Time Series Minimum Wage Studies

Meta-Analysis

Byler J., Korzeń K.

University of Warsaw, Faculty of Economic Sciences

May, 2021

Introduction

The effect of minimum wage on the employment and especially on the employment among teenagers is a well-known research problem that was addressed multiple times in the past. Conducted studies usually refer to a negative impact of minimum wage increase on the employment rate. In other words, the coefficient for minimum wage as an independent variable is negative, when the dependent variable considered is the unemployment rate.

There are numerous ways on how to examine this relationship. Among papers related to this problem, we found evidence of panel data models, cross-sectional data models as well as aggregated time series data models. Although the majority of researchers consider only the United States data, we found examples of different regions such as European or Asian countries analysed as well.

We believe that reproducing results obtained by other researchers is a crucial part of science, especially when it comes to conclusions of that importance. Therefore, the main goal of this research paper is two-fold. First, we aim to reproduce the results of a well-known meta-analysis conducted in the late 1990s by Card and Krueger (1995). In the aforementioned paper, authors examined 15 studies on this topic and drew multiple conclusions considering the quality of the cited studies. Moreover, authors put an emphasis on the problem of *publication bias*, while conducting their own research. When it comes to meta-research, the obtained and aggregated results, such as coefficients are not the most important factors. In this type of research, authors usually look for various biases that could lead to wrong conclusions, which were later replicated over time by other scientists. After reproducing the results obtained by Card and Krueger, we aim to further enhance the analysis by adding additional papers, especially focusing on these, which were published later than the meta-analysis we reproduce. This is important considering the fact that in the original meta-analysis authors claimed that the sample size can have a substantial effect on the t-statistics obtained by the researchers. With research papers published later, the probability of a higher sample is naturally greater.

The next section presents the process of reproducing the meta-analysis done by Card and Krueger. Then we enrich the analysis with two additional papers and present the obtained results. Last section concludes.

Previous Meta-Analysis

Original paper that we aim to reproduce was published in 1995. In the past, more than 25 years ago, reproducibility was not considered such an important topic as it is today. Although the authors presented a reliable meta-analysis, they did not include the original data such as *t-statistics* in their research. We not only reproduce the obtained results in a form of replicating the modeling and visualization process, but we need to look for the required information in original papers or in other meta-analyses. Two research papers were especially helpful. One has explored the older studies (Brown, Gilroy, and Kohen 1982), while the other was aggregating newly published research papers as well (Neumark and Wascher 2006).

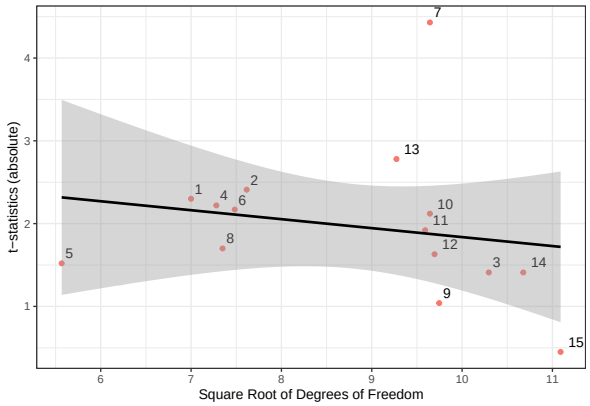
For the purpose of reproducibility, we have gathered the information of all 15 papers analysed in the original meta-analysis. Our dataset consists of the author(s), date of publication (`year`), *t-statistic* in absolute terms[1] (`t_stat`), *degrees of freedom* (`df`), coefficient of the minimum wage variable in absolute terms[2] (`coef`), number of explanatory variables of the model (`no_exp_var`), the error of the model (`error`) and two dummy variables. One binary variable is set to 1, when there was a logarithmic specification of the model (`log_spec`) and the second one is set to 1, when the autoregression correction was applied (`autoreg_correction`). We additionally calculate the square roots of `df` and the natural logarithm of the square root of `df` as in the original research paper, and name these variables `sqrt_df` and `l_sqrt_df`, respectively. Due to lack of sufficient information from the original meta-analysis authors, we lack the binary variable indicating whether the model had taken the subsample of teenagers, rather than the total population. We had gathered the information for all research papers considered but one. In result, we were missing one datapoint, which is the number of explanatory variables for Klerman's study published in 1992, but we have managed to find that number by looking at the mean of this variable given in the original Card and Krueger paper.

Authors originally looked at earlier meta-research, similarly as we are. They extended the previous study by an additional three papers. Looking for a direct specification of the models, rather than just for the coefficient values is an exceptional effort. Most studies either show only the narrow results or they are not available to find in an open source research aggregators. Nevertheless, we have managed to find the details for two papers published after the Card and Krueger publication in 1995. To be more precise, we will enrich our analysis by adding paper by Bernstein and Schmitt (2000) as well as by Bazen and Marimoutou (2002). We have also looked for information on detailed model specification in other papers such as Williams and Mills (2001) but we were unable to find sufficient information to support the analysis. First, we present the results of the reproduced original research, with the exclusion of teenager sub-sample variable.

[1] All considered t-statistics are negative.
[2] All considered coefficients are negative.

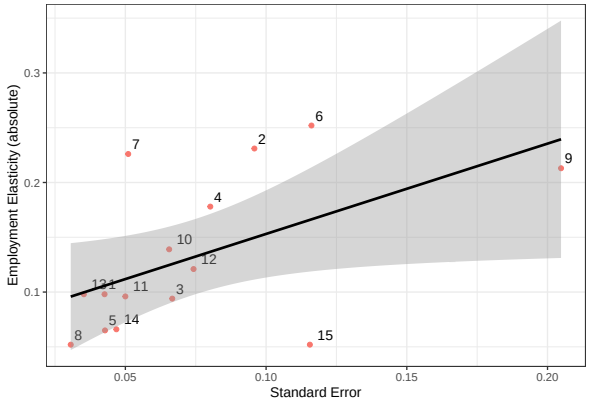
On the Figure 1, we present the reproduced results for the relationship between absolute t-statistics and square root of `df`. On the Figure 2, we present the estimated elasticities for employment compared to the standard error estimates.

Figure 1. Estimated t-statistics compared to Degrees of Freedom



Note: Presented sample is the one analysed by Card and Krueger. The fitted regression line is simple linear model with 95 pct. confidence intervals.

Figure 2. Estimated Employment Elasticity compared to Standard Error Estimate

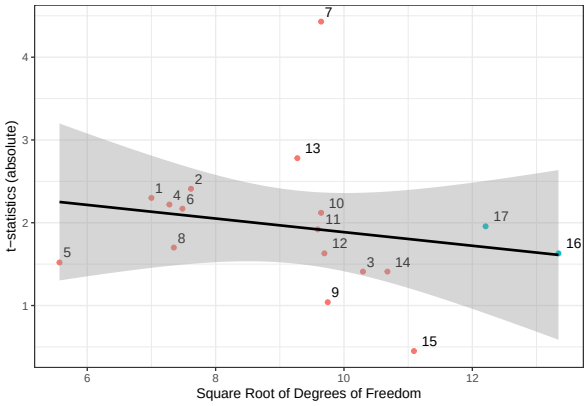


Note: Presented sample is the one analysed by Card and Krueger. The fitted regression line is simple linear model with 95 pct. confidence intervals. Line without confidence intervals represent the Standard Error multiplied by 2.

We present the reproduced regressions in Table 1, in Appendix.

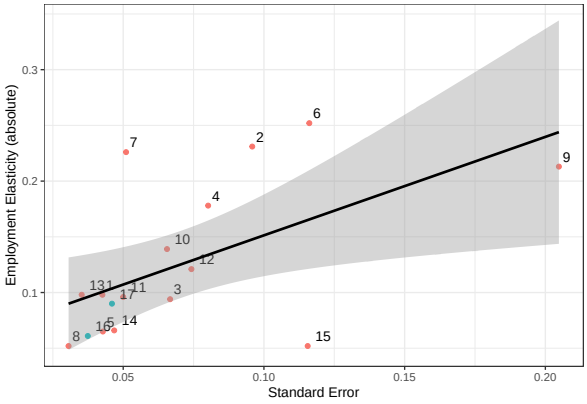
Extended Meta-Analysis

Figure 3. Estimated t-statistics compared to Degrees of Freedom (Extended)



Note: Presented sample is the one analysed by Card and Krueger extended by two additional studies published after the publication of the original meta-analysis. The fitted regression line is simple linear model with 95 pct. confidence intervals. Blue colour indicates the studies added to the reproduced original meta-analysis by Card and Krueger.

Figure 4. Estimated Employment Elasticity compared to Standard Error Estimate (Extended)



Note: Presented sample is the one analysed by Card and

Krueger extended by two additional studies published after the publication of the original meta-analysis. The fitted regression line is simple linear model with 95 pct. confidence intervals. Line without confidence intervals represent the Standard Error multiplied by 2. Blue colour indicates the studies added to the reproduced original meta-analysis by Card and Krueger.

Add 2-5 newer studies, preferably using the selection process reported in the original study.

Replicate the results with the extended sample.

Present your findings and discuss them.

Conclusion

Lorem Ipsum sit dolor amet

Appendix

Table 1. Regression Models for the Logarithm of Absolute t-statistics of Minimum Wage Emplyoment Effect

	Dependent variable:		
	log(t_stat)		
	(1)	(2)	(3)
l_sqrt_df	−0.81	−0.64	−0.94
	(0.69)	(0.66)	(0.62)
autoreg_correction		−0.07	−0.11
		(0.27)	(0.24)
log_spec		−0.55*	−0.63**
		(0.28)	(0.26)
no_exp_var			0.05*
			(0.03)
Constant	2.31	2.41	2.61*
	(1.49)	(1.40)	(1.27)
Observations	15	15	15
R^2	0.10	0.33	0.50
Adjusted R^2	0.03	0.15	0.30
Residual Std. Error	0.50 (df = 13)	0.47 (df = 11)	0.43 (df = 10)
F Statistic	1.37 (df = 1; 13)	1.83 (df = 3; 11)	2.51 (df = 4; 10)
Note:			*p<0.1; **p<0.05; ***p<0.01

Note: The sample used to estimate regression models is the same as in original meta-analysis by Card and Krueger. The binary variable for teenager sub-sample was removed, due to lack of information available to authors.

Table 2. Regression Models for the Logarithm of Absolute t-statistics of Minimum Wage Emplyoment Effect (Extended)

	Dependent variable:		
	log(t_stat)		
	(1)	(2)	(3)
l_sqrt_df	−0.54	−0.31	−0.47
	(0.53)	(0.54)	(0.52)
autoreg_correction		−0.05	−0.07
		(0.26)	(0.24)
log_spec		−0.52*	−0.57**
		(0.27)	(0.25)
no_exp_var			0.04
			(0.03)
Constant	1.76	1.69	1.65
	(1.18)	(1.13)	(1.07)
Observations	17	17	17
R^2	0.06	0.28	0.40
Adjusted R^2	0.001	0.11	0.20
Residual Std. Error	0.48 (df = 15)	0.45 (df = 13)	0.43 (df = 12)
F Statistic	1.02 (df = 1; 15)	1.64 (df = 3; 13)	2.00 (df = 4; 12)
Note:			*p<0.1; **p<0.05; ***p<0.01

Note: The sample used to estimate regression models is the same as in original meta-analysis by Card and Krueger extended by two additional studies published after the publication of the original meta-analysis. The binary variable for teenager sub-sample was removed, due to lack of information available to authors.

References

Abowd, John M, and Mark Killingsworth. 1981. "Structural Models of the Effects of Minimum Wages on Employment by Age Groups." *Report of the Minimum Wage Study Commission* 5: 143–69.

Bazen, Stephen, and Velayoudom Marimoutou. 2002. "Looking for a Needle in a Haystack? A Re-Examination of the Time Series Relationship Between Teenage Employment and Minimum Wages in the United States." *Oxford Bulletin of Economics and Statistics* 64. Wiley Online Library: 699–725.

Bernstein, Jared, and John Schmitt. 2000. "The Impact of the Minimum Wage." *Economic Policy Institute*.

Betsey, Charles L, and Bruce H Dunson. 1981. "Federal Minimum Wage Laws and the Employment of Minority Youth." *The American Economic Review* 71 (2). JSTOR: 379–84.

Brown, Charles. 1983. "Time Series Evidence on the Effect of the Minimum Wage on Youth Employment and Unemployment." 18(1). *Journal of Human Resources*.

Brown, Charles, Curtis Gilroy, and Andrew Kohen. 1982. "The Effect of the Minimum Wage on Employment and Unemployment: A Survey." National Bureau of Economic Research.

Card, David, and Alan B Krueger. 1995. "Time-Series Minimum-Wage Studies: A Meta-Analysis." *The American Economic Review* 85 (2). JSTOR: 238–43.

Gramlich, Edward M, Robert J Flanagan, and Michael L Wachter. 1976. "Impact of Minimum Wages on Other Wages, Employment, and Family Incomes." *Brookings Papers on Economic Activity* 1976 (2). JSTOR: 409–61.

Hamermesh, Daniel S. 1981. "Minimum Wages and Demand for Labor." *NBER Working Paper*, no. 656. National Bureau of Economic Research.

Iden, George. 1980. "The Labor Force Experience of Black Youth: A Review." *Monthly Lab. Rev.* 103. HeinOnline: 10.

Kaitz, Hyman. 1970. "Experience of the Past: The National Minimum." *Youth Unemployment and Minimum Wages*. US Department of Labor, Bureau of Labor Statistics Washington, 30–54.

Klerman, Jacob Alex. 1992. *Employment Effect of Mandated Health Benefits*. RAND.

Mincer, Jacob. 1976. "Unemployment Effects of Minimum Wages." *Journal of Political Economy* 84 (4, Part 2). The University of Chicago Press: S87–S104.

Neumark, David, and William Wascher. 2006. "Minimum Wages and Employment: A Review of Evidence from the New Minimum Wage Research." *National Bureau of Economic Research Working Paper Series*, no. w12663. National Bureau of Economic Research.

Ragan, James F. 1981. "The Effect of a Legal Minimum Wage on the Pay and Employment of Teenage Students and Nonstudents." *The Economics of Legal Minimum Wages. Washington*

DC, American Enterprise Institute.

Ragan, James F. 1977. "Minimum Wages and the Youth Labor Market." *The Review of Economics and Statistics* 59 (2). The MIT Press: 129–36.

Solon, Gary. 1985. "The Minimum Wage and Teenage Employment: A Reanalysis with Attention to Serial Correlation and Seasonality." *The Journal of Human Resources* 20 (2). JSTOR: 292–97.

Wachter, Michael L., and Choongsoo Kim. 1979. "Time Series Changes in Youth Joblessness." *NBER Working Paper*, no. w0384.

Welch, Finis. 1973. "Minimum Wage Legislation in the United States." RAND Corporation.

Wellington, Alison J. 1991. "Effects of the Minimum Wage on the Employment Status of Youths: An Update." *Journal of Human Resources*. JSTOR, 27–46.

Williams, Nicolas, and Jeffrey A Mills. 2001. "The Minimum Wage and Teenage Employment: Evidence from Time Series." *Applied Economics* 33 (3). [London, etc.] Chapman; Hall [etc.]: 285–300.