	(0.015)	(0.009)	(0.013)	(0.008)	(0.010)	(0.008)	(0.010)
Observations	60,202	41,409	62,768	43,158	52,612	35,422	75,325	50,171
Occupation and industry	-0.055***	-0.047***	-0.025***	-0.014	-0.015**	0.002	0.010	0.001
	(0.009)	(0.012)	(0.008)	(0.012)	(0.007)	(0.009)	(0.008)	(0.010)
Observations	60,202	41,409	62,768	43,158	52,612	35,422	75,325	50,171
Sample:	2005-2017	2007-2015	2005-2017	2007-2015	2005-2017	2007-2015	2005-2017	2007-2015

Notes: The dependent variable is the log of hourly wages. All regressions include controls for a constant, age and age squared, firm tenure, linear pre-trend, education dummy, continuous exposure variable, region fixed effects, and year fixed effects. The sample restricted to full-time paid employees with at least a high school degree observed in the waves 2005-2017. The observations from year 2011 are excluded from all regressions. The standard errors clustered at region level are given in round parentheses with the patterns of p-values denoted by * for $p<0.1$, ** for $p<0.05$, and *** for $p<0.01$.

Many studies in the literature point out the labor market institutions, such as the unionization, firing, and minimum wage regulations, as important contributors to the educational wage differentials (Lee, 1999; Koeniger, Leonardi, and Nunziata, 2007). The effect of the reform might differ for the workers employed

in the private and public sector since the payment arrangements are more centralized in the public sector and the labor market institutions are more effective than the private sector, whose equilibrium dynamics are closer to the free market (Grimshaw, 2000).

The information on the public or private sector employment of individuals is available in HLFS starting from 2009. Hence, we exclude the years before 2009 and re-estimate the impact of the reform with public and private sector controls to capture the variations in the educational wage differentials due to the sector of employment. Table 10 gives the replication of baseline analysis for the restricted sample in odd columns, by controlling public sector and private sector employment dummies in columns even columns. The causal impact of the reform is negative and significant for men in all columns, except for the sixth one, which suggests the additional controls does not change the qualitative power of our results.

Table 10: Robustness check with sector controls

Ages:	**25-29**		**30-34**		**35-39**		**40-49**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Education×exposure	-0.093***	-0.072***	-0.062***	-0.042***	-0.017	0.015	-0.010	-0.015
	(0.017)	(0.013)	(0.013)	(0.012)	(0.010)	(0.010)	(0.011)	(0.012)
Observations	40,528	31,269	45,699	34,083	39,785	28,790	54,221	39,553
Control for:								
Sector dummies	✗	✓	✗	✓	✗	✓	✗	✓

Notes: The dependent variable is the log of hourly wages. All regressions include controls for a constant, age and age squared, firm tenure, linear pre-trend, education dummy, continuous exposure variable, region fixed effects, and year fixed effects. The sample restricted to full-time paid employees with at least a high school degree observed in the waves 2009-2017. The observations from year 2011 are excluded from all regressions. The standard errors clustered at region level are given in round parentheses with the patterns of p-values denoted by * for p<0.1, ** for p<0.05, and *** for p<0.01.

9 Conclusion

Many countries experienced inflation in the number of college graduates at varying times in different countries, which has led to dramatic changes in the labor market structure all around the world. While an increasing wage dispersion between college and high school graduates documented in the US (Bound and Johnson, 1995; Katz and Murphy, 1992), flatter educational wage differentials are observed in European countries as the supply of college graduates expanded gradually.

Earlier studies established the relation of wage differentials with demand increase -due to skill-biased technological change- and labor market institutions in the age of rapid increase of college graduates. However, the impact of supply increase on the college wage premium, the additional wage enjoyed by college graduates compared to their high school graduate peers got very little attention, partly because establishing a causal link between supply and wage differentials is hard to investigate owing to data limitations. The higher education expansion in Turkey provides an excellent case to identify the role of the supply increase in the educational wage differentials.

The country experienced a politically driven higher education expansion occurred by the establishment of new universities all around the country, and the increase in educational opportunities in all higher education institutions. It has experienced a fall in the college wage premium of young adults parallel to the entering of young college graduates exposed to the expansion to the labor market. The aim of this paper is to address this recent fall in the college wage premium. In doing so, we investigate the role of the recent higher education expansion policy, exogeneous to existing labor market conditions and macroeconomic conditions, on the fall in the college wage premium of young adults.

Our findings indicate a significant fall in both college wage premium of 25-29-year-old men, exposed to the expansion, by 9%. We conjecture that this fall could be attributed to either the fall in the productivity

of college graduates who attained their education in the post-expansion period, or the sudden jump in the number of college graduates, or both.

We further investigate the causal effect of the expansion on the wage premiums of the older age groups in order to determine if the rise in the supply of skilled worker is a mechanism driving our results for the younger workers. These employees were not expected to have lower productivity in the post expansion years since their human capital accumulation occurs prior to the establishment of new universities and expanding the educational opportunities in the existing universities. Because younger and older graduates are not close substitutes for one another, given their varied experience profiles in the labor market, we only anticipate labor market equilibrium impacts for these cohorts, and even then, these benefits are probably going to be minimal. Our findings on the higher fall in the college wage premium of young workers in the lower tail of the wage distribution compared to those in the higher tail provide suggestive evidence that the lower productivity of young workers is a driving force for the lower labor market advantage enjoyed by college graduate youth.

Our investigation on whether the supply increase is a contributing factor for the fall in the college wage premium is not conclusive, since the expansion does not lower the wage premium of older college graduates who are not subject to the expansion. These findings could be due to either young graduates not being a close substitute for older workers in the labor market due to their differentiating experience profiles, or insignificant impact of the sudden supply increase.

References

Abadie, Alberto et al. (2017). "When should you adjust standard errors for clustering?" National Bureau of Economic Research.

Aksu, Ege, Refik Erzan, and Murat Güray Kırdar (2018a). *The impact of mass migration of syrians on the turkish labor market*. Tech. rep. Working Paper.

— (2018b). *The impact of mass migration of syrians on the turkish labor market*. Tech. rep. Working Paper.

Angrist, Joshua D and Alan B Keueger (1991). "Does compulsory school attendance affect schooling and earnings?" In: *The Quarterly Journal of Economics* 106.4, pp. 979–1014.

Arap, Kavili Sultan (2010). "Türkiye yeni üniversitelerine kavuşurken: Türkiye'de yeni üniversiteler ve kuruluş gerekçeleri". In: *Ankara Üniversitesi SBF Dergisi* 65.3, pp. 001–029.

Aydemir, Abdurrahman and Murat Kirdar (2017). "Low wage returns to schooling in a developing country: Evidence from a major policy reform in Turkey". In: *Oxford Bulletin of Economics and Statistics* 79.6, pp. 1046–1086.

Aydemir, Abdurrahman and Murat G Kirdar (2017). "Low wage returns to schooling in a developing country: Evidence from a major policy reform in Turkey". In: *Oxford Bulletin of Economics and Statistics* 79.6, pp. 1046–1086.

Bank, World (2020). *Labor force participation rate*. URL: https://data.worldbank.org/indicator/SL.TLF.ACTI.FE.ZS. (accessed: January 2020).

Berlinski, Samuel, Sebastian Galiani, and Paul Gertler (2009). "The effect of pre-primary education on primary school performance". In: *Journal of public Economics* 93.1-2, pp. 219–234.

Bertrand, Marianne, Esther Duflo, and Sendhil Mullainathan (2004). "How much should we trust differences-in-differences estimates?" In: *The Quarterly journal of economics* 119.1, pp. 249–275.

Bound, John and George Johnson (1995). "What are the causes of rising wage inequality in the United States?" In: *Economic Policy Review* 1.1.

Bound, John, Michael F Lovenheim, and Sarah Turner (2010). "Why have college completion rates declined? An analysis of changing student preparation and collegiate resources". In: *American Economic Journal: Applied Economics* 2.3, pp. 129–57.

Card, David (1992). "Using regional variation in wages to measure the effects of the federal minimum wage". In: *ILR Review* 46.1, pp. 22–37.

Card, David and John E DiNardo (2002). "Skill-biased technological change and rising wage inequality: Some problems and puzzles". In: *Journal of labor economics* 20.4, pp. 733–783.

Card, David and Thomas Lemieux (2001). "Can falling supply explain the rising return to college for younger men? A cohort-based analysis". In: *The Quarterly Journal of Economics* 116.2, pp. 705–746.

Ceritoglu, Evren et al. (2017). "The impact of Syrian refugees on natives' labor market outcomes in Turkey: evidence from a quasi-experimental design". In: *IZA Journal of Labor Policy* 6.1, p. 5.

Crivellaro, E (2014). *College wage premium over time: trends in Europe in the last 15 years, University of Venice*. Tech. rep. Department of Economics Working Paper 03.

Del Carpio, Ximena V and Mathis Wagner (2015). *The impact of Syrians refugees on the Turkish labor market*. The World Bank.

Development, Ministry of (2013). "Public investment". Ministry of Development, Ankara.

Devereux, Paul J and Wen Fan (2011). "Earnings returns to the British education expansion". In: *Economics of Education Review* 30.6, pp. 1153–1166.

Devereux, Paul J and Robert A Hart (2010). "Forced to be rich? Returns to compulsory schooling in Britain". In: *The Economic Journal* 120.549, pp. 1345–1364.

Duflo, Esther (2001). "Schooling and labor market consequences of school construction in Indonesia: Evidence from an unusual policy experiment". In: *American economic review* 91.4, pp. 795–813.

Eren, Okan et al. (2018). *Evolution of the University Wage Premium in Turkey: 2004-2015*. Tech. rep.

Fortin, Nicole M (2006). "Higher-education policies and the college wage premium: Cross-state evidence from the 1990s". In: *American Economic Review* 96.4, pp. 959–987.

Goldin, Claudia and Lawrence F Katz (2007). *Long-run changes in the US wage structure: Narrowing, widening, polarizing*. Tech. rep. National Bureau of Economic Research.

Goldin, Claudia Dale and Lawrence F Katz (2009). *The race between education and technology*. harvard university press.

Grimshaw, Damian (2000). "Public sector employment, wage inequality and the gender pay ratio in the UK". In: *International Review of Applied Economics* 14.4, pp. 427–448.

Harmon, Colm and Ian Walker (1995). "Estimates of the economic return to schooling for the United Kingdom". In: *The American Economic Review* 85.5, pp. 1278–1286.

Hendricks, Lutz and Todd Schoellman (2014). "Student abilities during the expansion of US education". In: *Journal of Monetary Economics* 63, pp. 19–36.

Hungerford, Thomas and Gary Solon (1987). "Sheepskin effects in the returns to education". In: *The review of economics and statistics*, pp. 175–177.

Işık, Enes, Özgür Orhangazi, and Hasan Tekgüç (2020). "Heterogeneous effects of minimum wage on labor market outcomes: A case study from Turkey". In: *IZA Journal of Labor Policy* 10.1.

Jaeger, David A and Marianne E Page (1996). "Degrees matter: New evidence on sheepskin effects in the returns to education". In: *The review of economics and statistics*, pp. 733–740.

Katz, Lawrence F and Kevin M Murphy (1992). "Changes in relative wages, 1963–1987: supply and demand factors". In: *The quarterly journal of economics* 107.1, pp. 35–78.

Kawaguchi, Daiji and Yuko Mori (2016). "Why has wage inequality evolved so differently between Japan and the US? The role of the supply of college-educated workers". In: *Economics of Education Review* 52, pp. 29–50.

Koeniger, Winfried, Marco Leonardi, and Luca Nunziata (2007). "Labor market institutions and wage inequality". In: *ILR review* 60.3, pp. 340–356.

Kyui, Natalia (2016). "Expansion of higher education, employment and wages: Evidence from the Russian Transition". In: *Labour Economics* 39, pp. 68–87.

Lee, David S (1999). "Wage inequality in the United States during the 1980s: Rising dispersion or falling minimum wage?" In: *The Quarterly Journal of Economics* 114.3, pp. 977–1023.

Li, Shi, John Whalley, and Chunbing Xing (2014). "China's higher education expansion and unemployment of college graduates". In: *China Economic Review* 30, pp. 567–582.

Lucas, Robert E (1989). "On the mechanics of economic development". In: *Journal of Monetary Economics*.

Mankiw, N Gregory, David Romer, and David N Weil (1992). "A contribution to the empirics of economic growth". In: *The quarterly journal of economics* 107.2, pp. 407–437.

Mincer, Jacob (1974). "Schooling, Experience, and Earnings. Human Behavior & Social Institutions No. 2." In.

Moretti, Enrico (2013). "Real wage inequality". In: *American Economic Journal: Applied Economics* 5.1, pp. 65–103.

Müller, Kai-Uwe and Katharina Wrohlich (2020). "Does subsidized care for toddlers increase maternal labor supply? Evidence from a large-scale expansion of early childcare". In: *Labour Economics* 62, p. 101776.

OECD (2020). *Population with tertiary education*. URL: https://data.oecd.org/eduatt/population-with-tertiary-education.htm. (accessed: May 2020).

Oppedisano, Veruska (2011). "The (adverse) effects of expanding higher education: Evidence from Italy". In: *Economics of Education Review* 30.5, pp. 997–1008.

Oreopoulos, Philip (2006). "Estimating average and local average treatment effects of education when compulsory schooling laws really matter". In: *American Economic Review* 96.1, pp. 152–175.

OSYM (2013). "OSYM Almanacs". Measuring, Selection and Placement Center, Ankara.

Pischke, Jörn-Steffen and Till Von Wachter (2008). "Zero returns to compulsory schooling in Germany: Evidence and interpretation". In: *The Review of Economics and Statistics* 90.3, pp. 592–598.

Schofer, Evan and John W Meyer (2005). "The worldwide expansion of higher education in the twentieth century". In: *American sociological review* 70.6, pp. 898–920.

Taber, Christopher R (2001). "The rising college premium in the eighties: Return to college or return to unobserved ability?" In: *The Review of Economic Studies* 68.3, pp. 665–691.

Turkstat (2005). "Population data". Turkish Statistical Institute, Ankara.

— (2013a). "Address based population registry data". Turkish Statistical Institute, Ankara.

— (2013b). "Gross domestic product per capita". Turkish Statistical Institute, Ankara.

— (2013c). "High school graduates". Turkish Statistical Institute, Ankara.

Valero, Anna and John Van Reenen (2019). "The economic impact of universities: Evidence from across the globe". In: *Economics of Education Review* 68, pp. 53–67.

Walker, Ian and Yu Zhu (2008). "The college wage premium and the expansion of higher education in the UK". In: *Scandinavian Journal of Economics* 110.4, pp. 695–709.

Xing, Chunbing, Peng Yang, and Zhilong Li (2018). "The medium-run effect of China's higher education expansion on the unemployment of college graduates". In: *China Economic Review* 51, pp. 181–193.