

EFFECTS OF THE MINIMUM WAGE ON CHILD HEALTH

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Motivation

Minimum Wage Affects Labor Market Outcomes (First Stage)

- An increase in the minimum wage will increase wages of low-skilled workers
- An increase in the minimum wage will have a small to no effect on employment of low-skilled workers
- An increase in the minimum wage will increase incomes for most low-skilled workers

Income and Employment Affects Child Health (Second Stage)

- Income will increase investments in child health
- Employment may affect child health directly by changing time investments in child

Minimum Wage Affects Child Health (Reduced Form)

- Through higher income
- Through greater investment
- And perhaps because of changes in time investments

Contributions

- First study of how minimum wage changes impact child health.
- We provide the first analysis of how minimum wage changes during early and later childhood impact health outcomes for older children.
- An important contribution of our article is to the literature on the effects of income on child health.
 - Cooper and Stewart (2017) reported that among 15 quasi-experimental studies of the effect of income on child health, findings were decidedly mixed: 8 reported evidence of no association between income and child health and 13 reported evidence of a positive association.
 - Almost all the positive associations pertain to birthweight or child height and weight.
 - There were very few studies of the effect of income on general health or measures of health other than height and weight, and in these, results generally indicated no relationship between income and child health.

Conceptual Model (Not a Behavioral Model)

- Child development (health, H) production function (e.g., for a child age seven but can be adapted to any age):

$$H_7 = H_0(1 - \delta_0)\dots(1 - \delta_6) + \alpha_0 I_0(1 - \delta_1)\dots(1 - \delta_6) + \dots + \alpha_{(6)} I_6$$

- Health (H_7) of a child age seven depends on her initial health (H_0) and all investments (I) in health from birth (age 0) to age seven.
- The productivity (effects) of investments are measured by the coefficients α_t .
- The depreciation in child's health and in effects of investments over time is noted by δ_t .
- Note that the productivity of investments will differ by age and this reflects the possibility that child development, in this case health, may be particularly affected by investments at certain ages.

Conceptual Model (Not a Behavioral Model)

- The minimum wage raises wages and income, and this increase in income is likely to increase investment.
- If so, then the effect of the minimum wage on child development at age seven is given by:

$$H_7 = H(1 - \delta_0) \dots (1 - \delta_6) + \alpha_0 I_0(MW_0)(1 - \delta_1) \dots (1 - \delta_6) + \dots + \alpha_{(6)} I_6(MW_6)$$

$$\frac{\partial H_7}{\partial MW} = \frac{\partial H_0}{\partial MW_{-1}} (1 - \delta_0) \dots (1 - \delta_6) + \alpha_0 \frac{\partial I_0}{\partial MW_0} (1 - \delta_1) \dots (1 - \delta_6) + \dots + \alpha_{(6)} \frac{\partial I_6}{\partial MW_6}$$

- As indicated, minimum wages throughout the child's life (including prenatal period here indicated by age subscript -1) may affect health at a particular age, in this case age seven.
- It is also the case that a change in the minimum wage at different stages of a child's life may have different effects and not just because of the greater or less depreciation of the investments at that age, but because of differences in the productivity of investments at different ages ($\alpha_i \neq \alpha_j$).
- Finally, the minimum wage may have different effects at different stages of a child's life because it may have a different effect on the quantity of investments at different stages of life $\left(\frac{\partial I_t}{\partial MW_t} \neq \frac{\partial I_{(t-1)}}{\partial MW_{(t-1)}} \right)$

Two Insights of the Conceptual Model

- The first is that analyses of the effect of the minimum wage on child health and development need to be age-specific

The minimum wage may not have the same effect at all ages.

- The second is less obvious and stems from the underlying behavioral model.

Past minimum wages affect past investments in child health

Past investments in child health affect the current stock of health

**The current stock of health may affect the quantity of current investment in child health—
behavioral aspect**

Past minimum wages may affect current investments.

Two Insights of the Conceptual Model

Past minimum wages may affect current investments.

$$H_7 = [H_6(MW_0, \dots, MW_6)](1 - \delta_6) + \alpha_{(6)}I_6[H_6, MW_6]$$

$$\frac{\partial H_7}{\partial MW_t} = \frac{\partial H_6}{\partial MW_t} (1 - \delta_6) + \alpha_{(6)} \left[\frac{\partial I_6}{\partial H_6} \frac{\partial H_6}{\partial MW_t} \right]$$

- So, effect of minimum wage at any age, for example age 3, will measure the effect of minimum wage on investment at that age (3) and the future effects of the age 3 minimum wage on future investments

$$\frac{\partial H_7}{\partial MW_3} = \alpha_3 \frac{\partial I_3}{\partial MW_3} (1 - \delta_3) \dots (1 - \delta_6) + \dots + \alpha_{(6)} \frac{\partial I_6}{\partial MW_3}$$

- This makes the sign of the effect of minimum wage a little less intuitive vis-à-vis the simple model in which higher minimum wage unambiguously leads to greater investment and better health
- Also suggests that the cumulative effects of the minimum wage over the life are arguably best measure of effect of minimum wage

Linking Minimum Wage to Child Development—Via Investment in Child

- Primary effect of an increase in the minimum wage is to raise income (Congressional Budget Office 2019)
- There may be some changes in time allocation (e.g., employment and hours of work)—direct investment in child health.
- Greater family income will increase consumption of goods and services, such as better nutrition and more use of health care that are beneficial to the child.
- More income can also affect residential and employment stability because of a greater ability to smooth consumption through both savings and access to credit—may have effects on child health that work through access to medical care.
- Greater earnings is likely to reduce financial stress, which may lead to improved mental health of all family members and reduce unhealthy behaviors that are caused by stress, for example, tobacco and alcohol use.
- Income effects of minimum wage may be particularly important at different points in the child's life.

Likely Effect of \$1 Increase in Minimum Wage on Earned Income

Table 3. “Affected Hours”: Average annual work hours affected by an increase in minimum wage for low-educated and college-educated women assuming no disemployment effects.

	Low Educated (High School or Less)								College Educated Age 25–44	
	Age 18–44	Age 18–29	Age 30–44	Married	Single	Age 18–29		Age 30–44		
						Married	Single	Married		Single
Annual Working Hours for wage <1.25* Minimum Wage	477	568	400	537	496	652	449	660	280	189
Annual Working Hours for wage <1.33* Minimum Wage	558	661	470	628	572	760	527	755	332	222
Annual Working Hours for wage <(Minimum Wage+\$1)	441	523	371	502	455	609	418	609	255	171

Data

- Data from the 2003, 2007, and 2011/12 waves of the National Survey of Child's Health(NSCH).
- The NSCH is a nationally representative, cross-sectional telephone survey of children aged 0-17 years in the U.S.
- NSCH selects a sample of equal size from each state to insure sufficient sample sizes from smaller states
- We focus on children in low-educated families.
- We limit the sample to children aged 6 years and older (age 17 is the oldest age in the survey).

Measures of Child Health

- General health rated by the parent/caregiver on a five-category scale (excellent to poor)
 - Two binary indicators, one for excellent or very good health versus less (good, fair, and poor), and another for poor or fair health versus better (good, very good, and excellent).
- Dental health rated by the parent/caregiver on a five-category scale (excellent to poor)
 - Two binary indicators, one for excellent or very good health versus less (good, fair, and poor), and another for poor or fair health versus better (good, very good, and excellent).
- Indicator of poor health derived from three questions:
 - Current need of medications because of medical condition
 - Greater use of medical care than peers (a version for chronic conditions)
 - Less able to engage in things peers do because of health condition (a version for chronic conditions)
- Number of missed school days in the past 12 months due to illness or injury.

Measures of Mechanisms

- Labor Market Related Mechanisms
 - Anyone in household employed
 - Child has health insurance coverage
 - Family income is below 100% of FPL
- Preventive visits
 - Medical
 - Dental

<i>Child health</i>	Age 6-12	Age 13-17
General health (1-5 scale poor to excellent)	4.09	4.10
Excellent/very good general health	0.71	0.72
Fair/poor general health	0.07	0.07
Dental health (1-5 scale poor to excellent)	3.47	3.67
Excellent/very good dental health	0.48	0.55
Fair/poor dental health	0.20	0.15
Currently need or use prescribed medicine	0.21	0.21
Need or use prescribed medicine more than 12 months	0.16	0.15
Need or use more healthcare than peers	0.15	0.14
Need or use more healthcare than peers because chronic conditions	0.10	0.09
Unable to do things as peers because of any health conditions	0.06	0.06
Unable to do things as peers because of chronic health conditions	0.06	0.05
# missed school days in past 12 months due to illness or injury	3.68	3.95
<i>Demographics</i>		
Age	9.08	14.96
Male	0.51	0.52
Female	0.49	0.48
Non-Hispanic white	0.40	0.45
Non-Hispanic black	0.16	0.17
Non-Hispanic others	0.06	0.06
Hispanic	0.38	0.32

Empirical Model

- Ideally, we would like to estimate equation (1), but most investments in child health are not available.
- But, as I showed

$$H_7 = H(1 - \delta_0) \dots (1 - \delta_6) + \alpha_0 I_0 (MW_0) (1 - \delta_1) \dots (1 - \delta_6) + \dots + \alpha_{(6)} I_6 (MW_6)$$

$$\frac{\partial H_7}{\partial MW} = \frac{\partial H_0}{\partial MW_{-1}} (1 - \delta_0) \dots (1 - \delta_6) + \alpha_0 \frac{\partial I_0}{\partial MW_0} (1 - \delta_1) \dots (1 - \delta_6) + \dots + \alpha_{(6)} \frac{\partial I_6}{\partial MW_6}$$

- So, a regression of child health on minimum wage at various ages over child's life will yield the estimates of interest

$$H_{iskt} = \alpha_s + \gamma_t + \beta_1 MW_{P_{ist}} + \beta_2 \overline{MW_{0-5}}_{ist} + \beta_3 \overline{MW_{6-5}}_{iskt} + \mathbf{X}_{iskt} \Phi + \mu_{iskt}$$

$$B_2 = \alpha_{(0-5)} \frac{\partial I_{0-5}}{\partial MW_{0-5}}$$

- The coefficient on minimum wage measures the change in investment multiplied by the productivity (effect) of that investment

Empirical Model

- So, a regression of child health on minimum wage at various ages over child's life will yield the estimates of interest

$$H_{iskt} = \alpha_s + \gamma_t + \beta_1 MW_{P_{ist}} + \beta_2 \overline{MW_{0_5}_{ist}} + \beta_3 \overline{MW_{6_S}_{iskt}} + \mathbf{X}_{iskt} \Phi + \mu_{iskt}$$

- H_{iskt} denotes the health outcome of child i , at age k , in state s at survey year t .
- $MW_{P_{ist}}$ is the real minimum wage (adjusted for inflation and converted to 2016 dollars) in pregnancy year
- $MW_{0_5}_{ist}$ is the real minimum wage (adjusted for inflation and converted to 2016 dollars) at ages 0 to 5
- $MW_{6_S}_{ist}$ is the real minimum wage (adjusted for inflation and converted to 2016 dollars) at ages 6 to current age (6-12)
- The model also includes state fixed effects (α), and birth year fixed effects (γ). \mathbf{X} are child demographics including race/ethnicity, gender, and dummies for child age (year by year).

Identification

- Conditional on other covariates in the model, we assume the minimum wage is exogenous—uncorrelated with missing investments and initial health shown in equation (1).
- The exogeneity of the minimum wage is based on the difference-in-differences research design that compares children in the same state who were “exposed” to different minimum wages at specific periods of their childhood while accounting for state, birth cohort, and age at interview effects.

Empirical Model-Mechanisms

- We also evaluate the effects of minimum wage on preventive health services use, which is one type of investment in child health that is available in the data, and employment, health insurance and poverty.
- For this analysis, we focus on effects of recent changes in the minimum wage on use of a preventive medical and dental services as follows:

$$M_{ist} = \alpha_s + \gamma_t + \beta_1 MW_{is(t-1)} + X_{ist} \Phi + \mu_{ist}$$

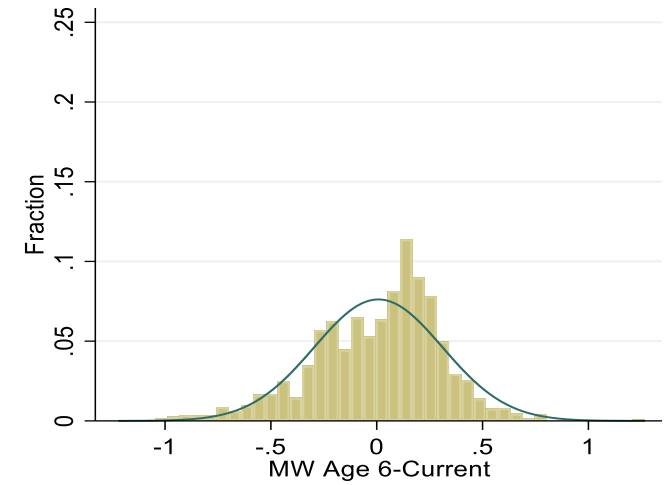
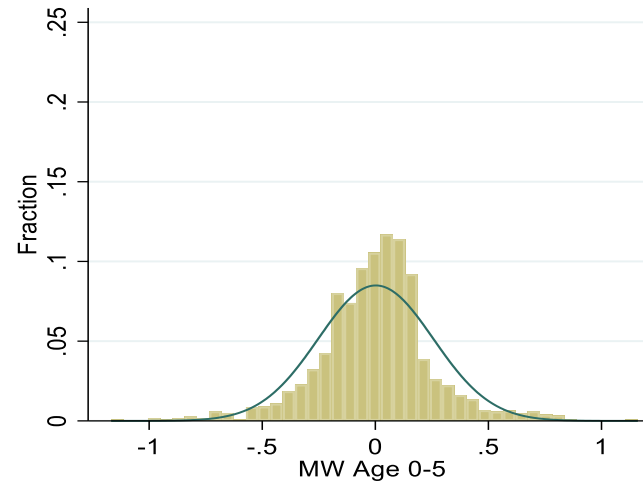
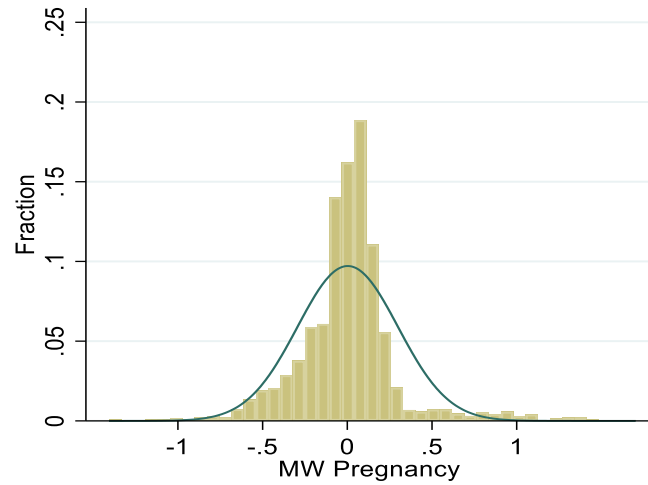
- M_{ist} is an indicator for any medical preventive visits; any dental preventive visits;
-
- MW is real minimum wage averaged over the year before the survey year.
- This regression model may be mis-specified if past minimum wages affect current investments and past minimum wages are correlated with current minimum wages.

Estimation Methods

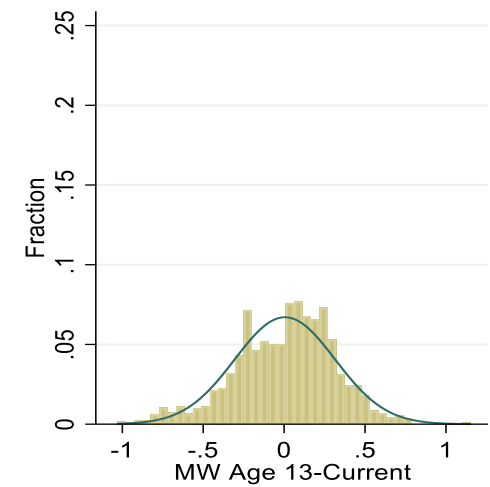
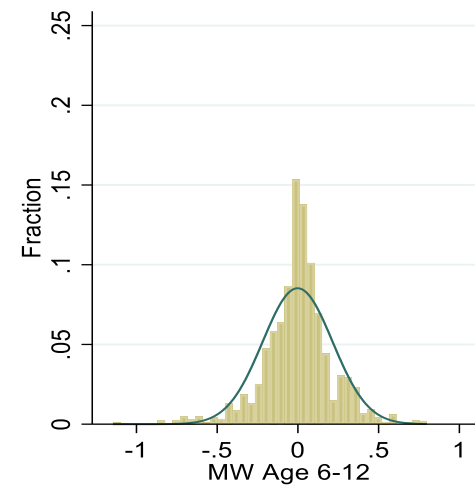
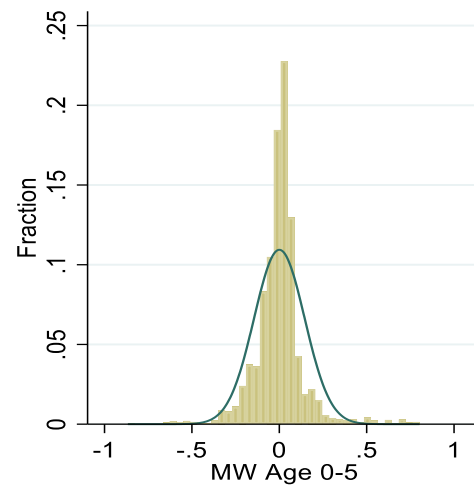
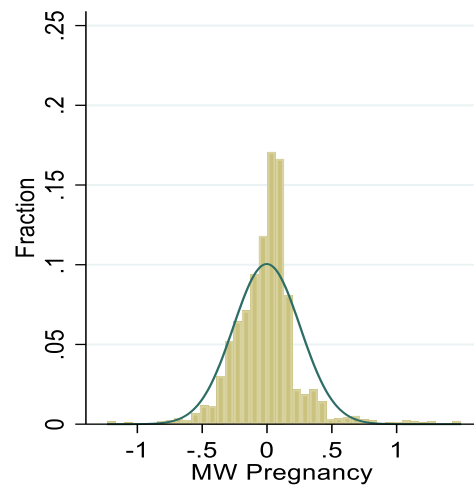
- The NSCH sampled an equal number of children from each state for each wave.
- Therefore, we weight the model using the NSCH sampling probability weights in order to approximate as best as possible the average partial treatment effect of the minimum wage.
-
- We estimate all models using OLS and cluster the standard errors at the state level.

Figure 1. Distribution of Residuals from Regressions of Minimum Wage Measures on Model Covariates

Children Aged 6-12 Years Old



Children Age 13-17 Years Old



	Mean of dependent variable	Minimum wage during pregnancy	Minimum wage from age 0 to age 5	Minimum wage from age 6 to current age	Sum of minimum wage estimates across all ages
General health (1-5 scale poor to excellent)	4.09	0.028 (0.031)	0.11** (0.045)	0.037 (0.053)	0.18** (0.071)
Excellent/very good general health	0.71	-0.0032 (0.014)	0.062*** (0.022)	0.011 (0.019)	0.070*** (0.022)
Fair/poor general health	0.067	-0.016** (0.0078)	-0.0071 (0.0076)	0.0041 (0.0079)	-0.019 (0.012)
Dental health (1-5 scale poor to excellent)	3.47	0.11** (0.045)	-0.10** (0.049)	0.082* (0.045)	0.095 (0.074)
Excellent/very good dental health	0.48	0.060*** (0.019)	-0.043 (0.023)	0.033 (0.022)	0.050 (0.035)
Fair/poor dental health	0.20	-0.016 (0.016)	0.030 (0.020)	-0.017 (0.017)	-0.0028 (0.028)
Combined Measure of Poor Health	0.28	-0.012 (0.014)	-0.038** (0.017)	-0.033** (0.016)	-0.083** (0.031)
Combined Measure of Poor Health-Chronic Conditions	0.20	-0.015 (0.015)	-0.027 (0.016)	-0.024 (0.017)	-0.066** (0.028)
# missed school days past 12 months due to illness or injury	3.68	-0.18 (0.14)	-0.57** (0.25)	-0.20 (0.25)	-0.95** (0.47)

Results: Ages 6-12

- Most estimates of the effect of the minimum wage during pregnancy are small and not statistically significant.
- Estimates of effect of minimum wages during age 0-5 years are more consistently indicative of a beneficial effect. A \$1 increase in the minimum wage is associated with a:
 - 0.11 (2.7%) improvement in general health (on the five category scale);
 - 6.2 percentage point (8.7%) increase in the probability of very good or excellent health.
 - 3.8 percentage point (14%) decrease in the combined measure of poor health
 - 0.57 (15.6%) decrease in missed school days.
- Changes in the minimum wage between ages 6 and the child's current age are generally not significantly significant.

Results: Ages 6-12

- Estimates of the cumulative effect of a \$1 change in the minimum wage over the child's life:
 - 0.18 unit (4.4%) improvement in general health;
 - 7 percentage point (10%) increase in the probability of very good or excellent health;
 - 8 percentage point (30%) decrease in the combined measure of poor health
 - and 0.95 (26%) fewer missed school days.
- While not statistically significant, all other estimates suggest that a \$1 increase in the minimum wage over the course of the child's life is associated with better health.
- Finally, if we focus on the 9 estimates of the cumulative effect of the minimum wage on child health outcomes and apply a Holm-Bonferroni correction for multiple testing bias, all estimates remain statistically significant.

	Minimum wage during pregnancy	Minimum wage from 0 to age 5	Minimum wage from age 6 to age 12	Minimum wage from age 13 to current age	<i>Sum of minimum wage estimates across all ages</i>
General health (1-5 scale poor to excellent)	0.040 (0.037)	0.20*** (0.065)	-0.066 (0.040)	0.026 (0.036)	0.20 (0.11)
Excellent/very good general health	0.017 (0.018)	0.077*** (0.022)	-0.022 (0.020)	0.0097 (0.016)	0.082 (0.046)
Fair/poor general health	-0.020 (0.012)	-0.064*** (0.020)	0.032 (0.023)	0.00023 (0.0099)	-0.052 (0.039)
Dental health (1-5 scale poor to excellent)	-0.023 (0.044)	-0.19* (0.11)	0.0059 (0.046)	0.021 (0.056)	-0.18 (0.15)
Excellent/very good dental health	-0.0053 (0.024)	-0.084 (0.050)	-0.0012 (0.024)	0.021 (0.027)	-0.070 (0.070)
Fair/poor dental health	-0.015 (0.013)	0.038 (0.039)	0.0091 (0.018)	0.0074 (0.023)	0.039 (0.065)
Combined Measure of Poor Health	-0.060** (0.019)	-0.057 (0.031)	-0.044 (0.024)	-0.003 (0.019)	-0.16** (0.06)
Combined Measure of Poor Health-Chronic Conditions	-0.017 (0.016)	-0.082** (0.032)	-0.041** (0.016)	0.003 (0.015)	-0.14** (0.05)
# missed school days in past 12 months due to illness or injury	-0.31 (0.30)	-0.65 (0.46)	-0.41 (0.23)	-0.28 (0.21)	-1.65** (0.79)

Results: Ages 13-17

- An increase in the minimum wage during pregnancy is strongly correlated with improved health, as measured by the combined measure of poor health
 - Effect sizes are large
 - A \$1 increase in the minimum wage during pregnancy period is associated with a 30% decrease in poor health
- Similar effects are found for an increase in the minimum wage between ages 0 and 5 on these outcomes.
 - In addition, a \$1 increase in the minimum wage during ages 0 to 5 is associated with approximately a 10% increase in the probability of being in excellent health and a 90% decrease in the probability of being in poor health.
- All but one estimate of the effect of the minimum wage at other ages are not statistically significant.

Results: Ages 13-17

- A \$1 increase in minimum wages throughout childhood is associated with:
 - large (60%-70%) decrease in combined measure of poor health
 - 40% decrease in missed school days.
- Other estimates of the cumulative effect of the minimum wage on child health, while not significant, also suggest improved health except for the case of dental health.
- A Holm-Bonferroni correction would make the cumulative effect of the minimum wage on missed school days not statistically significant at conventional levels..

Effects of contemporaneous minimum wage on linkages between minimum wage and child health

	Age 6-12		Age 13-17	
	N	Contemporaneous Minimum Wage	N	Contemporaneous Minimum Wage
Any Insurance Coverage	21254	-0.014 (0.016)	18068	-0.019 (0.026)
Any preventive care use	21065	0.0052 (0.0095)	17922	-0.022 (0.019)
Any Preventive dental care use	20182	0.013 (0.011)	16797	0.017 (0.015)
Household income below 100% FPL	19413	0.0013 (0.013)	16402	-0.026 (0.022)
Any employment in household	21219	0.012 (0.015)	18009	0.0099 (0.016)

Results-Mechanisms

- No evidence that MW affects employment or health insurance
- Current minimum wage is not associated with preventive medical or dental care
- We lack clear evidence linking minimum wage to child health, although we have few good measures of investment

Sensitivity Tests

- Include 3-year and 6-year leads of MW
- Estimate Model on sample of higher-educated (>12 years) households

	Ages 6-12				Ages 13-17			
	3-Year Lead MW	6-Year Lead MW	Sum MW Effects	Sum MW Effects (No Leads)	3-Year Lead MW	6-Year Lead MW	Sum MW Effects	Sum MW Effects (No Leads)
General Health	-0.054 (0.052)	-0.029 (0.034)	0.120 (0.068)	0.180** (0.070)	0.031 (0.043)	0.042 (0.029)	0.22** (0.11)	0.20 (0.11)
Excellent Health	-0.016 (0.023)	-0.017 (0.016)	0.060 (0.032)	0.070** (0.02)	0.027 (0.025)	0.010 (0.015)	0.11** (0.067)	0.082 (0.046)
Poor Health	0.015 (0.010)	-0.006 (0.007)	0.0046 (0.019)	-0.019 (0.012)	-0.012 (0.010)	-0.024 (0.018)	-0.055 (0.045)	-0.052 (0.039)
Dental Health	-0.070 (0.050)	0.050 (0.027)	-0.037 (0.010)	0.095 (0.074)	0.048 (0.055)	0.033 (0.026)	-0.13 (0.15)	-0.18 (0.15)
Excellent Dental Health	-0.023 (0.023)	0.024 (0.012)	0.0013 (0.040)	0.050 (0.035)	0.028 (0.027)	-0.001 (0.016)	-0.032 (0.074)	-0.070 (0.070)
Poor Dental Health	0.037** (0.018)	-0.021 (0.013)	0.063 (0.048)	-0.003 (0.028)	-0.010 (0.011)	-0.024 (0.007)	0.038 (0.067)	0.039 (0.065)
Combined Measure Poor Health	0.031** (0.031)	-0.004 (0.015)	-0.036 (0.038)	-0.083** (0.031)	-0.023 (0.022)	0.001 (0.018)	-0.19** (0.065)	-0.16** (0.061)
Combined Measure Poor Health- Chronic Conditions	0.037** (0.014)	-0.015 (0.011)	-0.005 (0.036)	-0.066** (0.028)	-0.021 (0.019)	0.009 (0.013)	-0.17** (0.056)	-0.14** (0.050)
# Missed School Days	0.053 (0.23)	0.029 (0.019)	-0.90 (0.64)	-0.95** (0.47)	-0.048 (0.22)	-0.052 (0.22)	-1.68** (0.83)	-1.65** (0.79)

	Ages 6-12		Ages 13-17	
	Sum MW Effects Low-Educ	Sum MW Effects High-Educ	Sum MW Effects Low-Educ	Sum MW Effects High-Educ
General Health	0.180** (0.070)	-0.037 (0.033)	0.20 (0.11)	0.081 (0.081)
Excellent Health	0.070** (0.02)	-0.017 (0.012)	0.082 (0.046)	0.044 (0.024)
Poor Health	-0.019 (0.012)	0.005 (0.005)	-0.052 (0.039)	-0.006 (0.016)
Dental Health	0.095 (0.074)	-0.12** (0.024)	-0.18 (0.15)	0.150** (0.073)
Excellent Dental Health	0.050 (0.035)	-0.050** (0.012)	-0.070 (0.070)	0.064 (0.036)
Poor Dental Health	-0.003 (0.028)	0.010 (0.008)	0.039 (0.065)	-0.037** (0.016)
Combined Measure Poor Health	-0.083** (0.031)	0.042 (0.021)	-0.16** (0.061)	0.003 (0.042)
Combined Measure Poor Health-Chronic Conditions	-0.066** (0.028)	0.028 (0.021)	-0.14** (0.050)	0.024 (0.037)
# Missed School Days	-0.95** (0.47)	0.19 (0.13)	-1.65** (0.79)	-0.024 (0.48)

Results-Sensitivity Analyses

- While not uniformly supportive, overall the evidence suggest that main results are plausibly valid
- Some evidence of an effect of 3-year leads for poor health outcome in sample of children ages 6-12
- Some evidence that MW has an association with dental health in high-education sample

Conclusion

- Substantial evidence that increase in minimum wage improve child health
- Our findings are noteworthy because they suggest that higher minimum wages throughout childhood may have significant and relatively large effects on child health.
- If so, then the debate over the value of minimum wage increases needs to incorporate this evidence, and consider other potential effects that the minimum wage may have.
- An interesting finding in this article is that much of the beneficial effects of the minimum wage are associated with minimum wage increases during ages 0 to 5.
- Overall, our findings demonstrate that consequences beyond the labor market should be considered when assessing the use of the minimum wage to improve the welfare of low-skilled and low-income families.
- The increases in income associated with the minimum wage may have wide ranging and meaningful impacts particularly for children in low-income families.

A Model of Educational Achievement (Lagniappe for CHAS Lecture)

- A standard way to write human capital production function is:

$$HC_t = HC_{t-1}(1 - \delta_{t-1}) + \alpha_{(t-1)}I_{t-1}$$

$$HC_t - HC_{t-1} = \alpha_{(t-1)}I_{t-1} - HC_{t-1}\delta_{t-1}$$

- The change in stock of human capital between ages t and t-1 is equal to the effect of last period investment plus depreciation on the stock of health
- If depreciation is zero (unlikely perhaps, but it could be small), then:

$$HC_t - HC_{t-1} = \alpha_{(t-1)}I_{t-1}$$

- The change in stock of human capital between ages t and t-1 is equal to the effect of last period investment
- Makes it easy to estimate the model, which is age-specific and identifies the effect of investment on human capital

A Model of Educational Achievement

- If depreciation is not 0, then the model includes previous investments because they influence the stock of health last period:

$$HC_t - HC_{t-1} = \alpha_{(t-1)}I_{t-1} - HC_{t-1}(I_0, \dots, I_{t-2})\delta_{t-1}$$

- This restriction (lagged investments belong) can be detected and distant investments may have very small effects because of depreciation.

An Empirical Model of Effect of Income on Child Educational Achievement

- If depreciation is 0:

$$HC_t - HC_{t-1} = \alpha_{(t-1)} I_{t-1}$$

- Make Investment a function of income (Y):

$$HC_t - HC_{t-1} = \alpha_{(t-1)} I_{t-1}(Y_{t-1})$$

- And,

$$\frac{\partial(HC_t - HC_{t-1})}{\partial Y_{t-1}} = \alpha_t \frac{\partial I_{t-1}}{\partial Y_{t-1}}$$

- Regression Model; regress first differences on *level* of income:

$$HC_t - HC_{t-1} = b_0 + b_1 Y_{t-1} + e$$

An Empirical Model of Effect of Income on Child Educational Achievement

- Regression Model; regress first differences on *level* of income:

$$HC_t - HC_{t-1} = b_0 + b_1 Y_{t-1} + e$$

- Instrument for income using the minimum wage
- Instruments are the minimum wage interacted with mother's characteristics (e.g., AFQT, education)
- The interactions identify mother's likely affected by minimum wage
- Data are from C-NLSY79
 - PIAT test scores

Estimates of the Effect of \$1000 of Mother's Earnings
(Mean=\$10,000)

Ages	Math (s.d.≈10)		Reading Recognition (s.d.≈10)		Reading Comprehension (s.d.≈10)	
	OLS	IV	OLS	IV	OLS	IV
Age 5-7	0.020 (0.013)	0.160 (0.075)	0.015 (0.014)	0.038 (0.059)	0.015 (0.014)	0.011 (0.069)
Age 7-9	0.035** (0.014)	0.017 (0.091)	0.014 (0.013)	0.110 (0.055)	0.022 (0.012)	0.045 (0.084)
Age 9-11	0.012 (0.010)	0.140 (0.085)	0.013 (0.011)	-0.150 (0.087)	0.036** (0.014)	0.036 (0.085)

Conclusion

- Not much evidence that mother's income affects child test scores
- OLS estimates are very small
- IV estimates are small