The Impact of a $15 Minimum Wage on Hunger in America

Appendix A: Theoretical Model

SEPTEMBER 1, 2016 — WILLIAM M. RODGERS III

Since I only observe the outcome of whether the household nutritional level exceeds a particular threshold, and not the actual nutritional level, I model food security for the *hth* household as an unobserved latent variable, y^*, such that

(1)

$$y_h^* = X_h \beta + \varepsilon_h .$$

Depending on the specification, the vector X_h contains household-specific information such as the age, gender, race, educational attainment, industry, and occupation of the reference person in the household (e.g., householder). The vector also contains household-level information on the number of individuals in the household, urban residency, and food stamp usage and amount. The vector also contains state level information: the natural logarithm of the ratio of state and federal minimum wages and the state unemployment rate. I assume that ∑ has a standard normal distribution with mean zero and variance one. To operationalize Equation (1), I write

(2)

$$y_h = 1, \; if \;\; N_h^* > N_{\min},$$
$$y_h = 0, \; if \; N_h^* \le N_{\min},$$

where y_h denotes a dummy variable that equals 1 if the nutrition level of the *hth* household exceeds some minimum threshold and 0 if not. Given our assumption that the residual is distributed with mean zero and variance of 1, I estimate a probit model.

It is well-known that the estimated coefficients for probit models can only be utilized to determine the direction of a variable's impact on the probability of food security. To estimate the impact that a change in a variable has on the probability of food security, I use the estimated coefficients from our probit equation and each household's vector of characteristics to construct an index ($X_h \hat{\beta}$) for the each household. I then calculate each household's partial derivative, the change in the probability of food security with respect to a change in the *kth* variable, and compute the average of the partial derivatives over the *H* households. The resulting marginal effect of the *kth* explanatory variable on the probability of food security is

(3)

$$\overline{\frac{\partial P[y=1]}{\partial X_k}} = \frac{1}{H}\sum_{h=1}^{H}\left(\frac{\partial P[y=1]}{\partial X_k}\right)_h = \frac{1}{H}\sum_{h=1}\phi(X\hat{\beta}_h)\hat{\beta}_k$$

where $\phi(\cdot)$ is the density function of the standard normal distribution.

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Food security is one of three potential thresholds that a household can achieve. To model the dynamics of how an increase in the minimum wage works, I estimate ordered probit models. I write the model as follows:
(4)

$$y_h = 2, if \quad N_h^* > N_{2,}$$
$$y_h = 1, \; if \; N_2 > N_h^* > N_1,$$
$$y_h = 0, \; if \; N_h^* \le N_{\min},$$

where y_h denotes a discrete variable that equals 2 if the nutrition level of the *hth* household exceeds the threshold N_2, which indicates "Food" secure. The variable equals 1, denoting "Low" security if the nutrition level exceeds the threshold N_1 but is less than the threshold N_2, and the variable equals 0 if the nutrition level does not exceed the threshold N_{min}, denoting "Very Low" food security. Given our assumption that the residual is distributed with mean zero and variance of 1, I estimate an ordered probit model.

Similar to the probit model, the estimated coefficients for the ordered probit models can only be utilized to determine the direction of a variable's impact on the probability of food security. To estimate the impact that a change in a variable has on the probability of "Food Security," "Low" security, and "Very Low" security, I use the estimated coefficients from the ordered probit equation and each household's vector of characteristics to construct an index (($X_h \hat{\beta}$)) for the each household. I then calculate each household's partial derivative, the change in the probability of food security with respect to a change in the *kth* variable, and compute the average of the partial derivatives over the *H* households.

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Appendix B: Methods and Data

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This section first describes the econometric specifications and data used in the analysis.

Allegretto, Dube, and Reich (2011) estimate a minimum wage specification that takes into account heterogeneous employment patterns that are correlated with selectivity among states with minimum wages. To account for these factors, the specification controls for long-term growth differences among states and for heterogeneous economic shocks. However, there exists a debate about its validity. Neumark and Wascher (2014) argue that Allegretto, Dube and Reich's specification is over specified. It removes potentially useful variation that identifies the minimum wage's impact. At issue, is whether division-specific time effects and state-specific linear trends should be included in the model?

Because of this unresolved conflict, this report presents an alternate approach, the regression discontinuity (RD) approach to identifying the impact of a minimum wage increase on food security. The RD approach has become a popular way to achieve identification in a wide variety of social policy evaluation questions.[1] I compare estimates from the RD approach to what I call the baseline or "preferred" model in the literature.

Formally, the baseline model is written as:

(1)

$$y_{ist} = \beta_1 \log(MW_{st}) + \beta_2' X_{ist} + \gamma_t + \lambda_s + \varepsilon_{ist},$$

where the term y_{ist} denotes the outcome for the *ith* householder that resides in state *s* at time *t*. The term $log(MW_{st})$ denotes the ratio of the state and federal minimum wage in year *t* for the *ith* householder. The vector X_{ist} captures demographic information about the individual and their household (gender, race, ethnicity, age, educational attainment, household structure, number of people in the household, urban residence, and the state unemployment rate). The terms λ_s and γ_t denote state and year fixed effects.[2] Allegretto, Dube and Reich (2011) add division-specific time effects and state-specific linear trend. Neumark and Wascher (2014) argue that this approach removes a large amount of useful information for identifying the minimum wage's impact.

Why does the Regression Discontinuity approach to identifying the impact of an increase in the minimum wage provide a suitable alternate estimator? The "preferred" model in the literature, Equation (1) mixes the impact of how far the higher state minimum wage is from the federal with a state where the minimum wage exceeds the federal minimum

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wage. Basically, the "preferred" model excludes a dummy variable that captures whether a state's minimum wage exceeds the federal minimum wage. The RD framework contains two minimum wage variables: this dummy variable and a variable that captures the actual difference between the state and federal minimum wage.

However, in the RD framework, the variable of interest is the dummy variable that captures whether the respondent lives in a state where the state minimum wage exceeds the federal, while the difference variable addresses a potential omitted variable bias: the correlation between the dummy variable and the difference between the federal and state minimum wage, and the impact that difference has on the outcome.

The other key distinction between the two models can be the sample. The RD non parametric framework limits the sample to households in states where the federal minimum wage is the binding wage floor and households where the state minimum wage exceeds the federal but is "near" the federal minimum wage. The RD parametric framework's sample utilizes the full sample of states. Higher order terms in the difference variable control for how far a state's minimum wage is from the federal minimum wage.

I now describe the parametric RD framework. Utilizing the exposition in Jacob, et. al. (2012), the basic RD parametric estimator can be written as follows:

(2)

$$y_{ist}=\gamma_1 D_{st}+\gamma_2 X_{ist}+f(r_{st})+v_{ist}$$

where y_{ist} denotes the outcome for the *ith* householder in state *s* at year t,γ_1 denotes the average value of the outcome for those in the treatment group after controlling for the state's minimum wage, D_{st} denotes the minimum wage treatment dummy variable that equals 1 if the householder resides in a state (*s*), where the state minimum wage exceeds the federal minimum wage in year *t*, and 0 if the householder lives in a state where in year t the federal minimum wage is the law. The variable r_{st} denotes the minimum wage "rating" or distance variable for state *s* at year *t*. It captures in dollar terms how far an individual's state minimum wage is from the federal minimum wage. I center the variable at the cut-point, which means that its minimum value equals zero. Equation (2) is written as a nonlinear function $f(r_i)$, which allows for the inclusion of higher order terms.

When estimated, the coefficient,γ_1 captures the marginal impact of the minimum wage at the cut-point (e.g., federal and state minimum wage equal or federal minimum wage is the binding wage). The "rating" variable accounts for selection bias because the characteristics of minimum wage workers in "high" minimum wage states may be better (e.g., higher levels of educational attainment) than the characteristics of minimum wage workers in states where the minimum wage just exceeds the federal minimum wage. I center the minimum wage "rating" variable on the cut-point by creating a new variable r_{st}cut-score= (r_{st} — cut-score). This centered variable is used in all of the regressions.

Centering the rating variable makes it easier to interpret the results. The regression's intercept is now located at the cut-point (where the state and federal minimum wages equal) because the value of the rating at the cut-point equals zero. This means that any shift at the cut-point can be interpreted as a shift in the intercept. To improve precision and control for observable differences in characteristics, the same covariates as in the "preferred" model are added to the model (X*ist*).

The function $f(r_i)$ represents the relationship between the minimum wage "rating variable" and the outcome, such as food security. I estimate linear, quadratic, cubic, and quartic models in the minimum wage rating variable. Models that have valid observations below the cutoff will add interactions with the treatment dummy variable. Doing so allows for the slopes to be different above and below the cut off. However, since all of the states with no minimum wage fall under the federal law, there is no left tail and thus the interactions drop out of the model.

The Data

The Current Population Survey is a monthly survey of about 60,000 households conducted by the Bureau of the Census for the Bureau of Labor Statistics. The CPS is the primary source of information on the U.S. labor force. Respondents are interviewed to obtain information about the employment status, earnings, and hours of work for each household member aged 15 years and older. Along with this information that is collected each month, several supplements are administered throughout the year.

I utilize the CPS Food Security supplements from 1995 to 2011. The supplement was first collected in April 1995 by the U .S. Census Bureau and sponsored by the U.S. Department of Agriculture. Subsequent supplements have been administered in September 1996, April 1997, August 1998, April 1999, and September 2000. For the 2001 to 2011 supplements, the survey was administered in December. Using a respondent's state resident indicator, I link information on a state's minimum wage to each respondent's record. Respondents differ from year to year, but the pooling across years creates a state panel of their minimum wage policy. The major sample restrictions are that each respondent must have complete information on the age, sex, race, ethnicity, and educational attainment, as well as information on the respondent's household structure, number of household members, and residency in metropolitan statistical areas.[3]

Notes

1 The technique has been used to evaluate the impact of unionization, anti-discrimination laws, social assistance programs, limits on unemployment insurance benefits, and the impact of financial aid offers on college enrollment decisions. Within the education literature, the RD approach researchers have used the approach to estimate the impact of class size reduction, remedial education, delayed entry to kindergarten, and the impact of the Reading First program on instructional practice and student achievement.

2 There is an ongoing debate as to whether the model should include time effects that vary by Census division and state-specific linear time trends.

3 An earlier version of this report limited the sample to households with hourly earnings. Possessing information on industry and occupation of employment were also added as screens. The impact of this restriction is that the samples are reduced because hourly wages are only collected for the outgoing rotation groups (4 and 8), which represent 20 percent of the CPS sample. Further, in 1998 and 1999, a food security test question was used in rotation group 8, leading to households with multiple children or adults being excluded during the computation of food security status. The Bureau of Census and Bureau of Labor Statistics adjust the sample weights of the remaining rotation groups to account for the sample's reduction. This report also excludes households in which the reference person's (head of household) hourly wages are below $1.00 per hour. If the individual receives tips, overtime pay or commissions then hourly wages is the ratio of weekly earnings and usual hours worked per week. During the 2007, 2008, and 2009 increases, many states increased their own minimum wages. In each year, 30, 33, and 27 states, respectively, had minimum wages that exceeded the federal minimum wage. However, in 2010 and 2011, only 15 and 17 states had minimum wages that exceeded the federal minimum wage.

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Appendix C: Food Security Questions

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For the first six statements, respondent answers are coded as the following:

- Worried food would run out before we got money to buy more.
- Food just bought didn't last and didn't have money to get more.
- Couldn't afford balanced meals.
- Relied on low-cost food because run out of money.
- Couldn't feed our children a balanced meal, because we could not afford it.
- The children were not eating enough because we just couldn't afford enough food

For the next three questions, respondent's answers are coded as the following:

- Almost every month did adults in your household ever cut the size of your meals or skip meals because there wasn't enough money for food?
- Almost every month did adults in your household ever not eat for a whole day because there wasn't enough money for food?
- Almost every month did any of the children ever skip meals because there wasn't enough money for food?

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