Title
Effects of the Minimum Wage on Employment and Productivity

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Effects of the Minimum Wage on Employment and Productivity

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Abstract: This is a panel data study of the effects of the minimum wage increase on youth employment and productivity for the years 2000 to 2017. To address the implementation of sub-state minimum wages during my time sample, I use a weighted average formula when calculating the minimum wage. Overall, I find no statistical significance in the effects of the minimum wage on employment and productivity. I do however find statistical significance when not accounting for sub-state minimum wages, as much of the general literature on the effects of the minimum wage has done. This suggests that accounting for sub-state minimum wages is important, as otherwise researchers may find conclusions that are not truly statistically significant.

[1] I am grateful to my advisor Kelly Bedard, Heather Royer, Chang Hyung Lee, Clement de Chaisemartin, and my classmates for helpful comments and guidance. This paper has benefited from presentations at the UCSB Economics Honors Thesis Seminar. Any remaining errors are attributable to the author.

Background

Economic theory suggests that an increase in a price floor, such as the minimum wage, will result in a market surplus, as supply is greater than demand. In the case of an increase in the minimum wage, it is argued that labor supply will increase, while labor demand will decrease, ultimately resulting in a surplus of labor (unemployment). This theory's relation to the minimum wage has been greatly debated. Contradictory to economic theory, modern research has concluded that the increase in minimum wage has very little to no effect on unemployment. Due to its size, many economists argue that this effect is not truly significant and conclude that the increase in the minimum wage has essentially no effect on employment overall. This conclusion comes from the idea that the demand for labor is almost completely inelastic and that firms will hire labor at essentially any market price in response. I test this argument by looking at the elasticity of labor in addition to the effect of the minimum wage on employment using panel data, as was first modeled by Newmark and Wascher (1992).[2]

The second part of my research question focuses on the effect of the minimum wage on productivity. The efficiency wage theory, developed by George Akerlof (1982), argues that a wage increase leads to an increase in productivity. In my project, I will test the validity of this theory in regards to an increase in wage through the minimum wage policy. Looking at the increase in the minimum wage is slightly different, as this increase in wage is created through government policy instead of through a firm's decision. I will measure productivity using industry specific gross domestic product (GDP) for each state over time. Overall, the effect of the increase in the minimum wage on GDP is ambiguous. It is likely that GDP will increase due to the increase in the minimum

[2] Regardless to elasticity, it should also be noted that even a small negative effect on employment is significant, as increases in the minimum wage are typically just a few cents at a time.

wage for three reasons. First, if employment stays the same (or increases), the higher wage leads to the increase in consumption of these employees. Second, if employment decreases, it effectively becomes more competitive. In response, employees will be required to increase their training and schooling, which will potentially lead to greater levels of innovation. Lastly, the efficiency wage theory may hold, and we may have an increase in employee effort, both because employees are paid more and because employment becomes more competitive. On the other hand, GDP may also decrease in response to the increase in the minimum wage for two reasons. First, the increase in the minimum wage may decrease employment or hours of employment, which leads to a decrease in output and consumption. Second, if firms have to pay a higher price for labor, the marginal cost of production increases, which in turn increases the price of output and decreases demand. This results in a decline in output and GDP. Because of this ambiguity, testing the effect of the minimum wage increase on GDP is especially important.

Overall, I hypothesize that the increase in the minimum wage will decrease employment and increase productivity.

Significance

Although the effect of the minimum wage on employment has been studied extensively, this paper makes several contributions to the literature. First, this paper studies at the years 2000 to 2017, which may result in differences in findings as many states (and sub-states) have increased their state minimum wages by substantial amounts since 2014.[3] For example, District of Columbia has increased its state minimum wage from $8.25 in 2013 to $13.25 in 2018.

Like in the previous literature, I focus on changes in youth employment, particularly for youth between the ages of 16 and 24, as modeled by Neumark and Wascher (1992). This age group makes up about fifty percent of minimum wage earners. Although many states allow individuals aged 14 and 15 to work, there are many laws limiting their hours and job types, which could lead to potential endogeneity.

Second, there is little research studying the effects of the minimum wage on productivity. Studying GDP is especially interesting due to their predicted ambiguity as described earlier.

Lastly, when looking at GDP, I am focusing my analysis on the industries that hire significant percentages of the population of workers with hourly rates that are at the minimum wage. In particular, I will be focusing on retail trade, professional and business services, education and health services, leisure and hospitality, other services within the private sector. The retail trade industry comprises firms that retail merchandise. The professional and business services industry provides professional, scientific, technical, managerial, administrative, and waste management services. The education and health services industry provides educational, health care, and social assistance services. The leisure and hospitality industry provides arts, entertainment, recreation, accommodation, and food services. Lastly, other services within the private sector refers to services such as automobile and heavy equipment repair, dry cleaning and death services, religious

[3] Please refer to *Table 2* in appendix for a list of all cities and counties with minimum wages that are greater than the effective minimum wage for years 2000-2017.

activities and social advocacy.[4] *Table 1* displays the exact percent of minimum wage earners each of the industries encompasses.

*Table 1.*Industries Employing Minimum Wage Earners, 2017.

Industry	Percent of Overall Minimum Wage Workers
Retail Trade	5.2%
Professional and Business Services	2.6%
Education and Health Services	1.2%
Leisure and Hospitality	11%
Other Services within the Private Sector	2.4%

Note: Data from a report entitled "Characteristics of Minimum Wage Workers" published by the Bureau of Labor Statistics for the year 2017.

Data

I. Minimum Wage Data

I use annual sub-state, state, and federal minimum wage data published by Ben Zipperer. This data set includes an *adjusted* minimum wage variable, which is essentially a weighted minimum wage visible. This is necessary, as minimum wage increases do not typically follow the calendar year, resulting in a fluctuation in the minimum wage during a given year. To see how this is calculated, suppose that the original minimum wage for state *s* is $10 in the beginning of year *t* and that a new minimum wage of $12 was imposed halfway into year *t*, the adjusted minimum wage for state *s* at year *t* is therefore 0.5*$10+0.5*$12 or $11. Zipperer creates an adjusted minimum wage variable for both the state and federal minimum wages.

[4] I refer to each industry as defined by the Bureau of Labor Statistics. Please refer to their website for a full definition of each industry.

Creating the adjusted minimum wage variable is a bit more complicated for the time sample studied in this paper, as many cities and counties have imposed their own minimum wages that are higher than the state and federal minimum wages.[5] To account for this, I created a *sub-state adjusted* minimum wage variable using the following formula:

$$SAMW_{st} = \left(\frac{pop_{ct}}{pop_{st}}\right) \times AMW_{ct} + \left(1 - \frac{pop_{ct}}{pop_{st}}\right) \times AMW_{st}$$

Where $SAMW_{st}$ is the sub-state adjusted minimum wage for state *s* in year *t*, pop_{ct} is the population for city *c* in year *t*, pop_{st} is the population for state *s* in year *t*, AMW_{ct} is the adjusted minimum wage for city *c* in year *t*, and AMW_{st} is the adjusted minimum wage for city *s* in year *t*. Overall, we use the *effective* minimum wage, which is the higher of the federal or state adjusted minimum wage.

Lastly, we create a *relative* minimum wage using the following formula:

$$RMW_{st} = \left(\frac{SAMW_{st}}{AW_{st}}\right)$$

Where RMW_{st} is the relative minimum wage for state *s* at year *t*, $SAMW_{st}$ is the sub-state adjusted minimum wage for state *s* at year *t*, and AW_{st} is the average wage for youth in state *s* at year *t*. We use a relative minimum wage as opposed to just the adjusted minimum wage, as it allows us to see the minimum wage in levels.

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[5] Two of the counties with local minimum wages above the effective minimum wage (Los Angeles County and Santa Fe County) also encompass cities with minimum wages above the county minimum wage (Los Angeles City and Santa Fe City) as portrayed by *Table 2*. To account for this, I took a weighted average using a the following formula:

$$\left(\frac{pop_{ct}}{pop_{dt}}\right) \times AMW_{ct} + \left(1 - \frac{pop_{ct}}{pop_{dt}}\right) \times AMW_{dt}$$

Where pop_{ct} is the population for city *c* in year *t*, pop_{dt} is the population for county *d* in year *t*, AMW_{ct} is the adjusted minimum wage for city *c* in year *t*, and AMW_{dt} is the adjusted minimum wage for county *d* in year *t*.

Previous research uses a coverage-adjusted minimum wage, also known as the Kaitz Index. This adjustment is necessary when looking at older data, as many employers were exempt from paying employees wages at or above the minimum wage. These employers encompass what was referred to as the "uncovered sector," while employers in the "covered" sector had to follow the minimum wage laws. Today, the Kaitz Index has lost its relevance, as the majority of employers are within the "covered" sector.

Although we do not need to calculate a coverage-adjusted minimum wage when using current data, it is essential to calculate the relative minimum wage. Dividing the sub-state adjusted minimum wage by the average youth wage allows us to control for changes in inflation per state over time. That is because the average wage of all youth fluctuates relative to inflation, as wage increases when inflation increases and decreases when inflation decreases.[6]

II. Employment Data

I gathered employment and wage data for individuals aged 16-24 using the Integrate Public Use Microdata Series (IPUMS). Using the wage data, I was able to create the annual average wage variables by computing the average wage for individuals aged 16-24 for every state for each year between 2000 and 2017. With regards to the employment data, I am looking at the change in employment as opposed to unemployment, as this data tends to be more. That is, unemployment measures civilians that would like to be employed but are not. This data is collected through self-reporting and is not necessarily accurate. On the other hand, employment data is probably more

[6] Ideally, we would use inflation data across states over time, but this data is unavailable. Using the relative minimum wage has been common practice across the literature.

accurate, as being employed is less abstract and easier to answer. The wage data gathered was used to calculate the relative minimum wage.

III. Gross Domestic Product

I gathered per capita real GDP data by industry, state and year for each year between 2000 and 2017 from the Bureau of Economic Analysis (BEA).

IV. Population

Lastly, I gathered population data by state and year using the Federal Reserve Economic Data (FRED). I use this data to control for changes in the state population, as changes in population likely result in changes in employment and GDP. We must account for these changes to prevent potential endogeneity in our model. When looking at city and county populations, I used a combination of data from FRED and the United States Census Bureau for missing variables.[7] The city and county populations are used when calculating the sub-state adjusted minimum wage.

Empirical Model

In this paper I run two separate sets of regressions: one looking at the effects of the minimum wage increase on employment and the other on GDP. These regressions are based on the canonical two

[7] Although I am not using population data for individuals between the ages 16-24, this should not result in biased results, as it is fair to assume that the population of individuals within this age group in state *s* is increasing at the same rate as the overall population of state *s*.

way fixed effects panel approach studied by Neumark and Wascher (1992). When measuring the effect on GDP, I will be repeating each of these regressions for the five industries I am studying.

$$\log(Emp_{st}) = \beta_0 + \beta_1 \log(RMW_{st}) + \beta_2 \log(pop_{st}) + \delta_s + \pi_t + \varepsilon_{st} \qquad (1.1)$$

$$\log(GDP_{st}) = \beta_0 + \beta_1 \log(RMW_{st}) + \beta_2 \log(pop_{st}) + \delta_s + \pi_t + \varepsilon_{st} \qquad (1.2)$$

Emp_{st} is the employment rate in state *s* at year *t*, RMW_{st} is the relative minimum wage for state *s* at year *t*, pop_{st} is a variable controlling for the population of state *s* at year *t*, δ_s is a state fixed effects dummy variable, π_t is a year fixed effects dummy variable, and ε_{st} is an error term. Similarly, GDP_{st} is GDP in state *s* at year *t*, RMW_{st} is the relative minimum wage for state *s* at year *t*, pop_{st} is a variable controlling for the population of state *s* at year *t*, δ_s is a state fixed effects dummy variable, π_t is a year fixed effects dummy variable, and ε_{st} is an error term.

The state fixed effect dummy variable controls for time invariant state effects, while the year fixed effect dummy variable controls for state invariant year effects. The variable controlling for the population of state *s* at year *t* is an important characteristic, as we want to ensure that changes in employment and GDP are due to increases in the minimum wage and not to changes in population. Lastly, I am taking the natural logs of employment, minimum wage, and GDP in order to measure elasticity.

Findings

Table 3 reports the estimated effect of the minimum wage on youth employment and GDP growth from the canonical two-way fixed effects regression. Each of the six columns corresponds to the six dependent variables studied: GDP of retail trade, GDP of professional and business services, GDP of education and health services, GDP of leisure and hospitality, GDP of other services within the private sector, and employment of individuals aged 16-24. Contrary to the previous literature, I find no statistical significance when looking at the effect of an increase in the minimum wage neither on GDP of the industries studied nor on youth employment.

Table 3. Accounting for Sub-State Minimum Wage, 2000-2017.

	(1) log(retail)	(2) log(profbus)	(3) log(educ)	(4) log(leisure)	(5) log(other)	(6) log(employed)
log(rmw)	0.00480	0.0264	-0.0303	-0.00495	-0.00741	0.0470
	(0.0197)	(0.0181)	(0.0275)	(0.0106)	(0.0394)	(0.110)
log(pop)	-0.286	-0.434	0.525*	-0.0937	-0.0209	0.957
	(0.275)	(0.252)	(0.259)	(0.102)	(0.146)	(0.667)

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Data from IPUMS, BEA, FRED, Census Bureau from 2000 to 2017. Minimum wage is collected by Ben Zipperer and is crosschecked by data collected by the author. All specifications include state level characteristics yearly changes in population for each state, state fixed effects, and year fixed effects. Observation sample size is 918.

Table 4 reports the estimated effect of the minimum wage on youth employment and GDP growth using the same regression, but different data. Here, I ran a regression on data where I did not calculate the sub-state adjusted minimum wage, but just the state adjusted minimum wage. This data therefore does not account for cities and counties that have implemented a minimum wage increase that is above the effective minimum wage. Looking at these results, we can see that we do get a misleading statistical significance when analyzing the effect of the minimum wage on GDP in retail trade and on youth employment. Using this data, we wrongfully conclude that a ten percent increase in the minimum wage is associated with essentially no change in retail trade GDP and a 1.9 percent increase in youth employment. Although I did not find statistical significance in the effect of the minimum wage, I did find evidence that accounting for changes in the sub-state minimum wage can be extremely important. Not accounting for changes in sub-state minimum wages can lead to false conclusions.

Table 4. Not Accounting for Sub-State Minimum Wage, 2000-2017.

	(1)	(2)	(3)	(4)	(5)	(6)
	log(retail)	log(profbus)	log(educ)	log(leisure)	log(other)	log(employed)
log(rmw)	-0.0516*	-0.0209	0.00167	-0.00640	-0.0326	0.189***
	(0.0249)	(0.0219)	(0.0275)	(0.00503)	(0.0238)	(0.0375)
log(pop)	-0.296	-0.445	0.534*	-0.0934	-0.0244	0.976
	(0.271)	(0.250)	(0.261)	(0.103)	(0.143)	(0.662)

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Data from IPUMS, BEA, FRED, Census Bureau from 2000 to 2017. Minimum wage is collected by Ben Zipperer and is crosschecked by data collected by the author. All specifications include state level characteristics yearly changes in population for each state, state fixed effects, and year fixed effects. Observation sample size is 918.

Lagged Effects

As argued by Baker, Benjamin, and Stanger (1999), it is necessary to account for lagged effects, as increases in the minimum wage lead to two potential changes that happen in the long run. The first is when wages increase due to the minimum wage, employers may respond by substituting between labor and capital. The second is when wages increase, the marginal cost of production increases, which results in an increase in the price of output and a decrease in demand and therefore an overall decrease in production. Because both of these processes occur in the long run, it is important to run a lagged regression to check for any potential variation. I will be running two sets of regressions, as these lagged effects could be potentially evident with both changes in employment and changes in GDP. For these reasons I am also looking at the following regressions:

$$\log(Emp_{st}) = \beta_0 + \beta_1 \log(RMW_{st}) + \beta_2 \log(RMW_{st-1}) + \beta_3 \log(pop_{st}) + \delta_s + \pi_t + \varepsilon_{st}$$

$$\log(GDP_{st}) = \beta_0 + \beta_1 \log(RMW_{st}) + \beta_2 \log(RMW_{st-1}) + \beta_3 \log(pop_{st}) + \delta_s + \pi_t + \varepsilon_{st}$$

These regressions are the same as regressions (1.1) and (1.2), but with an added term (RMW_{st-1}), which measures the relative minimum wage of state s in year t-1 (the previous year).

Table 5 reports the estimated effect of the minimum wage on youth employment and GDP growth when accounting for lagged effects. Looking at the table we can see that we do get statistical significance for two variables: GDP of the professional business industry and GDP of the leisure and hospitality industry. That is, a ten percent increase in the minimum wage is associated with a .36 percent increase in GDP of the professional business industry and a .13 percent decrease in GDP of the leisure and hospitality industry.

Table 5. Accounting for Sub-State Minimum Wage and Lagged Effects, 2000-2017.

	(1) log(retail)	(2) log(profbus)	(3) log(educ)	(4) log(leisure)	(5) log(other)	(6) log(employed)
log(rmw)	-0.0125	0.0363*	-0.0235	-0.0147**	-0.0126	0.00540
	(0.0260)	(0.0144)	(0.0195)	(0.00518)	(0.0351)	(0.0701)
Lagged log(rmw)	0.0643	-0.00881	-0.0120	0.0183	0.0151	0.0667
	(0.0338)	(0.0178)	(0.0217)	(0.0213)	(0.0155)	(0.0733)
log(pop)	-0.291	-0.477	0.572	0.136	-0.123	1.046
	(0.284)	(0.290)	(0.305)	(0.170)	(0.178)	(0.700)

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Data from IPUMS, BEA, FRED, Census Bureau from 2000 to 2017. Minimum wage is collected by Ben Zipperer and is crosschecked by data collected by the author. All specifications include state level characteristics yearly changes in population for each state, state fixed effects, and year fixed effects. Observation sample size is 918.

Serial Correlation

As argued by Bertrand, Duflo, and Mullainathan (2004), many difference-in-differences studies suffer from serial correlation as each variable has some correlation with the lagged version of itself. In this paper, it is important to address serial correlation for three main reasons. First, similar to other minimum wage studies, I am looking at a large time period. Second, the relative minimum wage of each state is highly positively serially correlated. That is, if the minimum wage is very high in state *s* in year *t=0,* it is very likely that it will also be very high in the following years. Lastly, the relative minimum wage variable (treatment variable) changes very little within a state over time. Although this is up for debate in regards to the last couple of years of our data, it is true for the majority of the time sample. To account for this, I cluster the standard errors on state and get the results depicted by *Table 6.* When accounting for serial correlation, we find that a ten percent increase in the minimum wage is associated with a .63 percent increase in the GDP of other industries within the private sector.

Table 6. Accounting for Sub-State Minimum Wage and Serial Correlation, 2000-2017.

	(1)	(2)	(3)	(4)	(5)	(6)
	log(retail)	log(profbus)	log(educ)	log(leisure)	log(other)	log(employed)
log(rmw)	-0.0428	-0.0190	-0.123	0.0303	0.0631**	0.310
	(0.0576)	(0.0424)	(0.0773)	(0.0262)	(0.0181)	(0.308)
log(pop)	0.00126	0.00324	-0.00226	0.00346	0.00910	0.867***
	(0.00761)	(0.0125)	(0.0116)	(0.00372)	(0.0110)	(0.0204)

Standard errors in parentheses clustered at the state level
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Data from IPUMS, BEA, FRED, Census Bureau from 2000 to 2017. Minimum wage is collected by Ben Zipperer and is crosschecked by data collected by the author. All specifications include state level characteristics yearly changes in population for each state, state fixed effects, and year fixed effects. Observation sample size is 918.

Conclusion

This paper studies how the minimum wage affects youth employment and overall productivity as measured using GDP for the years 2000 to 2017. When accounting for sub-state minimum wage increases, our findings suggest that there is no correlation between the minimum wage and neither youth employment nor GDP in the five industries studied.

Interestingly, this paper is able to highlight the importance of accounting for sub-state minimum wage changes, as when we ran the same regression on data that does not account for these sub-state minimum wages we find misleading statistical significance.

Further research on this topic may consider the effect of the minimum wage on employment in particular industries. Focusing on particular industries could potentially help us gain insight on lagged effects, as they might be specific to industry type.

The minimum wage remains an important area of research, as these studies help guide policymakers in making important decisions regarding the minimum wage and its overall effectiveness. Although we did not find statistically significant results, it does not mean that the minimum wage does not have an effect on total welfare. Further research in the upcoming years will be of great interest, as many states and sub-states have already planned large increases in the minimum wage.

Appendix:

Table 2. Cities and Counties with Minimum Wage Above Effective Minimum Wage, 2000-2017.

State	Year	Cities/ Counties with $MW_c > MW_s$
California	2004	San Francisco
	2005	San Francisco
	2006	San Francisco
	2007	San Francisco
	2008	San Francisco
	2009	San Francisco
	2010	San Francisco
	2011	San Francisco
	2012	San Francisco
	2013	San Francisco, San Jose
	2014	Berkeley, San Francisco, San Jose
	2015	Berkeley, Emeryville, Mountain View, Oakland, Richmond, San Diego, San, Francisco, San Jose, Sunnyvale
	2016	Berkeley, El Cerrito, Emeryville, Los Angeles, Los Angeles County, Mountain View, Oakland, Palo Alto, Richmond, San Diego, San Francisco, San Jose, Santa Clara, Santa Monica, Sunnyvale
	2017	Berkeley, Cupertino, El Cerrito, Emeryville, Los Altos, Mountain View, Oakland, Palo Alto, Richmond, San Diego, San Francisco, Santa Clara, Sunnyvale
Illinois	2015	Johnson County
	2016	Johnson County
	2017	Johnson County, Wapello County
Kentucky	2015	Louisville
	2016	Lexington, Louisville
	2017	Lexington
Maine	2016	Portland
	2017	Portland
Maryland	2014	Montgomery County, Prince George's County
	2015	Montgomery County, Prince George's County
	2016	Montgomery County, Prince George's County
	2017	Montgomery County, Prince George's County
New Mexico	2004	Santa Fe
	2005	Santa Fe
	2006	Santa Fe
	2007	Albuquerque, Santa Fe
	2008	Albuquerque, Santa Fe
	2009	Santa Fe
	2010	Santa Fe
	2011	Santa Fe
	2012	Santa Fe
	2013	Albuquerque, Bernalillo County, Santa Fe
	2014	Albuquerque, Bernalillo County, Santa Fe, Santa Fe County
	2015	Albuquerque, Bernalillo County, Las Cruces, Santa Fe, Santa Fe County
	2016	Albuquerque, Bernalillo County, Las Cruces, Santa Fe, Santa Fe County
	2017	Albuquerque, Bernalillo County, Las Cruces, Santa Fe, Santa Fe County
New York	2016	Long Island & Westchester, New York City

	2017	Long Island & Westchester, New York City
Washington	2014	SeaTac
	2015	SeaTac, Seattle
	2016	SeaTac, Seattle, Tacoma
	2017	SeaTac, Seattle, Tacoma

Note: Data wage is collected by Ben Zipperer and is crosschecked by data collected by the author for the years 2000 to 2017.

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