Econometrics Final Project

20201036 MulkyeolKim

2022.06.20

Abstract

In this project, I looked up the answer to " What is the impact of higher minimum wage rates on the employment of teenagers in the United States?" In a total of 56 states, I analyzed how the rise in the minimum wage over a 24-year period affects employment. Two major analyses were conducted, one to examine the effect on the employment rate itself, and one to examine the effect on the type of employment(part time or full time). I also analyzed how gender, age, and race particularly affect employment. As a result of the analysis, it was found that the increase in the minimum wage generally reduces the employment rate and the overall reduction in full-time employment. And it was found that if the race is ‘minorities’, it is particularly severely affected by two things.

I. Introduction

Our research question is “What is the impact of higher minimum wage rates on the employment of teenagers in the United States?”

‘Minimum wage’ refers to the minimum wage to be paid to employees set by the government to prevent the exploitation of employees making employees low wages. Usually, people working in low-skilled jobs or people with low education levels receive the minimum wage, and people working in high-skilled jobs or people with high education levels receive higher wages than the minimum wage. That is why raising the minimum wage could raise the wage for such people, thereby narrowing the wage gap, which could contribute to narrowing the gap between the rich and the poor. However, a rise in the minimum wage may lead to a decrease in employment rates. This is because from the employer's point of view, it is burdensome to give a lot of money to many workers and roll them. Then employers can hire less to reduce costs.

In the question, the target of the employment was designated as a teenager. The reason is that teenage workers are usually relatively less educated and are more likely to work in low-skilled jobs (ex: simple interpersonal service jobs such as sales, sales, and food service). So knowing the effect of minimum wage on teenagers, we can infer the effect of minimum wage on the lower class (the class with relatively low wages).

II. A Review of the Relevant Literature

I found a literature has similar types of data to us, and the research topics we want to analyze are consistent. It is also expected to be similar to the model we should use in that literature solved the problem using fixed effects. Therefore, I chose this literature.

The literature constructed an independent-level repeated cross-section sample from the CPS Outgoing Rotation Groups for the years 1990–2009. For those aged 16 to 17 and 18 to 19, it was examined whether the employment rate rose or decreased when the minimum wage rose. The focus of Literature is 'to estimate the effect of minimum wage on wages'. Literature classified the models into three main types. The natural log of hours of employment measure that takes on the value one if the teen is working; and the natural log of the hours of work.

Data used is as follows:

Sample statistics : ‘All teans 16-19’, ‘Teens 16-17’, ‘Teens 18-19’, ‘Male’, ‘White, non-Hispanic’, ‘Black’, ‘Hispanic’, ‘Female’, ‘White, non-Hispanic’, ‘Black’, ‘Hispanic’

Labor market outcomes : ‘Hourly wage’, ‘Employed’, ‘Hours worked per week’

Policy variables : ‘Minimum wage’, ‘Minimum wage (federal binding)’, ‘Minimum wage (state binding)’, ‘Unemployment rate’

In addition, each data includes information on states, so it could be analyzed for each state.

Literature measured each labor market outcomes, and each sample statistic was input as an independent variable. Therefore, literature measured changes in labor market outcomes, such as changes in Hourly Wages by gender or race, and changes in employment, by inputting minimum wages into the basic independent variable and sample statistics into other independent variables.

Four models were used in this literature. But literature prefers and mainly use one model among these.

$$y_{ist} = \beta \mathrm{MW}_{st} + X_{ist}\Gamma + \lambda \cdot \mathrm{unemp}_{st} + \phi_s + \psi_s \cdot t + \tau_{dt} + \varepsilon_{ist}. \qquad (4)$$

where MW refers to the log of the minimum wage; i, s, and t denote, respectively, individual, state, and time indexes; X is a vector of individual characteristics; unemp is the quarterly (non-seasonally adjusted) unemployment rate in state s at time t; φ_s refers to the state-fixed effect; and τ_t represents time dummies incremented in quarters. ψ_s denotes the time trend for state s. In this canonical specification, including state and time dummies as well as the overall unemployment rate is thought to control sufficiently for local labor market conditions facing teenage workers.

Here, 'unemp' plays an important role. 'unemp' refers to the proportion of the population(in overall age) who are unemployed. And since it is the opposite concept of employment, it is deeply related to the values of y. Therefore, 'unemp' plays a role in removing the effect of variables other than the minimum wage on changes in y by occupying other terms which is independent of the minimum wage. This is why ‘unemp’ was used in literature's model.

Fore each for model, η and se are calculated. η refers to the minimum wage elasticity of the outcome. For employment, the elasticity is calculated by dividing the coefficient by the relevant employment-to-population ratio. In this literature, it was revealed that fourth model, which considers the most factors, is the most preferred.

The results of analyzing Minimum Wage Effects by Gender, Race, and Ethnicity are as follows.

First, male teen employment rates lost ground relative to female teen employment rates in every

race and ethnicity group. Estimated wage elasticity for teenage males is 0.099 and that of female teenage females is 0.176, which is 75% more effective for teenage females.

Second, employment rates are lower among minorities than among whites. During the sample period, the average employment rate was 0.24 for black teenagers and 0.33 for Hispanic teenagers and 0.45 for non-Hispanic white teenagers.

Third, literature compared young teenagers (16-17) and old teenagers (18-19). Literature initially assumed that there may be differences because of certificates with age-related restrictions such as driver's licenses, and that younger, the more likely it is to be affected by skills. In the first model, it was concluded that the younger the teenager, the lower the employment rate as the minimum wage increases. However, in the fourth model, the reverse employment effect results in a slightly positive outcome for both groups. Although score estimates are somewhat larger for young teens, neither group is statistically significant.

Literature's final conclusion: The minimum wage increase does not reduce teenage employment within the scope of implementation in the United States.

III. A Brief Outline of the Econometric Model

This is panel data. Panel data refers to data obtained by tracking multiple objects over multiple hours. Our data has multiple controls and treatment groups, and a total of 24 years of time period from 1990 to 2013. Therefore, we should use the general framework for policy analysis to analyze our data. This data shows that some states change their minimum wage over time, and others do not. To take all of these changes into account, we analyze our data using the

general framework for policy analysis of fixed effects instead of using a typical difference-in-difference model.

General framework for policy analysis :

$$y_{i,g,t} = \lambda_t + \alpha_g + \beta x_{g,t} + \mathbf{z_{i,g,t}}\mathbf{Y} + u_{i,g,t}$$

$\lambda_t$is aggregate time effect common to all groups and $\alpha_g$is fixed effects specific to each group. And $\beta x_{g,t}$ is Policy effect $z_{i,g,t}Y$ is explanatory variables measured at the individual and group level and $u_{i,g,t}$is error term and $x_{g,t}$ is policy with a dummy variable for group g and time t. And since T(time period) is bigger than 2(it is 24), linear time trend by group ψ_g is added.

$$y_{i,g,t} = \lambda_t + \alpha_g + \psi_g t + \beta x_{g,t} + \mathbf{z_{i,g,t}}\boldsymbol{\gamma} + u_{i,g,t}$$

What should be included in y is a value measured by several independent groups. In addition to the 'employed (degree of employment) and minimum wage rate relationship', I will also analyze the 'workpt&workft (type of employment) and minimum wage rate relationship', so a total of three should be included in y. As mentioned above, time effect should be substituted for λ_t, and fixed effect should be substituted for α_g. And $x_{g,t}$ should contain the minimum wage rate, the policy we want to find out the effect. In this case, since we focus on 'rate', log($x_{g,t}$) should be input, not $x_{g,t}$. In fact, also in the literature analyzed above, the value with log on the spot was used. $u_{i,g,t}$ is an error term.

My biggest concern was how to decide input on $\mathbf{z_{i,g,t}}\boldsymbol{\gamma}$. $\boldsymbol{\gamma}$ is coefficient value indicating how $\mathbf{z_{i,g,t}}$ affects y, so I had to determine what to put on $\mathbf{z_{i,g,t}}$. In the literature analyzed earlier, 'unemp' played role of $\mathbf{z_{i,g,t}}$. There are conditions on $\mathbf{z_{i,g,t}}$, which has a large effect on y (to eliminate any other association), and at the same time should not make the effect of minimum wage rate meaningless on y. To determine $\mathbf{z_{i,g,t}}$ which satisfying all of these, the panel OLS was estimated.

I can do t-test to detect significance using p-value.

1. Analysis of the rate of employment itself (y=employed)

When y = ‘employed’, the values starting with 'emp' cannot entered to $\mathbf{z_{i,g,t}}$. Then, the remaining candidates are three variables: 'workpt', 'workft', and 'inschool'. Table 3 contains information on p-value and t-static when estimating panel OLS with these three variables and minimum wage rate. P-value of the $\mathbf{z_{i,g,t}}$’s coefficient should be 0 and coefficient of minimum wage rate should be less than 0.05. In Table 3, we can check the performance of the model when the values are 'inschool', 'workpt', and 'workft', respectively. The p-value of coefficient of $\mathbf{z_{i,g,t}}$ were all zero. But except for ‘workpt’, no $\mathbf{z_{i,g,t}}$ could make log(real minimum wage) significant. Therefore, we can conclude that only ‘workpt’ can be $\mathbf{z_{i,g,t}}$ when y=employed.

2. Analysis of employment type (y='workft' or 'workpt')

When y is ‘workft' and ‘workpt’, the variables with 'ft' and 'pt' cannot enter the $\mathbf{z_{i,g,t}}$. And repeat the preceding process to find $\mathbf{z_{i,g,t}}$.

There are three possible candidates : 'inschool', 'emp_rest', and 'emp_retail'. Not any $\mathbf{z_{i,g,t}}$ can make value value of log (real minimum wage) less than 0.05 when ‘workpt’ is input to y. Since all $\mathbf{z_{i,g,t}}$ cannot make log(real minimum rage) significant, I judged that it is inappropriate to set ‘workpt’ to y. When ‘y=workft', only ‘emp_retail’ makes p value of $\mathbf{z_{i,g,t}}$ 0 and p value of real minimum wage less than 0.05. Therefore, since all of the aforementioned conditions were satisfied when ‘emp_retial’ is input to $\mathbf{z_{i,g,t}}$, I concluded that setting ‘workft' to y was

appropriate for predicting the relationship between employment type and minimum wage. And the appropriate $\mathbf{z_{i,g,t}}$ is 'emp_retail'.

IV. A Description of the Data

There are 75 variations in original data set. The data are sorted by year and state. In the year, various variables representing the status of employment and work in the state are included in the dataset.

The markings on the back:

1617: age from 16 to 17 / 1819: age from 18 to 19 / f: female(gender) / m: male(gender) / w: white(race) / min: minority(race)

1. Dependent variable : ‘employed’, ‘workft', ‘workpt’

It indicates the degree to which people were employed in the state in the year in Employed. The subdivisions can be divided into 'employed1617', 'employed1819', 'employedf', 'employedm', 'employedw', and 'employedmin'. Each represents the percentage of people employed corresponding to the following notation. Table2 shows summary statistics of variables about employment.

2. Explanatory variable measured at the individual and group level (control variable) : ‘minwage’

It represents the minimum wage in the state in the year. Figure 1 shows the minimum wage rate

for each state as a graph.

3. Policy effect

The data belonging to this are largely classified into gender, age, race, work type, and employment type. And it can be categorized within one type. For example, 'emp_restf' refers to a case where the type of work is restaurant (working at restaurant) and the gender is female. Categorization is not necessarily done once, but may be done several times. For example, 'emp_rest_ftf' refers to a case where the work type is restaurant (working at restaurant), the employment type is full time, and the gender is female. In this way, several conditions are set in one data.

Table1 shows summary statistics of main policy effect variables.

4. Additional data

Additionally, 'cpi' is included in the dataset. CPI stands for 'Consumer Price Index', an index that measures the average price of goods and services that families buy to consume. Inflation can be measured by its rate of change. The consumer price index can be used to adjust the impact of inflation by linking salaries, salaries, pensions, and prices.

To eliminate the effect of CPI on the minimum wage, I used the following formula.

$$real\ minimum\ wage = minimum\ wage \div CPI \times 100$$

(v) a discussion of the econometric results.

I conducted two major analyses; an analysis of the degree of employment itself (y = employed) & An Analysis of Employment Types(y = 'workft' or 'workpt')

1. Relationship between the rate of employment and minimum wage rate (y=employed)

Model was created by substituting 'workpt' for the value of $\mathbf{z_{i,g,t}}$, and using it, we found out how gender, age, and race are affected by the minimum wage rate. The results are summarized in Table 4.

First, according to the analysis results of the overall employment rate, there are the opposite effects of the minimum wage rate and the employment rate (as the minimum wage rate increases, employment decreases). This is because the coefficient (β) was negative. In addition, since the p-value value is also less than 0.05, this relationship is significant, and it can be said that the increase in the minimum wage leads to a decrease in the overall employment rate.

It was found that when the gender is male and female, there is an opposite effect between the minimum wage rate and the employment rate (as the minimum wage rate increases, their employment decreases). This is because the coefficient (β) value was negative. However, both are not significant because the p value is greater than 0.05. It can be concluded that there is not much correlation.

When the age is 16-17, the results show that the minimum wage rate and the employment rate have the opposite effect (as the minimum wage rate increases, their employment decreases). This is because the coefficient (β) value was negative. The results showed that there was a proportional effect when it was 18-19. However, both are not significant because the p value is greater than 0.05. It can be concluded that there is not much correlation.

It was found that when the race is either white or minority, there is an opposite effect between the minimum wage rate and the employment rate (as the minimum wage rate increases, their employment decreases). This is because the coefficient (β) value was negative. However, when the race is white, the p-value is greater than 0.05, so it is not significant, and in fact, when the race is minor, the minimum wage rate and the employment rate can be considered the opposite effect. It can be concluded that the employment rate decreases when the minimum wage rate rises only when the race is minimal.

2. Relationship between the type of employment and minimum wage rate (y=workft)

The results are summarized in Table 7.

First, according to the analysis results for the employment type, there is an opposite effect (the ratio of full time employment decreases as the minimum wage rate increases) between the minimum wedge rate and the full time. Because the coefficient (β) value was negative. In addition, since the p-value value is also less than 0.05, this relationship is significant, and it can be said that the increase in the minimum wage leads to a decrease in full-time work overall.

It was found that when the gender is either male or female, the ratio of minimum wage rate and full time employment rate has the opposite effect. This is because the coefficient (β) value was negative. Since the p value is less than 0.05 in female, it can be concluded that when the minimum wage rate rises, the full time employment rate decreases, but since the p-value is greater than 0.05, it is meaningless. It can be concluded that there is not much correlation.

When the age was 16-17, it was found that there was a proportional correlation between the minimum wage rate and the ratio of working full time. At 18-19, it was found that the they had

the opposite effect. Since the p-value is only large at 18-19, it can be concluded that the full-time employment rate decreases as the minimum wage rate increases only at age 18-19.

It was found that in race is either white or minority inproportional correlation between the minimum wage rate and the ratio of working full time. However, when the race is white, the p-value is greater than 0.05, so it is not significant. Correlation is only significant when the race is minority. It can be concluded that only when the race is minority, the employment full time decreases when the minimum wage rate rises.

(VI) Conclusion and Further Research

An increase in the minimum wage rate leads to a decrease in the overall employment and a decrease in the full-time employment rate.

Teenager, whose race is minor, are greatly affected by the decrease in employment due to the increase in the minimum wage ratio.

Teenagers aged 18-19 and teenagers of rage ‘minorities’ are greatly affected by the decrease in the full-time employment rate due to the increase in the minimum wage rate.

An increase in the minimum wage rate can negatively affect the employment of teenagers, and teenagers of rage ‘minorities’ are particularly affected.

This research confirmed that the minimum wage rate can have a negative effect on the employment rate and full-time work rate. But as a result of this, can we immediately conclude that the rise in the minimum wage has a negative impact on society? I think that is a hasty

conclusion. This is because, depending on the analysis method, some analyzed that the rise in the minimum wage does not significantly affect various employment. Also, there are many other factors that the minimum wage has a positive effect. This research did not take into account any other positive effects from the rise in the minimum wage. Only employment-related matters were considered. Therefore, I think that if we make a new model by considering various correlation such as 'the relationship between minimum wage increase and the rich and poor gap' and 'the relationship between minimum wage and income for people who low income level', we will be able to find out more accurately how the minimum wage can affect the people who are truly affected a lot by policies.

(VII) Reference

1. SYLVIA A. ALLEGRETTO, ARINDRAJIT DUBE, and MICHAEL REICH. Do Minimum Wages Really Reduce Teen Employment? Accounting for Heterogeneity and Selectivity in State Panel Data. INDUSTRIAL RELATIONS, Vol. 50, No. 2 (April 2011). 2011 Regents of the University of California Published by Wiley Periodicals, Inc., 350 Main Street, Malden, MA 02148, USA, and 9600 Garsington Road, Oxford, OX4 2DQ, UK

2. Madeline Zavodny. The effect of the minimum wage on employment and hours. Labour Economics 7 2000 729–750. Received 3 November 1997; accepted 17 March 2000. Research Department, Federal ReserÕe Bank of Atlanta, 104 Marietta Street, Atlanta, GA 30303, USA

Figure1. Minimum wage according to state

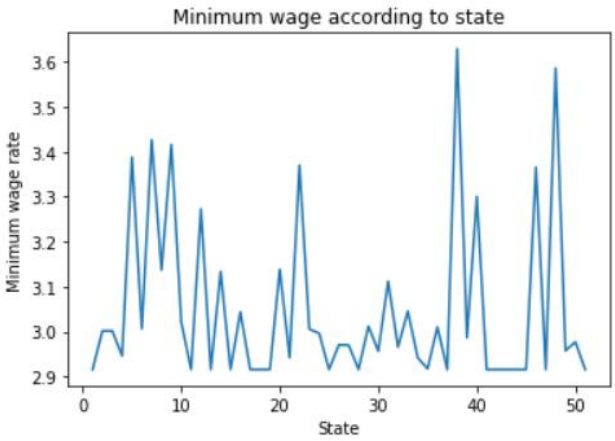

Table1. Summary statistics of main variables

Variables	count	mean	Standard deviation	min	25% percentile	50% percentile	75% percentile	max
Log(real minimum wage)	1224	1.11	0.10	0.92	1.03	1.10	1.18	1.39
Real minimum wage	1224	3.06	0.31	2.51	2.82	3.01	3.25	4.02
Part time work	1224	0.11	0.04	0.01	0.08	0.11	0.14	0.33
Full time work	1224	0.81	0.05	0.61	0.77	0.81	0.85	0.95
inschool	1224	0.81	0.05	0.61	0.77	0.81	0.85	0.95

Table2. Summary statistics of employment variables

Variables	count	mean	Standard deviation	min	25% percentile	50% percentile	75% percentile	max
employed	1224	0.36	0.10	0.05	0.30	0.37	0.43	0.68
Male employed	1224	0.35	0.11	0.00	0.28	0.35	0.43	0.72
Female employed	1224	0.38	0.11	0.01	0.30	0.37	0.45	0.74
Age 16-17 employed	1224	0.27	0.11	0.01	0.19	0.26	0.34	0.64
Age 18-19 employed	1224	0.47	0.11	0.07	0.40	0.47	0.54	0.82
Race: white employed	1224	0.40	0.11	0.00	0.33	0.40	0.47	0.71
Race: minority employed	1224	0.27	0.12	0.00	0.20	0.26	0.34	1.00

Table3. finding the most appropriate $z_{i,g,t}$ for $y = employed$

$z_{i,g,t}$	R squared	p-value of $z_{i,g,t}$	p-value of log(real minimum wage)	T- stats of $z_{i,g,t}$	t-stats of log(real minimum wage)	F-test for Poolability
inschool	0.0724	0	0.1088	-7.8680	-1.6050	55.249
Part time work	0.5895	0	0.0205	40.904	-2.3210	14.391
Full time work	0.2872	0	0.2621	22.836	-1.1219	48.249

Table4. Employment rate of according to change of minimum wage rate

	Original(Employed)	Gender: female	Gender: male	Age: 16-17	Age: 18-19	Race: whte	Race: minority
Coefficient(β)	-0.0503	-0.0573	-0.0373	-0.0609	0.0375	-0.0313	-0.1034
p-value of β	0.0205	0.0857	0.2135	0.0539	0.2851	0.1990	0.0419

Table5. finding the most appropriate $z_{i,g,t}$ for $y = workpt$

$\mathbf{z_{i,g,t}}$	R squared	p-value of $\mathbf{z_{i,g,t}}$	p-value of log(real minimum wage)	T- stats of $\mathbf{z_{i,g,t}}$	t-stats of log(real minimum wage)	F-test for Poolability
inschool	0.0057	0.0329	0.3420	2.1363	-0.9506	47.730
Restaurant employment	0.1417	0	0.7544	15.756	-0.3129	37.886
Retail employment	0.3723	0	0.9626	27.850	-0.0469	7.948

Table6. finding the most appropriate $z_{i,g,t}$ for $y = workft$

$\mathbf{z_{i,g,t}}$	R squared	p-value of $\mathbf{z_{i,g,t}}$	p-value of log(real minimum wage)	T- stats of $\mathbf{z_{i,g,t}}$	t-stats of log(real minimum wage)	F-test for Poolability
inschool	0.2501	0	0.0991	-16.165	-1.6505	0.736
Restaurant employment	0.0160	0.0151	0.0242	2.4337	-2.2572	13.494
Retail employment	0.0561	0	0.0305	6.4572	-2.1657	2.684

Table7. Full time employment rate of according to change of minimum wage rate

	Original (rate of working full time)	Gender: female	Gender: male	Age: 16-17	Age: 18-19	Race: whte	Race: minority
Coefficient(β)	-0.0442	-0.0568	-0.0291	0.0161	-0.0806	-0.0203	-0.1148
p-value of β	0.0305	0.0241	0.2613	0.1883	0.0123	0.4338	0.0003