The impact of a minimum wage increase on employment and school enrollment: evidence from Turkey

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Abstract

In 2004 minimum wage raised by 24.3% in Turkey. The effect of this increase on school enrollment rates of teenagers is uncertain. We use TurkStat's Household Budget Surveys and non-linear difference-in-difference estimation to evaluate the impact of the 2004 minimum wage change on teenage employment and school enrollment rates. We use regional variation in the share of minimum wage earners in all wage employees to define low- and high-impact regions, which then are defined as treatment and control groups. We find that the increase in the minimum wage in 2004 has encouraged young people to enroll in schooling and reduced their labor supply.

Keywords: Minimum wage; Education; Borrowing constraints; Turkey

JEL Classification Numbers: E24; I24; J24

1 Introduction

In 2004 minimum wage raised by 24.3% in Turkey (Figure 1). The main motivation behind this notable increase in comparison to the public and private wages was to improve the living conditions of the low-wage workers and to decrease the income inequality. However, the short- and long-run consequences of such a policy are ambiguous and even open to debate. The changing dynamics in the labor market not only affect the employment but are also closely related to the teenage enrollment outcomes.[1] Landon (1997), for example, explains that a reduction in the number of available jobs after the minimum wage increase might make it too difficult for the teenagers to find a job and hence push them back to schools. In addition, a higher minimum wage demands a higher level of human capital and thus more schooling. Ehrenberg and Marcus (1980, 1982), on the other hand, argue that such an increase would negatively affect the enrollment of teenagers

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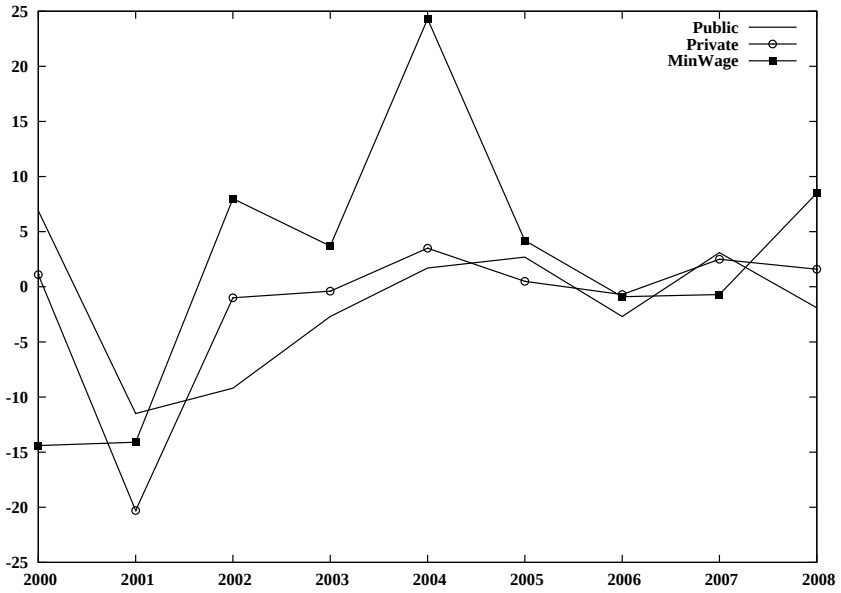
[1]See Neumark and Wascher (2008) and Todorovic and Ma (2008) for a review on employment effects of minimum wage.

from poor families due to them leaving school for full time jobs after a reduction in the number of available part-time positions.

This study follows an intra-household allocation framework to examine the employment and enrollment outcomes of teenagers. Minimum wage variations may affect the educational investment and employment decisions within the household by changing the work-school arbitrage of some teenagers; *ceteris paribus*, an increase in minimum wage not only decreases the wage premium between skilled and unskilled workers but it also increases the opportunity cost of education. A decrease in wage gap and an increase in the opportunity cost may prevent some teenagers from continuing to their education, especially if they are not very successful in school, implying a risky graduation. This is the usual price effect associated with the minimum wage increase.



Source: State Planning Org., `http://www.dpt.gov.tr/`

Figure 1: Percentage changes in net real wages: 2000-2008

There also is an income effect to take into account. If average family income raises with an increase in minimum wage we expect the demand for schooling to go up.[2] This effect will be stronger to the extent that income inequality alleviates and family income of the poor enhances with a higher minimum wage. The income effect may be substantial in the existence of credit constraints. Take, for instance, a teenager in a poor family, who is obliged to work and contribute to the family income in order to support a family investment in housing or to help finance the school expenditure of his/her younger siblings, as it usually is the case in Turkey. If family income is essentially determined

[2]A rise in minimum wage leads to higher wages for workers who keep their job, but it can also lead to a decrease in family income if some or all members of the family lose their job because of the excess labor supply created by this increase.

by minimum wage (consider the case where there are multiple minimum wage earners in the family) then an increase in the minimum wage may have a non-negligible effect on family income. An increase in minimum wage, in that respect, may increase family income, and thus ease off the credit constraints so that the need for the teenage family member to engage in an income earning activity diminishes. We expect the schooling ratio to increase in this case, at least for poor families.

There is a strong consensus about the positive effect of human capital on economic growth based on the endogenous growth literature and empirical works of the last two decennies.[3] Given the high share of young population in Turkey, minimum wage changes might play a crucial role in the future economic performance and social welfare through its effects on school enrollment.[4] Welfare gains from increased education levels may be higher than the short-run disemployment effects. It is, therefore, crucial to quantify the enrollment effects associated with changes in minimum wage.

This paper aims to explain how the enrollment rate in upper secondary school has changed with the sharp increase in minimum wage that occurred in the Turkish labor market. Using micro-level data obtained from TurkStat's Household Budget Surveys, we apply a nonlinear difference-in-difference (D-i-D) specification in order to evaluate the impact of the 2004 minimum wage change on teenage employment and enrollment rates. The results suggest that an increase in the minimum wage has encouraged young people to reduce their labor supply and to enroll in schooling.

The paper is organized as follows. Section II reviews the related literature. In Section III we construct a basic theoretical model that supports our discussion on the work-school arbitrage in the presence of credit constraints. Sections IV and V describes, respectively, our methodology and data. Section VI presents our results and Section VII concludes.

2 Literature review

There is vast amount of studies examining the effect of minimum wage on the labor market outcomes, i.e. changes in the average wages and employment rates, followed by the ones focusing on education outcomes only. Although limited in numbers, the employment – enrollment tradeoff has also been discussed intensively; these studies mostly focus on developed countries and provide mixed evidence on the enrollment effects of minimum wage.

The empirical approach followed by these studies depends on the data type and availability. The main challenge for the studies assessing minimum wage changes is that

[3] See Mankiw et al. (1992), Barro (1998, 2001), Krueger and Lindahl (2001), Vandenbussche et al. (2006) among others.

[4] If criminal activities are correlated with the lack of education, increased levels of schooling would also help to tackle crime. See Filiztekin (2013) for an investigation of the relationship between crime and labor markets.

the wage floor is introduced at national level, making it harder to examine the effects unless a time series data is used. Utilisation of time series data, however, is commonly problematic because of the small variation in minimum wage levels. Studies, therefore, make use of regional variation in the fraction of population affected from the minimum wage legislation, although this variation is utilised within different approaches. A set of studies capture this regional variation by introducing an explanatory variable in their regression models while others group regions according to the fraction of the population affected from the minimum wage changes and provide comparisons between them.

Most studies make use of the regional variation by adding an explanatory variable (coverage adjusted minimum wage), which is calculated by multiplying the minimum wage to average hourly earning ratio by the percentage of people affected from the minimum wage legislation. This variable or modifications of it have been used in various studies addressing the employment or enrollment effects of minimum wage. For example, Neumark and Wascher (1992), the two prominent names in this literature, use panel data at state level to estimate a model explaining the employment to population ratio with this variable together with some other controls. Two follow up studies of the authors (Neumark and Wascher, 1995a,b) address the effect of minimum wages on work-school arbitrage for teenagers in the US by estimating conditional/multinomial logit models with four mutually exclusive outcomes: (*i*) in school, but not employed, (*ii*) in school and employed, (*iii*) employed but not in school, and (*iv*) not in school, not employed. While the former study uses panel data at state level and measures the listed four outcomes as proportions of individuals in each category, the latter uses individual level panel data.

Ehrenberg and Marcus (1982) examine whether the introduction of the minimum wage legislation had a negative impact on the education of children from low-income families while it had a positive impact on the ones from high-income families. The authors use individual level cross sectional data to estimate a multinomial logit model of the four above-listed outcomes. In order to capture the effects of minimum wage legislation, the authors introduce a modification of the coverage adjusted minimum wage variable (explained above) to create two minimum wage variables for the low- and high-income families.

Landon (1997), Pacheco and Cruickshank (2007), and Chaplin et al. (2003) are examples to studies investigating only the minimum wage effects on teenage education outcomes in developed countries. Landon (1997) examines the enrollment rates of 16- and 17- year old males and females in Canada while Pacheco and Cruickshank (2007) study the enrollment rates for different age group specifications in New Zealand. Chaplin et al. (2003), on the other hand, criticise the accuracy of enrollment measures used by others[5] and use grade continuation ratios as a broad measure of enrollment in the US.

[5]There is no unique definition of school enrollment and employment in the literature. While some

Besides a new measure of enrollment, their contribution consists in using the difference in compulsory schooling laws across states in the US.

As for the results of these studies, Landon (1997) finds a negative impact of a minimum wage increase on the enrollment rates for 16- and 17-year old male and females. Chaplin et al. (2003) confirm this result for the US showing the consequence of imposition of a dropout age in states. They find that the effect minimum wage on teenage enrollment is insignificant in states where the dropout age is over 17 while it is negative and significant in states where dropout is possible for those aged 17 or younger. The results of Pacheco and Cruickshank (2007) are interesting as the authors find that a rise in minimum wage has an insignificant and a negative significant effect on, respectively, enrollment rates of 16-24 and 16-19 year old youngsters while the introduction of minimum wage legislation has a positive and statistically significant effect on enrollment rates for both age groups. The authors, therefore, point out the ineffectiveness of the level of the minimum wage in terms of the reservation wages of the youth.

Turning back to the tradeoff between enrollment and employment, Neumark and Wascher (1995a,b), as a result of their analyses both at the state and individual level, conclude that a minimum wage increase encourages teenagers to leave school and become neither employed nor enrolled. Neumark and Wascher (2003), with more recent data set at state level, confirm the negative effect of minimum wage rise on school enrollment. Furthermore, grouping the states into two according to the compulsory schooling age, they confirm the results of Chaplin et al. (2003). The results of Ehrenberg and Marcus (1982, 57), on the other hand, suggest that for white male and females, "an increase in minimum wage will induce some teenagers from low-income families to shift from enrolled-employed status to full-time schooling."[6]

The use of regional variation as a measure of treatment effect in examining the effects of minimum wage changes has been introduced by Card (1992, 22), by stating that "...a uniform minimum wage is an under-appreciated asset" and that variation in the ratio of people affected from the minimum wage change provides a simple natural experiment where the "'treatment effect' varies across states depending on the fraction of workers initially earning less than the new minimum." Card (1992), however does not make use of the policy evaluation techniques, which have taken considerable attention of the researchers in past few years. One of the stages of his analyses involves grouping states into low-, medium-, and high-wage and making comparisons across them using summary statistics on various labor market indicators. Another stage utilises a regression analysis where he regresses the 'fraction of affected teens' together with some

authors consider school enrollment as being enrolled in school and not employed, some others consider an employed individual as enrolled if this person reports schooling as his/her major activity in the survey week. Some others claim that even this second definition is too narrow, as it may exclude some individuals who are in school part-time so that schooling is not their major activity. See Neumark and Wascher (2003) and Neumark and Wascher (2008) for a discussion on this point.

[6]The results for nonwhite teenagers, on the other hand, are found to be inconclusive.

other control variables on the change in the mean log wage and the change in teenage employment-population ratio.

Stewart (2002), followed by Khamis (2013) takes Card (1992)'s approach one step further and uses the geographical variation in wages to evaluate the effect of the introduction of a minimum wage in 1999 in the UK. After defining low- and high-impact regions, he applies a difference-in-difference specification to compare the employment changes in the low- and high-wage regions. Using individual level data, Stewart (2002) focuses on teenagers aged 18-24; he does not find any significant negative effect on the introduction of the minimum wage on employment growth. Khamis (2013), on the other hand, makes use of the same quasi-experiment approach to evaluate the impact of minimum wage on the formal and informal sectors.

Following Stewart (2002) and Khamis (2013), this study makes use of the regional variation in the fraction of wage earners affected from the minimum wage increase of 2004 and applies a difference-in-difference specification to evaluate the impact of this change on enrollment and employment outcomes of teenagers. To our knowledge, it is the first to follow a quasi-experiment approach to evaluate the changes in education outcomes. Differently from other studies on the enrollment-employment tradeoff, we apply bivariate probit modelling rather than conditional/multinomial logit modelling. This allows us to model enrollment and employment choices as two separate, but related decisions.

3 Model

In this section we develop a simple model which will help us in deriving and interpreting our econometric model. The theoretical approach presented here is a simple household allocation model of investment in schooling. The model economy consists of two-period overlapping generations. There is a continuum of individuals who live for two periods. A new generation of individuals is born in each period. Since each individual gets only one offspring at the beginning of the second period, population is constant. The same individual is called "child" (or "young") in the first period of life and "parent" in the second one. To keep our model simple, we assume that individuals consume and save only in the first period. In the second period they derive utility from the gift they make to their offspring.

Individuals work only in the second period, either as skilled or unskilled workers. Only those who invested in human capital when young can work as skilled. Labor supply is inelastic; each agent has one unit of time endowment. Every young generation decides whether or not to go to school in the first period. It is plausible to think schooling decision is made at household (family) level. The schooling cost, f, is constant and indivisible as in Galor and Zeira (1993). There are borrowing constraints in the

economy, i.e. borrowing from financial markets is not possible. We assume that each child in the society is characterized by the same ability in order to focus on the role played by family income and borrowing constraints.

The representative firm has access to a constant returns to scale production technology with skilled and unskilled labor as the only inputs. We assume that w^L represents the minimum wage set by the government, while w^H is determined competitively in the labor market.

The utility function for the i^{th} family is defined by

$$U(c_t^i, b_t^i) = \log c_t^i + \log b_{t+1}^i$$

where c_t is the first period consumption, b_{t+1} is a bequest to the younger generation. The parents maximise this utility function subject to the following budget constraints:

$$\begin{aligned} c_t^i + s_t^i &= b_t^i - ef \\ b_{t+1}^i &= ew_{t+1}^H + (1-e)w_{t+1}^L + s_t^i R_{t+1} \\ s_t^i &\geq 0 \end{aligned}$$

where b_t^i is the bequest that the child gets from her parents and b_{t+1}^i is the gift she mades to her offspring. To simplify notation, hereafter we will omit the time subscript when the meaning is clear from the context. w^H and w^L are, respectively, skilled and unskilled wages; s^i is saving which is required to be non-negative; e is a discrete choice variable: it is equal to 1 if parents decide for investment in schooling and 0 otherwise. $R = 1 + r$ is the interest factor.

If there were no borrowing constraints, schooling decision would depend only on the difference between the wage premium and the schooling cost, which is given below:

$$\frac{w^H - w^L}{R} - f$$

On the other hand if there are borrowing constraints, the decision on whether or not to go to school will not only depend on the university wage premium but also on the family income level.

Consider a young agent with a level of bequest, b^i. Given her schooling decision she earns either w^H, or w^L as labor income; or equivalently, w^H/R, or w^L/R in terms of the 1st period good. In order to focus on poor agents let us assume $b^i < w^L/R$. Consumption smoothing would require $s < 0$ whether or not she becomes skilled in the second period, given that c and x are equal in her eyes but her income in her first period of life is insufficient. Even if her saving is zero, the decision of investment in schooling depends on whether expected benefits of that investment are larger than associated costs. Given

$s = 0$ we can write her expected lifetime utility as $U_i^L = \ln b_i + \ln w^L$ if she does not go to the school ($e = 0$); and $U_i^H = \ln(b_i - f) + \ln w^H$ if she goes to the school ($e = 1$). We see that $U_i^H \geq U_i^L$ is the case only if

$$b^i \geq b^*, \quad \text{where } b^* = \frac{f w^H}{w^H - w^L}$$

This means that, given credit market imperfections, there is a threshold level of bequests, b^*, under which it is not optimal to invest in education. Only the ones with $b^i \geq b^*$ will choose to be skilled.

A minimum wage increase affects both sides of the above inequality. The first one is about b^* which is the usual price effect. This price effect associated with a minimum wage increase is negative for school enrollment: $\Delta b^*/\Delta w^L > 0$ which implies that the number of families who would like to invest in their children's schooling decreases when minimum wage increases. This result can be interpreted in two ways. Firstly, this can be seen as negative incentive effect. Given that w^L increases with minimum wage, the wage gap between skilled and unskilled workers decreases. Thus, young children will be less motivated for higher education. Secondly, w^L is the opportunity cost of education, namely the cost of not working. When this cost increases, the demand for education decreases.

The second effect of a minimum wage increase is on the income (wage) distribution in the same period, that is b^i. To the extent that the family income of poor households increase with minimum wage, this is $\Delta b^i/\Delta w^L > 0$, one expects that the number of families (or children) who are able to invest in schooling goes up when minimum wage goes up. This is the usual income effect. Thus, we have two opposite effects. Depending on the conditions of the economy, either income or price effect will dominate one another.

4 Methodology

This paper aims to examine how the sharp increase in minimum wage level in 2004 has affected the school enrollment and employment outcomes of teenagers in Turkey. Using individual level data, we apply a difference-in-difference (D-iD) specification.

Considering that enrollment and employment decisions of individuals are not independent from each other, both activities should be modelled together. Previous literature, Neumark and Wascher (1995a,b, 2003); Ehrenberg and Marcus (1982) for example, utilise conditional/multinomial logit modeling by estimating models of choice between the four alternative outcomes obtained from binary combinations of employment and enrollment status[7]. Considering that the observed outcomes on enrollment and employment are a result of two separate, but related decisions, this study utilizes bivariate

[7]These four categories are: (*i*) enrolled and employed, (*ii*) enrolled and not employed, (*iii*) not enrolled and employed, and (*iv*) not enrolled and not employed.

probit modeling rather than multinomial choice modelling, which treats the outcome as a result of single decision making among distinct alternatives.[8] Bivariate probit model has the same spirit as the seemingly unrelated regressions model (Greene, 2012), allowing us to include a separate vector of independent variables for each regression of enrollment and employment.

The main idea behind the D-i-D specification is the comparison of control and treatment groups before and after a change. Treatment group is the one which is affected from the change while the control group would be the one which the change does not have any impact. Identification of these two groups has not been straightforward for this study since the minimum wage change was introduced all across the country. In his article on evaluating the effect of a change in the national minimum wage level on teenagers' schooling and employment outcomes, Card (1992) addresses this issue and suggests to make use of the regional variation in wages. Following the arguments developed in Card, and the empirical approach of Stewart (2002) and Khamis (2013) we use the extent to which regions are affected by minimum wage increase to determine our treatment and control groups. Considering that such a change would only effect the enrollment and labor supply decisions of the teenagers from low income households that have members who are earning at the minimum wage level or lower, but would hardly make any difference for the decisions of teenagers from high income households, low- and high-impact groups are specified according to the percentage of people earning at or lower than the minimum wage level in each region. For this purpose, regional percentages of people earning wages equal to or lower than the minimum wage are calculated as a first step. These percentages are then used to define the low-impact and high-impact regions, which respectively form the control and treatment groups in D-i-D specification:[9]

$$Y_{irt} = \beta_0 + \beta_1 \mathrm{T}_t + \beta_2 \mathrm{HI}_r + \beta_3 \mathrm{T}_t \times \mathrm{HI}_r + \beta_4 Z_{irt} + \beta_5 X_{rt} + u_{irt}$$

where Y_{irt} is a binary variable showing the employment or enrollment outcome for the i^{th} person living in region r at time t and T_t is a time dummy which takes value 1 for the years after the minimum wage increase (for year 2004 and following years) and 0 before. Similarly, HI_r is a dummy variable with a value equal to 1 for the high-impact (treatment) group and 0 for the low-impact (control) group. Z_{irt} represents individual characteristics and family background variables that are likely to affect schooling or employment decisions such as parental education, gender, urban residence, etc. X_{rt} denotes other regional and time specific variables susceptible to affect work-school arbitrage such as number of students per teacher to measure the education supply in a particular region or regional unemployment rate to measure for the labor market conditions. The param-

[8] See Greene (2012) for a detailed review of discrete choice models.

[9] One approach would be to divide the sample into two subsamples according to the household income and then compare the change in their behaviour over time. Although this could easily be done with panel data, we are restricted to cross sections belonging to different years.

eter of interest is β_3, which would be the estimator of the treatment effect if we were to estimate a linear regression model. Since the above explained model is estimated by bivariate probit modeling, the treatment effect is not constant across the treated group and is derived by Puhani (2012) as the following expression:

$$\tau = \Phi(\beta_1 + \beta_2 + \beta_3 + \Lambda) - \Phi(\beta_1 + \beta_2 + \Lambda)$$

where Λ denotes $\beta_0 + \beta_4 Z_{irt} + \beta_5 X_{rt}$ to simplify the expression above and $\Phi(.)$ is the cumulative standard normal distribution function. This is the difference of the cross differences for the potential outcome under treatment and potential outcome if there were no treatment.

As Puhani (2012, p.86) explains, the statistical significance of the parameter estimate for the interaction term could, nevertheless, be used to test for the existence of a treatment effect. Additionally, he shows that because $\Phi(.)$ is a strictly monotonic function, the sign of this parameter is equal to the sign of the treatment effect. However, Ai and Norton (2003) show that the statistical significance of an interaction term in nonlinear models (in our case β_3) cannot be tested for using the usual t-testing procedure from the regression output. Therefore, the standard error of both the interaction term and the calculated treatment effect in this study are obtained by bootstrapping after 500 replications.

5 Data

This study utilises individual level data from TurkStat's Household Budget Surveys of 2003 to 2006. As explained above, the control and treatment groups in the D-i-D specification are determined by making use of the regional variation in income levels. For each Nuts2 region, the percentages of wage earners with a wage income equal to 2003 minimum wage level or lower are calculated using the 2003 data. These percentages are then used to define the low- and high-impact groups.[10] Regions with a ratio lower than 16% are classified as the low-impact group and the ones with a ratio above 37% are classified as high-impact group.[11,12] Since the focus of the study is the schooling and employment outcomes of teenagers, estimation sample is restricted to teenagers aged 15-19. Although the 2003 survey data has a regional representativeness, TurkStat suggests

[10] See Appendix (Table 6) for the calculated percentages.

[11] There are three Nuts2 regions in the control: TR10 (Istanbul, 10%); TRA1 (Erzurum-Erzincan-Bayburt, 16%); and TR51 (Ankara, 16%) and five regions in the treatment group: TR83 (Samsun-Tokat-Corum-Amasya, 37%); TRC2 (S.urfa-D.bakir, 38%); TR33 (Manisa-A.karahisar-Kutahya-Usak, 38%); TR62 (Adana-Mersin, 40%); and TR63 (Hatay-K.maras-Osmaniye, 43%).

[12] The cutoff points for the classification are determined by observing the percentage distribution for the regions as well as the number of observations that we would end up with for the estimations. Analyses reported in this study are repeated by grouping the first five regions with the lowest percentages as control group rather than the first three regions. Similar results are obtained.

to use the three consecutive cross-sectional surveys together for an accurate regional representation for the pursuing years. We therefore use the 2003 survey data for the before treatment, and the pooled 2004-2005-2006 survey data for the after treatment period.

Table 1: Percentage distribution of teenagers into employment and enrollment outcomes

	Control Group		Treatment Group		Excluded Regions	
Outcome	Before	After	Before	After	Before	After
Not employed, not enrolled	27.71	28.16	30.45	32.39	30.87	30.37
Not employed, enrolled	53.34	50.89	35.92	42.67	49.90	48.57
Employed, not enrolled	16.32	17.66	31.04	22.02	17.04	17.42
Employed, enrolled	2.64	3.28	2.58	2.92	2.18	3.64
Total	100	100	100	100	100	100

Table 1 provides the percentage distribution of teenagers aged 15-19 into four mutually exclusive outcomes of employment and enrollment. The highest proportion of teenagers, as expected, is observed at the 'enrolled and not employed' category for both groups, the rate for the treatment group being much lower than the rate for the control group. Before the change, around 31% of teenagers in the high-impact group were in employment and not in school while this rate was 16% for the low-impact group. The impact of the change during the time periods examined is observed the most for these two categories. The proportion of teenagers who are in school and not in employment in the control group has decreased from around 53% to 51% while the number has increased by around 7 percentage points, from 36% to 43%, in the treatment group. As for those who are employed and not enrolled in schooling, there has been a slight increase for the control group while we observe around 9 percentage points decrease from 31% to 22% in the treatment group.

Table 2 provides statistics on the characteristics of all individuals in wage employment while Table 3 restricts the sample to teenagers aged 15-19 in wage employment.[13] Comparison of ratios of wage earners with a wage income below the minimum wage provides striking suggestions. In Table 3, we observe that a very high proportion of teenage wage earners in the treatment group earn equal to minimum wage or lower; around 94% before the increase and 81% after. Even after the rise, more than half of the teenagers in the treatment group earn equal to or below the pre-increase level. The ratio of teenage girls in wage employment has dropped from 35% to 30% over the years. The ratio of students among the wage earner teenagers is higher in control than in treatment groups. Interestingly, there has been an increase in the proportion of students among wage earners in both the low-impact and high-impact regions, the increase being higher

[13]Statistics for the excluded regions are provided in Appendix (Table 7).

Table 2: Statistics on the characteristics of all wage earners

	Control Group		Treatment Group	
Outcome	Before	After	Before	After
Wage≤226†	11.54%	5.95%	39.56%	23.62%
Wage≤311‡	31.15%	12.30%	58.0%	37.99%
Ln(wage)	6.10	6.34	5.61	5.92
	(0.70)	(0.68)	(0.80)	(0.82)
Wage	578.83	701.80	367.62	497.16
	(590.59)	(543.97)	(290.98)	(416.60)
Real wage⋆	578.83	581.42	367.62	423.53
	(590.59)	(446.43)	(290.98)	(351.92)
Weekly hours	50.35	53.41	49.69	49.86
	(16.03)	(15.68)	(15.99)	(15.99)
People aged 15-19	6.24%	6.72%	7.88%	9.12%
People aged 20-24	11.84%	12.24%	11.66%	11.92%

Note: Standard errors are reported in parentheses.

† Minimum wage in 2003; ‡ The mean minimum wage in 2004

⋆ Real wage in 2003 prices

in low-impact regions.

6 Results

The schooling and employment decisions of teenagers are estimated by bivariate probit modelling (Table 4). D-i-D estimators assess the impact of a change by introducing two dummy variables for identifying observations belonging to the treatment group and the time period after the change has happened together with an interaction of the two. The interaction term shows the impact of the change. These three variables, in particular the treatment effect is the focus of this study.

Additional explanatory variables are added to control for the individual and family background characteristics that influence schooling and work decisions as well some regional variables to control for the changes in demand for and supply of education and employment in the regions.[14] The enrollment and employment outcomes are derived mostly by similar factors. Therefore most of the individual level regressors in the two regressions are common, except for the inclusion of number of siblings in the enrollment and dependency ratio in the employment regressions.[15] At the regional level, number of students per teacher is included to proxy for the exogenous education supply while

[14]Summary statistics for the variables used in the estimations are provided in the Appendix.

[15]Dependency ratio shows the ratio of number of income earning household members to household size.

Table 3: Statistics on the characteristics of wage earner teenagers aged 15-19

	Control Group		Treatment Group	
Outcome	Before	After	Before	After
Wage≤226†	43.53%	17.47%	93.64%	61.69%
Wage≤311‡	82.93%	42.98%	99.19%	80.81%
Ln(wage)	5.35	5.67	4.74	5.14
	(0.50)	(0.57)	(0.59)	(0.68)
Wage	236.10	325.06	132.95	202.57
	(118.65)	(129.89)	(67.25)	(108.87)
Real wage⋆	236.10	268.34	132.95	170.13
	(118.65)	(102.90)	(67.25)	(89.62)
Weekly hours	54.75	55.99	51.58	52.23
	(16.48)	(14.90)	(18.28)	(16.51)
Female ratio	0.37	0.37	0.35	0.30
	(0.49)	(0.48)	(0.48)	(0.46)
Studying	14.89%	19.59%	8.43%	10.28%

Note: Standard errors are reported in parentheses.

† Minimum wage in 2003; ‡ The mean minimum wage in 2004

⋆ Real wage in 2003 prices

the unemployment among people aged 25-64 and ratio of teenagers aged 15-19 in total population, respectively, proxy for the labor demand and labor supply.

Turning back to results in Table 4, the models are estimated with (model 1) and without (model 2) regional controls. The first two columns of parameter estimates belong to the enrollment regression while the last two report the coefficients for the employment regression. The Wald chi-squared statistic suggests that both models overall have a statistically significant explanatory power. The rho coefficient, which measures the correlation between the error terms of the two regressions is also statistically significant suggesting that the enrollment and employment decisions of the teenagers are not independent from each other. This result confirms that these regressions should be estimated with a seemingly unrelated bivariate probit approach.

"After treatment" is a year dummy variable taking value zero for 2003, i.e. before the change in minimum wage and one for the following years. The parameter estimate for this variable shows the change in the enrollment and employment patterns in the low-impact regions over time. An insignificant estimate for this parameter signals that the school enrollment pattern in low-impact regions have not changed over time. The parameter estimate for the "treatment group" variable shows the difference in enrollment and employment patterns of the low-impact and high-impact regions before the change in minimum wage is observed. This parameter is statistically significant in both model specifications, implying a difference between the regions.

The "interaction term", which is the main variable of interest, shows the difference in the changes between these two regional groups. A change in minimum wage is expected to have an important impact on the decisions of individuals living in the high-impact regions while it is expected not to have an impact on the individuals in low-impact regions. The difference between the change in the high-impact and the change in the low-impact region is the treatment effect. As explained above, although we cannot comment on the magnitude of this variable without calculating the the treatment effect, we can comment on its sign and significance. The interaction term parameter is significant in both regressions and is positive for enrollment while it is negative for employment. This implies that the increase in minimum wage did have a positive impact on the enrollment of teenagers and a negative impact for employment.

The treatment effect for this nonlinear model is calculated by following the procedure described in Puhani (2012) and the standard errors are bootstrapped (Table 5). Results from these calculations are inline with the regression results in terms of the sign and the significance level of the terms. They suggest that the increase in minimum wage level in 2004 created a 0.02 to 0.12 percentage point[16] increase in the enrollment propensity while it created a decrease with a similar magnitude in employment propensity. Looking at the breakdown of the treatment effect for binary combinations of all outcomes in Table 5, the results suggest that the impact of a change in minimum wage is observed as a shift from employed, not enrolled category to enrolled, not employed.

All the control variables in the models have expected effects. Teenagers living in urban areas are more likely to enroll in schooling and less likely to be in employment. Higher levels of parental education favours education over employment. Teenagers with more siblings are less likely to be enrolled in schooling. Females are in a disadvantaged position in attaining education and are less likely to work in comparison to their male counterparts. Single people in this age group are more likely to enroll in schooling and less likely to work as they have less responsibilities towards family members in comparison to married ones. Household head's status in employment are included in the model to control for the income level of the family. In comparison to self-employment, household head being a wage earner or an employer has a positive impact on enrollment and a negative impact on employment. Household head engaging in agricultural activities raises as a barrier for education.

7 Conclusion

This study has examined the impact of a 24.3% increase in minimum wage level on teenage school enrollment and employment in Turkey. Using TurkStat's 2003-2006 Household Budget Survey data, we have applied a nonlinear D-i-D specification and es-

[16]The numbers show the 95% confidence interval estimate for Model 1.

timated bivariate probit models of enrollment and employment outcomes. For the D-i-D specification, we make use of regional variation in the share of minimum wage earners to assess the impact of the minimum wage increase in 2004 on work-school arbitrage. With the expectation that the consequences of a minimum wage increase on school enrollment rates to be stronger in relatively poor regions of the country, we have defined low-impact and high-impact regions, which have formed the control and treatment groups in our estimations.

The results suggest that an increase in minimum wage has encouraged teenagers to enroll in schooling and reduce their labor supply. With an increase in minimum wage, the financial barriers to education might have been lifted, people now being able to afford further education, lowering their labor supply.

Table 4: Bivariate probit estimation results

	Enrollment Regression		Employment Regression	
Variable	Model 1	Model 2	Model 1	Model 2
After treatment	-0.013	-0.052	0.095	0.127**
	(0.058)	(0.053)	(0.066)	(0.062)
Treatment group	-0.225***	-0.211***	0.178***	0.112*
	(0.051)	(0.051)	(0.066)	(0.059)
Interaction term†	0.205***	0.213***	-0.259***	-0.273***
	(0.069)	(0.071)	(0.085)	(0.082)
Female	-0.266***	-0.265***	-0.331***	-0.331***
	(0.035)	(0.035)	(0.039)	(0.039)
Urban	0.151***	0.152***	-0.175***	-0.172***
	(0.040)	(0.040)	(0.0450)	(0.045)
Father's education	0.097***	0.097***	-0.187***	-0.189***
	(0.017)	(0.017)	(0.021)	(0.021)
Mother's education	0.150***	0.140***	-0.114***	-0.074***
	(0.018)	(0.018)	(0.021)	(0.020)
Single	0.827***	0.828***	-0.466***	-0.466***
	(0.188)	(0.187)	(0.166)	(0.164)
HH head wager	0.110**	0.111**	-0.228***	-0.229***
	(0.045)	(0.045)	(0.050)	(0.050)
HH head employer	0.312***	0.314***	-0.381***	-0.372***
	(0.071)	(0.071)	(0.086)	(0.085)
HH head engaged in agriculture	-0.296***	-0.298***	0.759***	0.754***
	(0.054)	(0.054)	(0.057)	(0.056)
Number of Siblings	-0.042***	-0.045***		
	(0.011)	(0.010)		
Dependency ratio			0.593***	0.630***
			(0.103)	(0.103)
No of student per teacher (1000)	8.479			
	(5.545)			
Unemployment rate			-2.077	
			(2.302)	
Teenage ratio			-6.914***	
			(1.555)	
Constant	-1.281***	-1.073***	1.184***	0.367**
	(0.232)	(0.200)	(0.232)	(0.181)
Rho‡	-0.698***	-0.696***		
	(0.016)	(0.016)		
Number of observations	5704	5704		
Log-likelihood	-5683.561	-5700.287		
Wald chi2 (overall model)	1559.113	1544.136		
Prob > Wald chi2	0.000	0.000		

Note: Standard errors are reported in parentheses.

† Standard errors of the treatment effect are obtained by bootstrapping after 500 replications

‡ Stars next to rho parameter estimates show the significance levels for the Likelihood Ratio test for rho=0

* p<0.10, ** p<0.05, *** p <0.01

Table 5: Treatment effect

Outcome	Model 1	Model 2
Enrollment	0.073***	0.075***
	(0.025)	(0.025)
Employment	-0.070***	-0.073***
	(0.024)	(0.022)
Breakdown of the treatment effect		
Enrolled & employed	-0.003	-0.004
	(0.006)	(0.005)
Enrolled & not employed	0.076***	0.079***
	(0.023)	(0.022)
Not enrolled & employed	-0.066***	-0.069***
	(0.020)	(0.019)
Not enrolled & not employed	-0.007	-0.006
	(0.021)	(0.021)

Note: Bootstrapped standard errors are reported in parentheses.
* p<0.10, ** p<0.05, *** p <0.01

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Appendix

In order to form the treatment and control groups, ratio of wage earners with earnings equal to or below minimum wage (before the change) are calculated. The table below provides these ratios.

Table 6: Ratio of wage earners with earnings equal to or below minimum wage

Nuts2	% below MW	Nuts2	% below MW
TR10	*0.10*	TR61	0.23
TRA1	*0.16*	TR31	0.26
TR51	*0.16*	TR82	0.26
TRA2	0.17	TRB2	0.27
TR71	0.17	TRC1	0.31
TR72	0.18	TRC3	0.32
TR81	0.19	TR22	0.32
TR42	0.19	TR52	0.33
TR32	0.19	*TR83*	*0.37*
TRB1	0.20	*TRC2*	*0.38*
TR21	0.20	*TR33*	*0.38*
TR90	0.21	*TR62*	*0.40*
TR41	0.22	*TR63*	*0.43*
Overall : 0.23			

Note: The first 3 and last 5 regions in the table, respectively, are chosen as the control group and the treatment group

Table 7: Statistics on the characteristics of wage earners in excluded regions

	All wage earners		Wage earners aged 15-19	
Outcome	Before	After	Before	After
Wage≤226†	23.31%	13.86%	75.72%	48.67%
Wage≤311‡	45.30%	24.27%	96.58%	70.49%
Ln(wage)	5.87	6.12	5.02	5.32
	(0.72)	(0.77)	(0.56)	(0.66)
Wage	453.23	583.91	172.76	242.41
	(352.98)	(463.08)	(81.25)	(141.23)
Real wage⋆	453.23	489.89	172.76	203.03
	(352.98)	(379.24)	(81.25)	(115.72)
Weekly hours	48.92	49.24	52.51	52.89
	(15.43)	(14.72)	(16.19)	(15.97)
Female ratio	0.19	0.21	0.30	0.30
	(0.39)	(0.41)	(0.46)	(0.46)
People aged 15-19	5.24%	6.01%		
People aged 20-24	11.00%	12.29%		

Note: Standard errors are reported in parentheses.

† Minimum wage in 2003; ‡ The mean minimum wage in 2004

⋆ Real wage in 2003 prices

Table 8: Summary statistics for the estimation sample

	Control Group				Treatment Group			
	Before		After		Before		After	
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Enrolled	0.606	0.489	0.567	0.496	0.396	0.489	0.470	0.499
Employment	0.167	0.373	0.211	0.408	0.358	0.480	0.264	0.441
No. of siblings	2.011	1.398	2.003	1.393	2.951	2.151	2.856	2.040
Female	0.492	0.500	0.487	0.500	0.515	0.500	0.495	0.500
Urban	0.795	0.404	0.611	0.488	0.533	0.499	0.571	0.495
Father's education	2.809	1.339	2.746	1.336	2.248	1.281	2.316	1.283
Mother's education	2.046	1.334	1.970	1.243	1.350	1.227	1.339	1.315
Single	0.998	0.050	0.986	0.118	0.985	0.123	0.989	0.106
HH head wager	0.673	0.469	0.640	0.480	0.421	0.494	0.515	0.500
HH head employer	0.108	0.310	0.094	0.292	0.076	0.265	0.077	0.266
HH engaged in agriculture	0.105	0.307	0.107	0.309	0.403	0.491	0.297	0.457
Dependency ratio	0.155	0.163	0.158	0.166	0.181	0.187	0.161	0.172
No of student per teacher (1000)	0.022	0.002	0.018	0.001	0.024	0.004	0.020	0.005
Unemployment rate	0.038	0.008	0.027	0.005	0.029	0.010	0.032	0.014
Teenage ratio	0.096	0.005	0.095	0.008	0.112	0.016	0.110	0.023
No. of observations	1207		1282		1818		1397	