Discontinuous Distributions and Missing Persons: The Minimum Wage and Unemployed Youth

Authors: Robert H. Meyer and David A. Wise

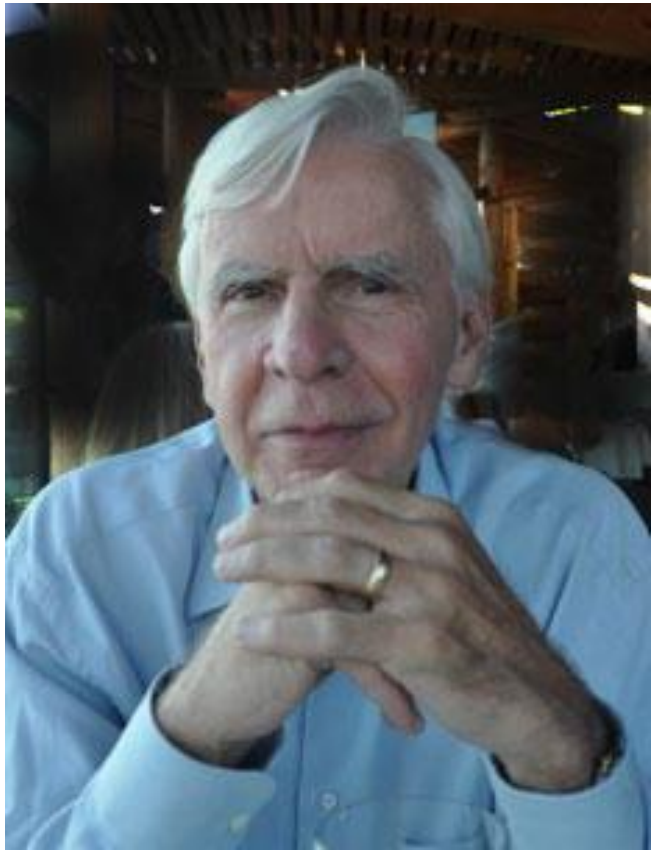
Source: *Econometrica*, Vol. 51, No. 6 (Nov., 1983), pp. 1677-1698

Times Cited: 104 (by Apr., 2014)

Presenter: Castiel Chen Zhuang

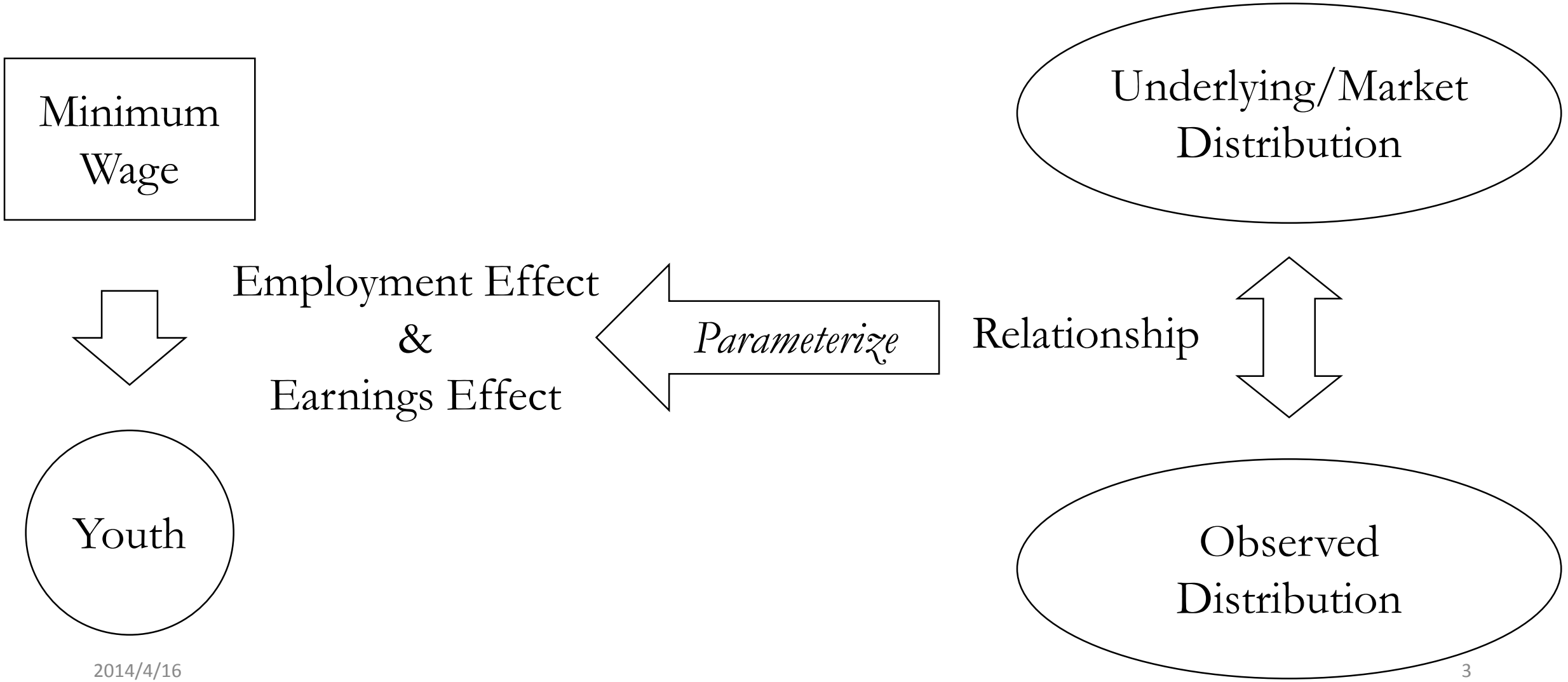
Vivid Authors

Robert H. Meyer



David A. Wise

Visualized Abstract



Observed Distribution

Low-Wage Area
(16-24 Years Old)

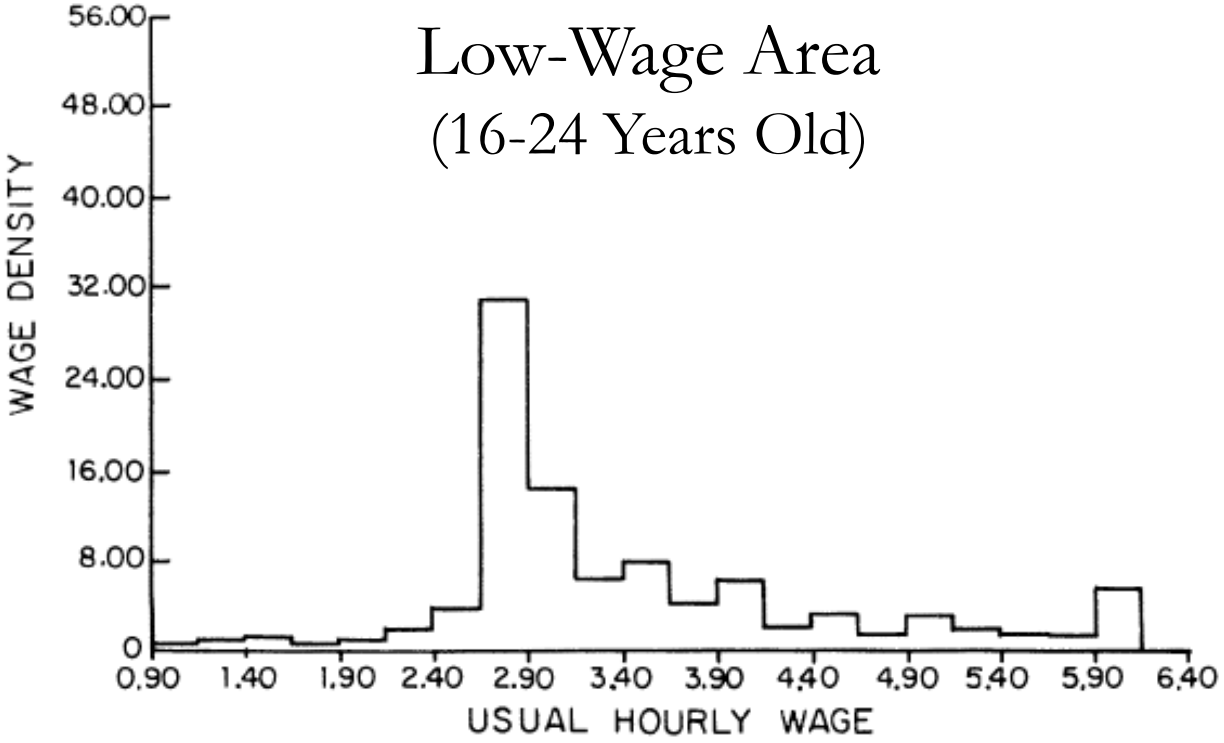


FIGURE 1—Wage distribution for 16 to 24 year olds; Subgroup: non-students, low wage area; Source: May 1978 CPS.

High-Wage Area
(16-24 Years Old)

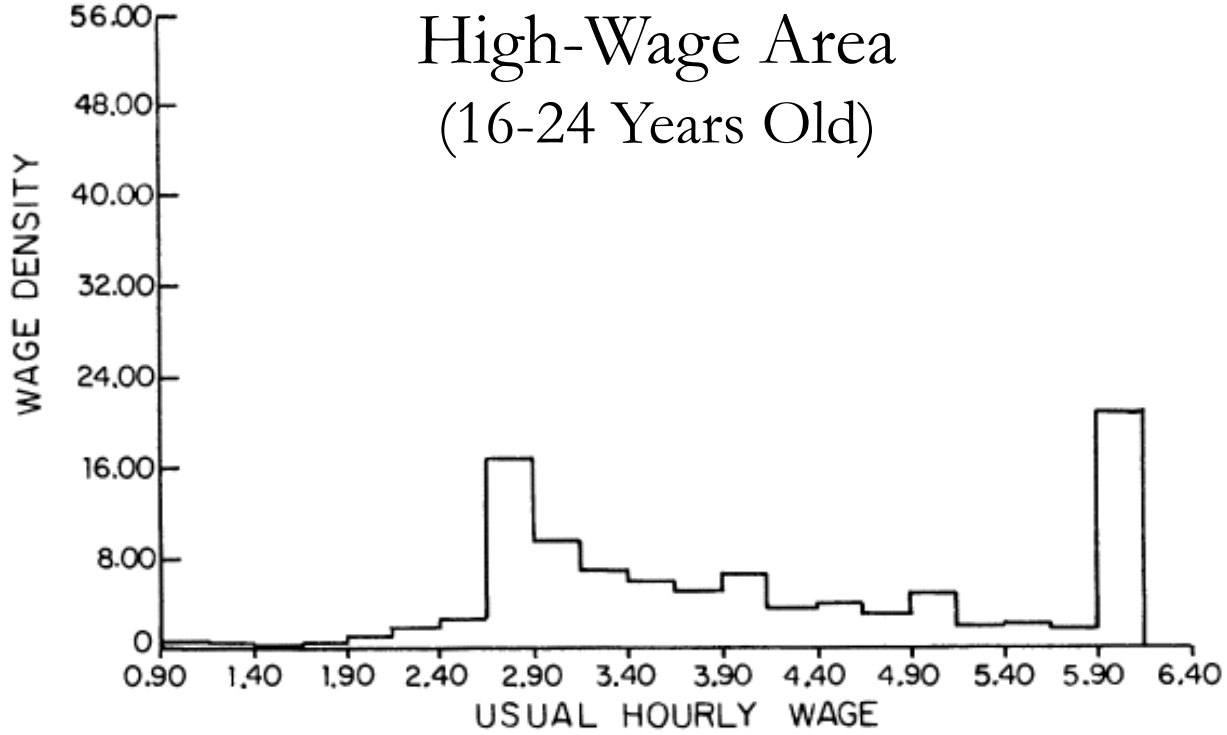


FIGURE 2—Wage distribution for 16 to 24 year olds; Subgroup: non-students, high wage area; Source: May 1978 CPS.

Observed Distribution

High-Wage Area
(16-24 Years Old)

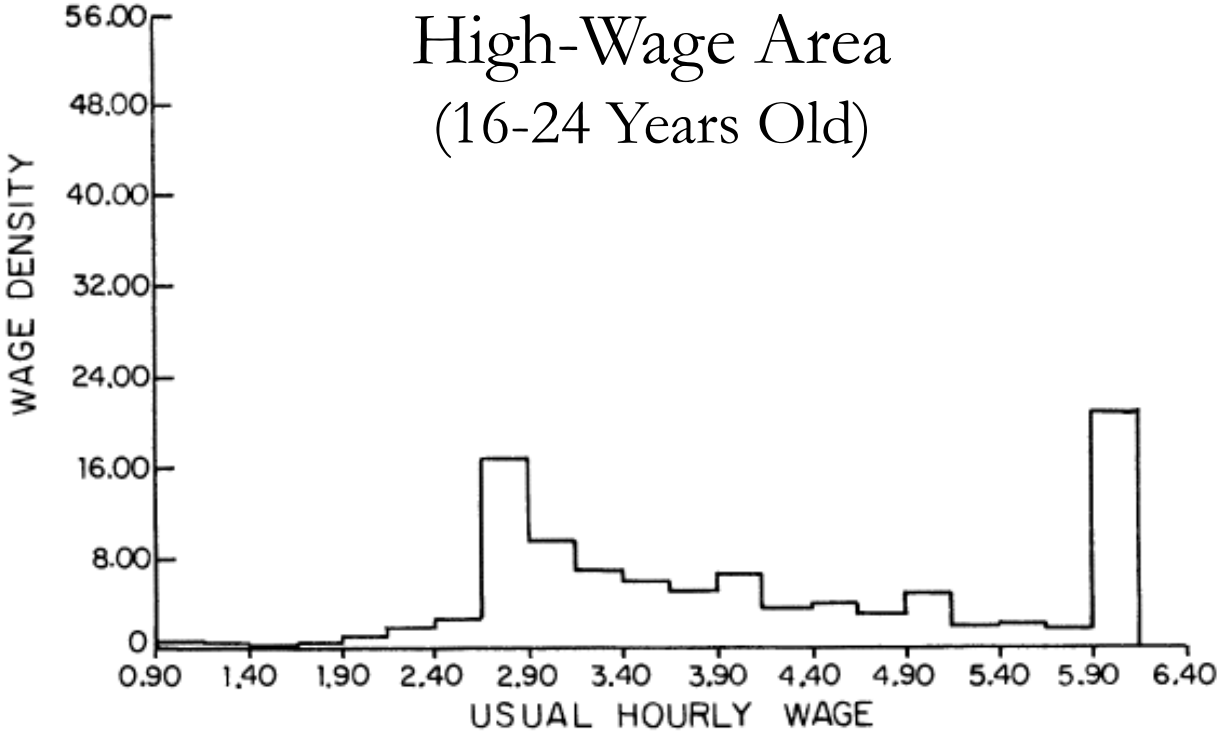


FIGURE 2—Wage distribution for 16 to 24 year olds; Subgroup: non-students, high wage area; Source: May 1978 CPS.

High-Wage Area
(20-24 Years Old)

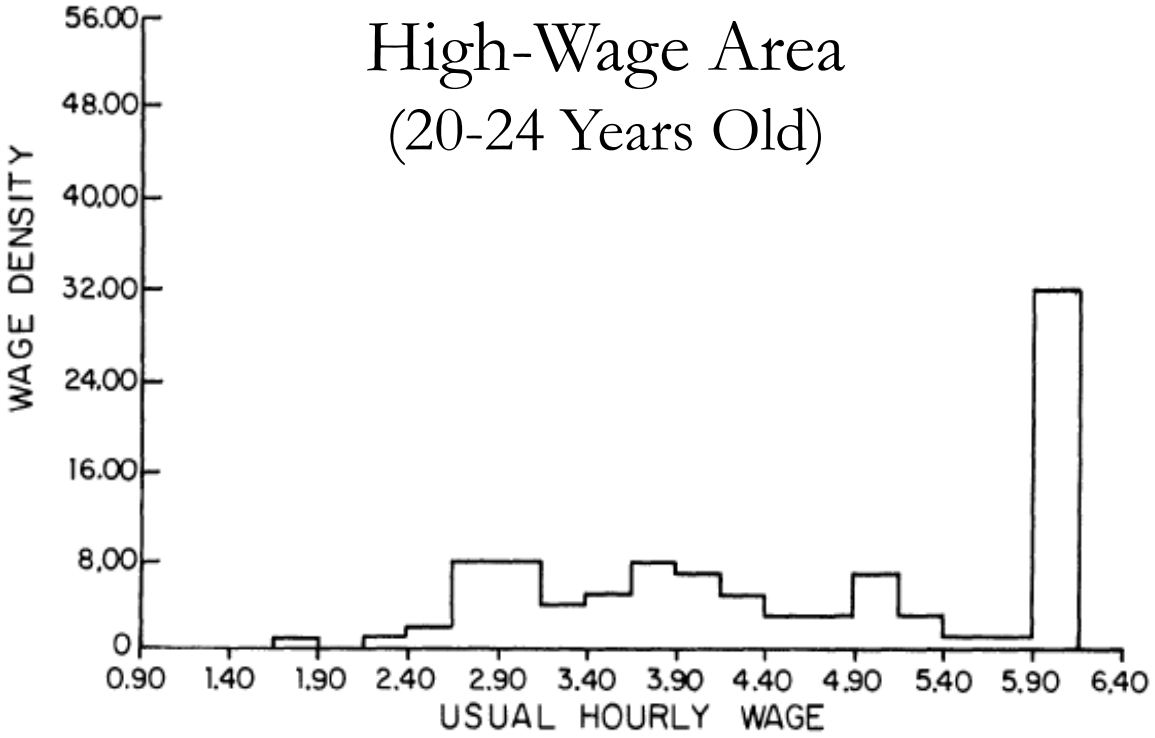


FIGURE 3—Wage distribution for 20 to 24 year olds; Subgroup: non-students, high wage area; Source: May 1978 CPS.

Two Presumptions

- Presumption I: The minimum wage should have a greater impact in low-wage than in high-wage areas;

- Presumption II: The minimum wage should impinge more on youth whose personal attributes are associated with lower earnings than on youth whose personal attributes are associated with higher earnings.

Step 1: Simple Approach

The Simple Model

Parameter Estimates Based on the Model

Underlying Distribution

non-covered or non-compliant

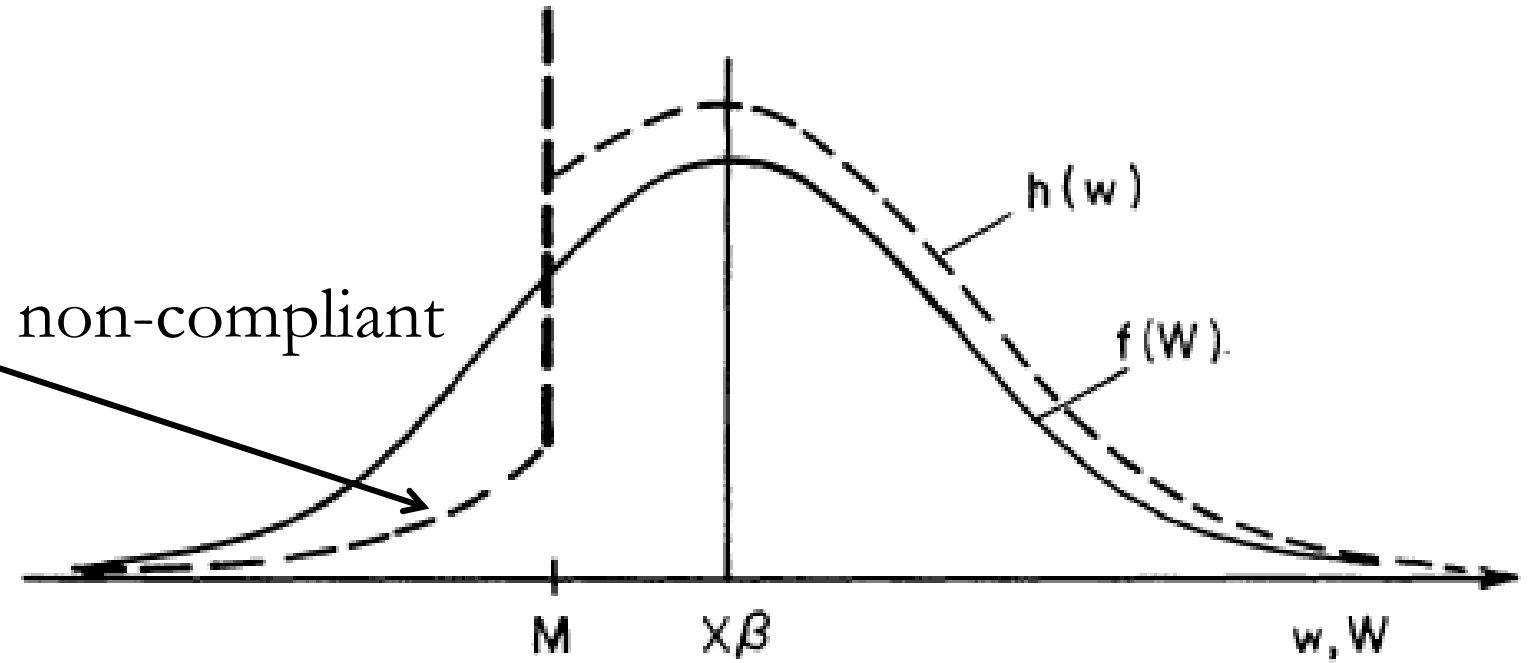


FIGURE 4.

Parameterize the Relationship

- Assumption I: A person with an underlying wage below the minimum will continue to receive a wage below this level with probability P_1, and will be employed and paid the minimum with probability P_2; therefore, he will become unemployed with probability $1-(P_1+P_2)=1-P$;

- Assumption II: The minimum wage does not affect the wages received by youth whose underlying wage is above the minimum.

Parameterize the Relationship

$$h(w) = \begin{cases} \dfrac{f(w) \cdot P_1}{D} & \text{if} \quad w < M, \\ \dfrac{\Phi\left[(M - X\beta)/\sigma\right] \cdot P_2}{D} & \text{if} \quad w = M, \\ \dfrac{f(w)}{D} & \text{if} \quad M < w, \end{cases}$$

$$D = 1 - \Pr[W < M](1 - P_1 - P_2) = 1 - \Phi[(M_1 - X\beta)/\sigma] \cdot (1 - P)$$

The Likelihood Function

$$L = \sum_{i=1}^{N_1} \ln h(w_i) + \sum_{i=1}^{N_2} \ln h(w_i) + \sum_{i=1}^{N_3} \ln h(w_i),$$

The function should be maximized with respect to β (in $W = X\beta + \epsilon$), σ (the variance of the disturbance term ϵ), P_1, and P_2.

```
capture program drop mysimple
program define mysimple
          args lnf Xb sigma p1 p2
          replace `lnf' = ln(`p1'*normalden($ML_y1,`Xb',`sigma')     /*
          */  /(1-(normalden(ln(2.65),`Xb',`sigma'))*(1-`p1'-`p2')) /*
          */  if $ML_y1<ln(2.65)
          replace `lnf' = ln(`p2'*normalden(ln(2.65),`Xb',`sigma')  /*
          */  /(1-(normalden(ln(2.65),`Xb',`sigma'))*(1-`p1'-`p2')) /*
          */  if $ML_y1==ln(2.65)
          replace `lnf' = ln(normalden($ML_y1,`Xb',`sigma')          /*
          */  /(1-(normalden(ln(2.65),`Xb',`sigma'))*(1-`p1'-`p2')) /*
          */  if $ML_y1>ln(2.65)
end

ml model lf mysimple (lnw = age school black women union parttime/*
*/ nevermarried city areawage areaunemploy northeast south west)
ml maximize
```

Data and Sample

- May 1978 CPS
- non-student
- hourly employees who reported hourly wage rates
- (In the *working paper* version, they use both non-employed and employed youth, salaried employees as well as hourly workers, and youth who don't report wage rates as well as those who do.)
- What about students who are more likely to be part-time workers with a minimum? (The effect of the minimum on school attendance should be further considered.)

Left Truncation (Partly)

- Some persons who would be employed and have observed market wage at M (the minimum) are not employed and thus not in the sample, while others have wage rates equal to M; some remain employed with wage rates below M;
- Least squares estimates (LSE) would underestimate the relationship between average area wage rates and the underlying market wage;
- The LSE of standard error of observed wage rates would be lower than the underlying variance of market wage rates.

Left Truncation

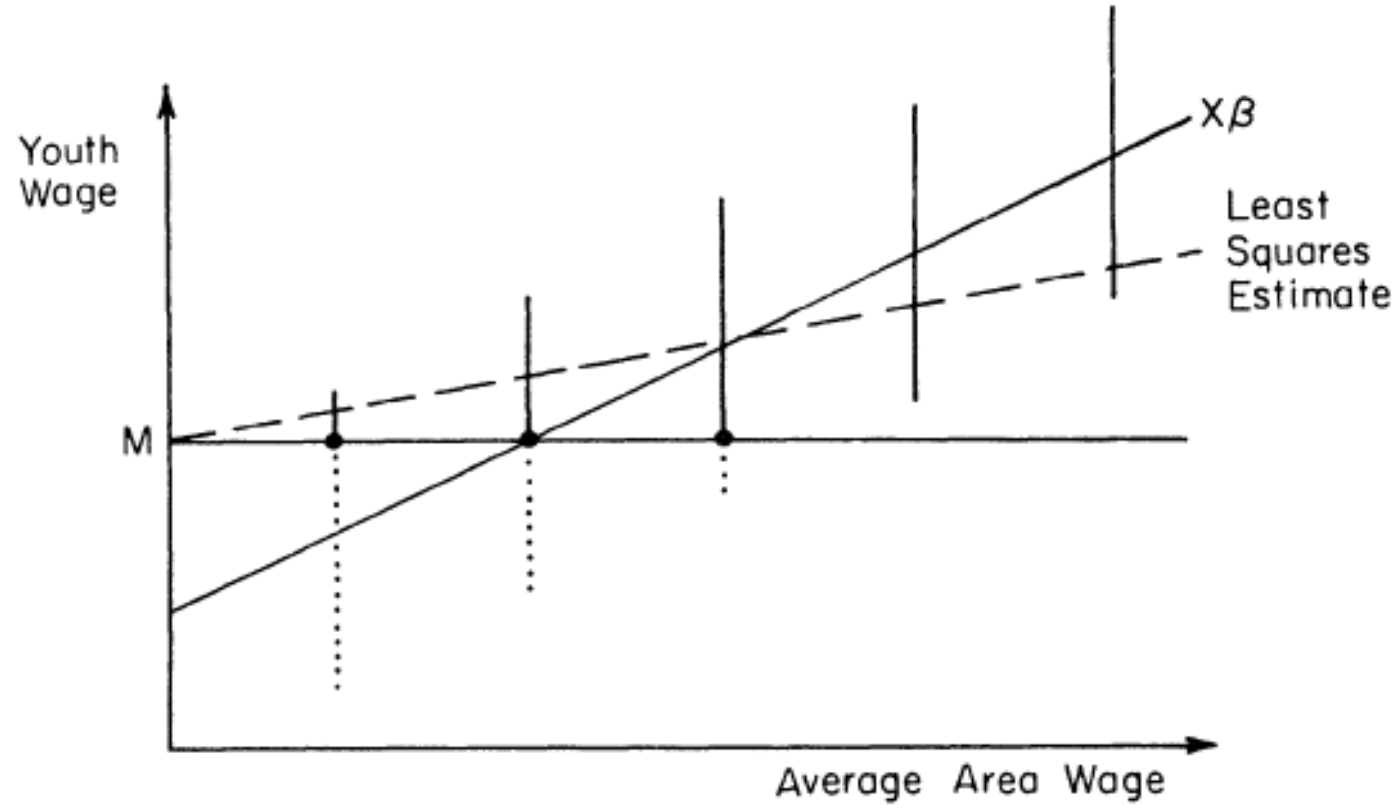


FIGURE 5.

Methodology

- Maximum Likelihood Estimate (MLE) that incorporates the interaction between an individual's market wage and the minimum
- This methodology can asymptotically generate a better estimate of the underlying coefficient and the underlying variance;
- The MLE of the coefficient is expected to be higher than the LSE;
- The MLE of standard error is expected to be higher than the LSE.

MLE and LSE

Variable	Parameter Estimate and (Asymptotic Standard Error)	Least Squares Comparison
Age	0.041	0.032
	(0.003)	(0.003)
School	0.031	0.024
	(0.003)	(0.002)
Black	− 0.069	− 0.059
	(0.019)	(0.016)
Women	− 0.224	− 0.186
	(0.012)	(0.010)
Union	0.373	0.325
	(0.015)	(0.013)
Part-time	− 0.189	− 0.138
	(0.014)	(0.012)
Never Married	− 0.095	− 0.075
	(0.013)	(0.011)
City	− 0.018	− 0.020
	(0.013)	(0.011)
Area Wage	0.066	0.054
	(0.007)	(0.007)
Area Unemployment	0.005	0.007
	(0.005)	(0.004)
Northeast	− 0.004	− 0.006
	(0.020)	(0.018)
South	0.028	0.033
	(0.018)	(0.016)
West	0.122	0.099
	(0.019)	(0.015)
Constant	− 0.459	− 0.037
	(0.085)	(0.070)
P_1	0.231	—
	(0.018)	
P_2	0.338	—
	(0.026)	
σ	0.335	0.296
	(0.003)	—
R^2	—	0.422
N	4000	4000

Personal Attributes and Employment (Male)

Variable	Blacks and Whites 16–24	Blacks 16–24	Whites 16–24	Blacks and Whites 20–24	Blacks and Whites 16–17
Age	0.065	0.078	0.063	0.046	0.068
	(0.004)	(0.015)	(0.004)	(0.006)	(0.051)
School	0.034	0.049	0.032	0.030	0.010
	(0.004)	(0.015)	(0.004)	(0.004)	(0.020)
Black	− 0.107	—	—	− 0.103	− 0.003
	(0.026)			(0.029)	(0.100)
Never Married	− 0.196	− 0.147	− 0.192	− 0.196	− 0.218
	(0.017)	(0.058)	(0.017)	(0.018)	(0.104)
City	− 0.032	− 0.030	− 0.031	− 0.036	− 0.024
	(0.016)	(0.054)	(0.016)	(0.019)	(0.051)
Area Wage	0.084	0.082	0.083	0.081	0.065
	(0.008)	(0.024)	(0.008)	(0.009)	(0.025)
Area Unemployment	0.008	0.024	0.007	0.012	− 0.031
	(0.005)	(0.018)	(0.006)	(0.006)	(0.017)
Constant	− 0.822	− 1.522	− 0.754	− 0.361	− 0.323
	(0.110)	(0.409)	(0.111)	(0.158)	(0.843)
P_1	0.229	0.212	0.245	0.232	0.341
	(0.025)	(0.066)	(0.028)	(0.039)	(0.076)
P_2	0.451	0.410	0.467	0.454	0.512
	(0.046)	(0.137)	(0.050)	(0.063)	(0.120)
σ	0.373	0.363	0.368	0.373	0.278
	(0.006)	(0.018)	(0.006)	(0.007)	(0.011)
N	3005	268	2737	2131	231

Does it violate the Presumptions?

Does it violate the Presumptions?

- The estimated variance of underlying market rates is smaller for *teenagers* (16-17) than for *older young persons* (20-24); therefore, market rates below the minimum among teenagers are bunched closer to the minimum than are the subminimum market rates of older youth.

- Subminimum market wage rates are more likely among older workers than among teenagers to be associated with poor employee attributes.

Sensitivity Test

- The underlying assumption is that wage functions are log-normal, and the results reported above are based on a log-normal distribution.
- Box-Cox transformation (Power transformation):
- $$w^{(\lambda)} = \begin{cases} \left(w^{\lambda} - 1\right)/\lambda, & \text{if } \lambda \neq 0 \\ \log w\,, & \text{if } \lambda = 0 \end{cases}$$
- (The parametric power transformation technique is often used to reduce anomalies such as non-additivity, non-normality, and heteroscedasticity.)

Sensitivity Test

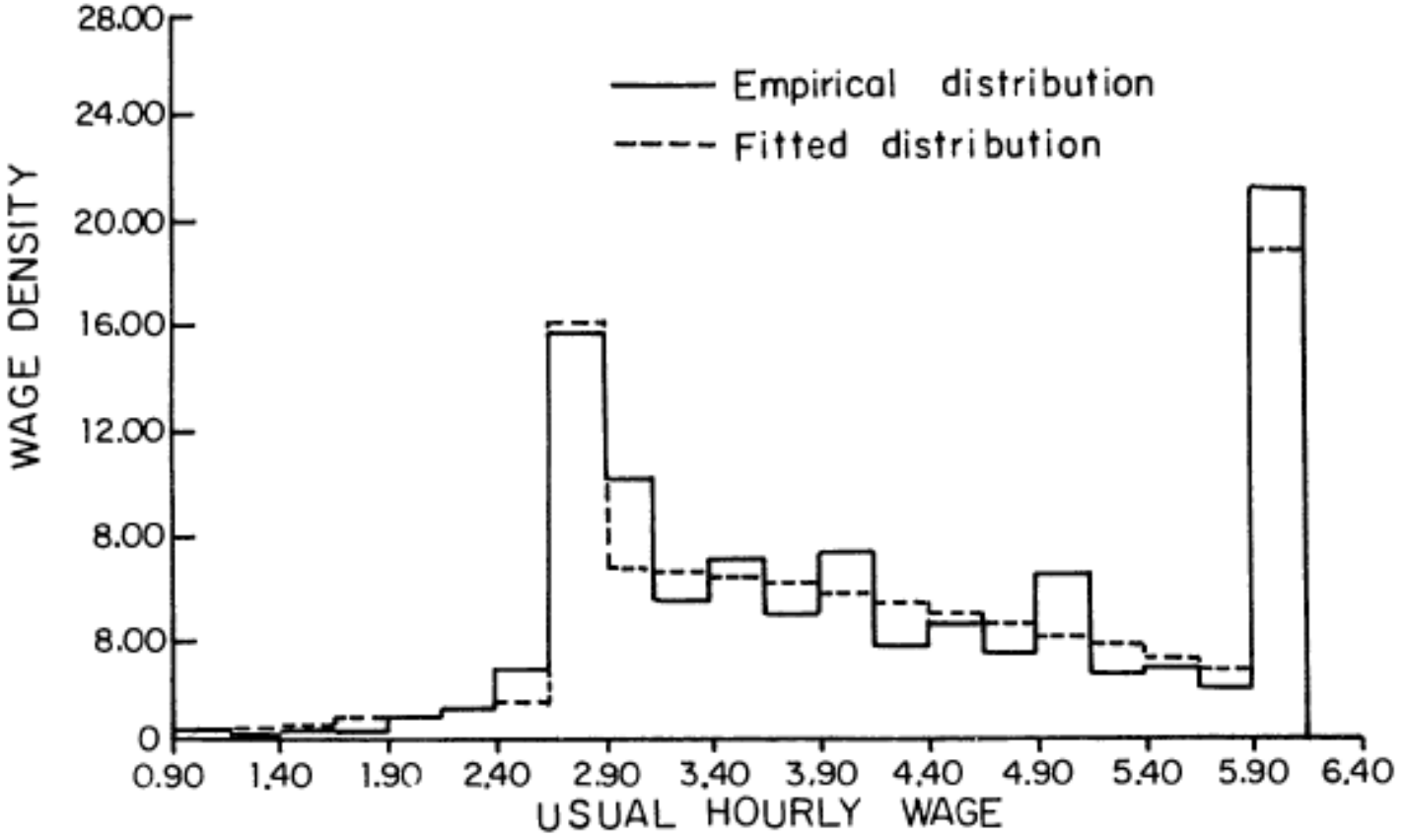


FIGURE 6—Wage distribution for 16 to 24 year olds; Subgroup: male non-students; Source: May 1978 CPS.

Sensitivity Test

- A somewhat more formal way to measure the fit:

$$\chi^2 = \sum_{j=1}^{J} \frac{(n_j - \hat{n}_j)^2}{\hat{n}_j}$$

- The statistic has a chi-square distribution with $N - (J - 1 + K)$ degrees of freedom.
- The log-normal ($\lambda = 0$) gives the smallest chi-square value (and hence the biggest *P value*), suggesting the smallest difference, which indicates that the wage function is most likely to be log-normal.

Step 2: Parameterize P

The Extended Model

Estimates with P Parameterized

The Extended Model

$$W = X\beta + \epsilon,$$

$$S = a + b(W - M) + \eta$$

$$= a + b(X\beta - M) + b\epsilon + \eta,$$

$$\Pr[\text{Employed} \mid W < M] = \Pr[S > 0] = P(X, \epsilon),$$ (P depends on wage level)

$$\Pr[w \text{ at } M \mid W < M, \text{Employed}] = Q,$$

$$\Pr[w \text{ below } M \mid W < M, \text{Employed}] = 1 - Q,$$

(conditional probability, $Q = P_2/P$)

The Extended Model

$$h(w) = \begin{cases} \dfrac{f(w \mid X) \cdot \Phi\left[a + b(w - M)\right] \cdot (1 - Q)}{D} & \text{if} \quad w < M, \\ \dfrac{\Phi\left[(M - X\beta)/\sigma, (a + b(X\beta - M))/\sigma_2; -b\sigma/\sigma_2\right] \cdot Q}{D} & \text{if} \quad w = M, \\ \dfrac{f(w \mid X)}{D} & \text{if} \quad w > M, \end{cases}$$

$$\sigma_2 = \mathrm{Var}(b\epsilon + \eta)^{1/2} = (b^2\sigma^2 + 1)^{1/2}$$

$$D = 1 - \Pr\left[W < M, S < 0\right]$$

$$= 1 - \Phi\left[(M - X\beta)/\sigma, (-a - b(X\beta - M))/\sigma_2; b\sigma/\sigma_2\right].$$

The Likelihood Function

$$L = \sum_{i=1}^{N_1} \ln h(w_i) + \sum_{i=1}^{N_2} \ln h(w_i) + \sum_{i=1}^{N_3} \ln h(w_i),$$

The function should be maximized with respect a, b, Q, β, and σ.

MLE of Male Youth

Variable	Parameter Estimate
Age	0.073 (0.005)
School	0.039 (0.005)
Black	− 0.123 (0.030)
Never Married	− 0.210 (0.020)
City	− 0.033 (0.018)
Area Wage	0.093 (0.009)
Area Unemployment	0.008 (0.006)
Constant	− 1.128 (0.149)

a	0.330 (0.131)
b	1.146 (0.346)
Q	0.660 (0.023)
σ	0.394 (0.009)
N	3005

Since $P = \Phi[a + b(W - M)]$, the smaller W is, the bigger the probability of being unemployed (i.e., $1 - P$) will be.

Simple or Extended Model?

- The results based on the extended model are in general consistent with those of the simple model;
- If $b = 0$, it then returns back to the simple model;
- Null hypothesis: $\hat{b} = b_0$
- T-test: $t_b = \frac{\hat{b} - b_0}{SE(\hat{b})} \sim t_{n-k-1}$
- Since the t *statistic* for b is $\frac{1.146-0}{0.346} \approx 3.32$, rejecting the hypothesis that $b = 0$ at a high level of significance, the extended model fits better.

Simulations

The Procedure

The Results

The Procedure (Methodology)

- Given a sample of size N of employed persons, the number that we predict would have been employed without the minimum is

$$T = \sum_{i=1}^{N} \frac{1}{D_i} \left(\textit{Recall} \text{ that } D_i = 1 - \Pr(W_i < M)\,(1 - P_1 - P_2)\right)$$

- For the minimum M_j, the predicted number of jobs lost is given by

$$L_j = \sum_{i=1}^{N} \frac{\Pr(W_i < M_j)(1 - P_1 - P_2)}{D_i}$$

The Procedure (Methodology)

- The percent increase in employment that would result if the minimum were eliminated is

$$\frac{T-N}{N}$$

- The employment elasticity with respect to a reduction in the minimum from 2.65 to 2.30 is

$$\frac{L_{2.65}-L_{2.30}}{N} \Big/ \frac{2.65-2.30}{2.65}$$

- Given the minimum, the expected wage of those employed is given by

$$\frac{1}{T-L}\sum_{i=1}^{N}\left\{\frac{\Pr(W_i \geq M)}{D_i}E(W_i|W_i \geq M)+\frac{\Pr(W_i < M)}{D_i}[P_2 M + P_1 E(W_i|W_i < M)]\right\}$$

The Procedure (Methodology)

- Given the minimum, the expected wage of those who would have been employed without the minimum is given by

$$\frac{1}{T}\sum_{i=1}^{N}\{\cdot\}$$ ("$\cdot$" is the same as under the above)

- The expected "market" wage of all persons who would have been employed without the minimum is given by

$$\frac{1}{T}\sum_{i=1}^{N}\frac{e^{X_i\beta}}{D_i}$$

The Procedure (Methodology)

- Since the general implications do not vary depending on the model, simulations based on the simple model should be preferred.

- Simulations based on the more highly parameterized model (or the two-equation model) are provided in their *working paper* version.

		Black & Whites 16–24	Blacks 16–24	Whites 16–24	Blacks & Whites 20–24	Blacks & Whites 16–17
1.	Percent increase in employment if *no minimum*	6.8	11.9	5.5	3.6	9.5
2.	Expected wage, *given the minimum*, of those *employed*	4.14	3.80	4.18	4.54	2.75
3.	Expected wage, *given the minimum*, of *all* those who would have been employed without the minimum	3.78	3.29	3.88	4.32	2.53
4.	Expected *market wage*, *without the minimum*, of all persons who would have been employed	3.87	3.43	3.95	4.39	2.49

The Results

- If there were no minimum wage, the number of male youth between 16 and 24 with jobs would be 6.8 percent higher than it was in 1978. More generally, the minimum have a crowding-out effect on the employment.
- The employment effect is larger in *Blacks* than in *Whites* (11.9 versus 5.5) and in *Teenagers* than in *Older Youth* (9.5 versus 3.6), which accords with the Presumptions.
- If there were no minimum wage, male youth between 16 and 24 would averagely earn 9 cents per hour more, which indicates that the increase of wages of some youth from below the minimum up to the minimum is more than offset by non-employment of others. (the earnings effect)

Conclusions

Conclusions

- Without the minimum, not only would the percent of out-of-school youth who are employed be higher than it is, but also that these youth would earn more.
- The employment and earnings effects of the minimum wage on youth are analyzed by parameterizing the relationship between the observed distribution of wage rates with the minimum and the hypothesized distribution that would be observed if there were no minimum.
- There are several effects of the minimum wage not being addressed. However, the model might capture the primary postulated effects of the minimum wage as they are described by most researchers.

Discussions

Minimum Wages and Employment

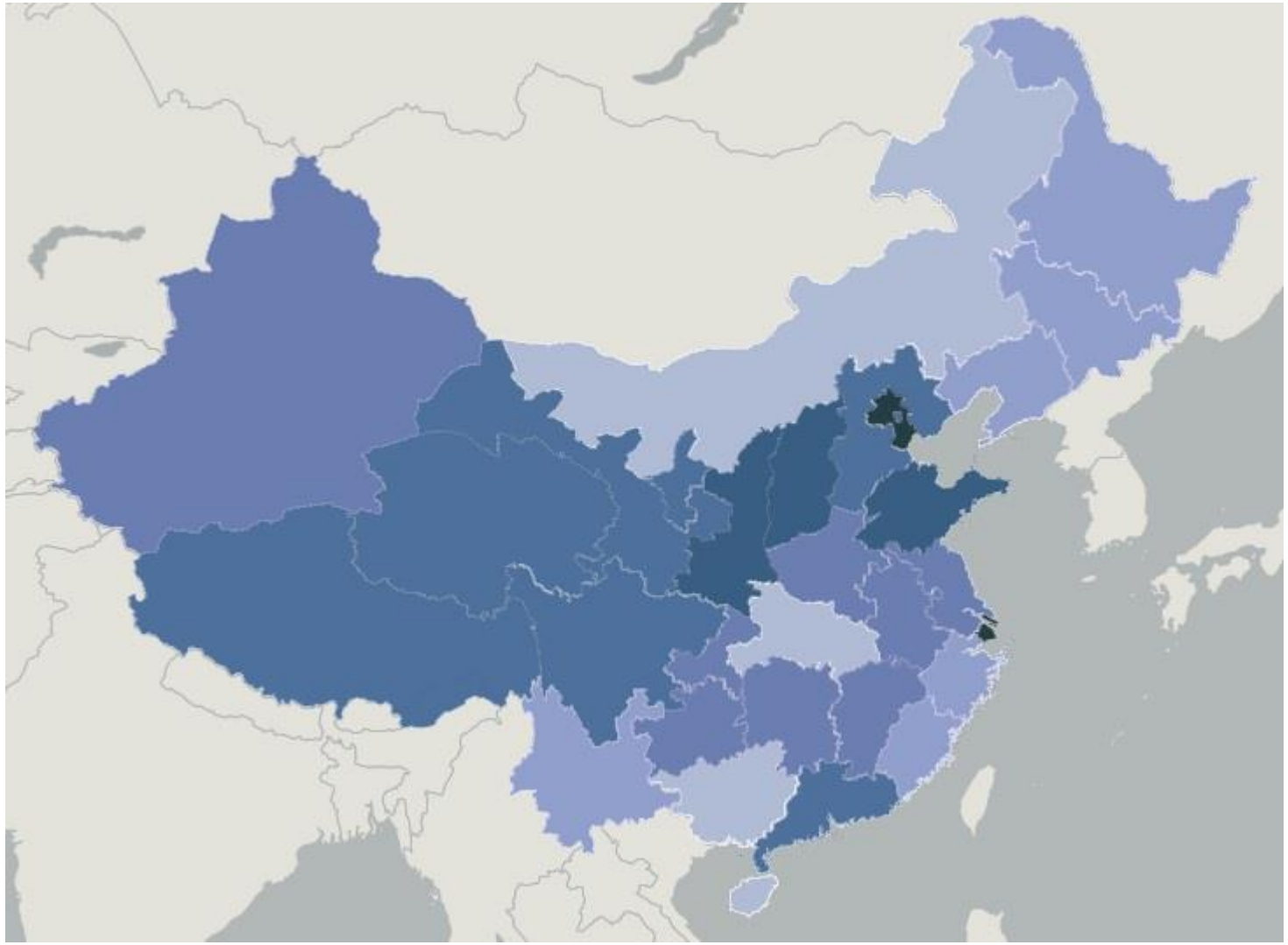
- Card and Krueger (1994) find no indication that the rise in the minimum wage reduced employment. [Card, David E., and Alan B. Krueger, 1994, "Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania", *American Economic Review*, 84(4), pp. 772-793. (Times Cited: 1439)]

- Neumark and Wascher (2007) point out that almost all related studies in recent years have agreed on negative employment effects of minimum wages. [Neumark, David, and William Wascher, 2007, "Minimum Wages and Employment", *IZA Discussion Paper* No. 2570. (Times Cited: 376)]

Minimum Wages in China

- In China, the formal system of minimum wages has just been carried out for two decades after the Ministry of Labor issued *the Regulations concerning Minimum Wages in Enterprises* in 1993, and it was not nationwide put into effect until the Ministry of Labor and Social Security issued *the Regulations on Minimum Wages* in 2004 (Du and Wang, 2008).

- Due to the short history of minimum wages, the related studies in China is considerably limited (Du and Wang, 2008). [Du, Yang, and Meiyan Wang, 2008, "The Implementation of Minimum Wage System and its Effects in China", *Journal of Graduate School of Chinese Academy of Social Sciences*, 28(6), pp. 56—62. (in Chinese) (Times Cited: 20)]



Minimum Wages in China (from *Wikipedia*)

Minimum Wages and Rural Migrant Workers

- Due to the negative employment effect of minimum wages, the carrying out and raising of minimum wages might be unfavorable to rural migrant workers in China, since they are more likely to be in the subminimum group in terms of wage rates. Although Zhang (2007) makes an effort to provide an explanation, more studies are still needed. [Zhang, Zhiyong, 2007, "Will Minimum Wage Decrease Immigrant Peasant Workers' Employment", *Finance & Economics*, 51(10), pp. 103—110. (Times Cited: 22)]

- A feasible study can be based on *Survey on Economic and Social Status of Rural Migrant Workers in Beijing* conducted by Professor Jingyi Ye in the undergraduate course *Development Economics* every year.

Raising Minimum Wages in Beijing

Minimum Wages (*Yuan/Month*)	Period of Validity
1560	Apr. 1, 2014—
1400	Jan. 1, 2013—Mar. 31, 2014
1260	Jan. 1, 2012—Dec. 31, 2012
1160	Jan. 1, 2011—Dec. 31, 2011
960	Jul. 1, 2010—Dec. 31, 2010
800	Jul. 1, 2008—Jun. 30, 2010
730	Jul. 1, 2007—Jun. 30, 2008
640	Jul. 1, 2006—Jun. 30, 2007

(Source: the Ministry of Human Resources and Social Security)

A Potential Topic

- "Missing Rural Migrant Workers and Raising Minimum Wages: A Study in Beijing"

Contact the Presenter

- Personal Website: http://cczhuang.weebly.com/
- Email: zogcee@gmail.com

- My research interests lie in Applied Econometrics, Labor Economics, Health Economics, Political Economics, Development Economics, and Economic History. Please feel free to email me for research (including potential collaborations), advising or any other scholarly inquiries.