Social Science Inquiry II

Week 7: Multivariate regression, part II

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Card, David and Krueger, Alan B. (1994). Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania. *American Economic Review.*

Loading packages for this class

```
> library(ggplot2)
> library(estimatr)
> library(modelsummary)
```

Reading in the data

```
> file <- "https://raw.githubusercontent.com/UChicago-pol-methods/SOSC13200-W23/ma
> dat <- read.csv(file, as.is = TRUE)
> head(dat)
```

	id	nj	d	d_nj	bk	kfc	roys	wendys	co_owned	centralj	southj	pa1	pa2	fte	ft
1	1	0	0	0	1	0	0	0	0	0	0	1	0	40.50	30.0
2	2	0	0	0	0	1	0	0	0	0	0	1	0	13.75	6.5
3	3	0	0	0	0	1	0	0	1	0	0	1	0	8.50	3.0
4	4	0	0	0	0	0	0	1	1	0	0	1	0	34.00	20.0
5	5	0	0	0	0	0	0	1	1	0	0	1	0	24.00	6.0
6	6	0	0	0	0	0	0	1	1	0	0	1	0	20.50	0.0

	pt	mgrs	wage	meal	hrsopen	bonus	ncalls	status	type	inctime	firstinc	nregs
1	15.0	3	NA	2.58	16.5	1	0	1	1	19	NA	3
2	6.5	4	NA	4.26	13.0	0	0	1	1	26	NA	4
3	7.0	2	NA	4.02	10.0	0	0	1	1	13	0.37	3
4	20.0	4	5.0	3.48	12.0	1	0	1	1	26	0.10	2
5	26.0	5	5.5	3.29	12.0	1	0	1	1	52	0.15	2
6	31.0	5	5.0	2.59	12.0	0	2	1	1	26	0.07	2

Reading in the data

```
> str(dat)
'data.frame':        820 obs. of  27 variables:
 $ id       : int  1 2 3 4 5 6 7 8 9 10 ...
 $ nj       : int  0 0 0 0 0 0 0 0 0 0 ...
 $ d        : int  0 0 0 0 0 0 0 0 0 0 ...
 $ d_nj     : int  0 0 0 0 0 0 0 0 0 0 ...
 $ bk       : int  1 0 0 0 0 0 1 1 0 0 ...
 $ kfc      : int  0 1 1 0 0 0 0 0 1 1 ...
 $ roys     : int  0 0 0 0 0 0 0 0 0 0 ...
 $ wendys   : int  0 0 0 1 1 1 0 0 0 0 ...
 $ co_owned: int  0 0 1 1 1 1 0 0 1 1 ...
 $ centralj: int  0 0 0 0 0 0 0 0 0 0 ...
 $ southj   : int  0 0 0 0 0 0 0 0 0 0 ...
 $ pa1      : int  1 1 1 1 1 1 0 0 0 1 ...
 $ pa2      : int  0 0 0 0 0 0 1 1 1 0 ...
 $ fte      : num  40.5 13.8 8.5 34 24 ...
 $ ft       : num  30 6.5 3 20 6 0 50 10 2 2 ...
 $ pt       : num  15 6.5 7 20 26 31 35 17 8 10 ...
 $ mgrs     : num  3 4 2 4 5 5 3 5 5 2 ...
 $ wage     : num  NA NA NA 5 5.5 5 5 5 5.25 5 ...
 $ meal     : num  2.58 4.26 4.02 3.48 3.29 2.59 2.86 2.85 3.78 3.99 ...
 $ hrsopen : num  16.5 13 10 12 12 12 18 24 10 10 ...
 $ bonus    : int  1 0 0 1 1 0 0 0 0 0 ...
 $ ncalls   : int  0 0 0 0 0 2 0 0 0 2 ...
 $ status   : int  1 1 1 1 1 1 1 1 1 1 ...
 $ type     : int  1 1 1 1 1 1 1 1 1 1 ...
 $ inctime : num  19 26 13 26 52 26 26 52 13 19 ...
 $ firstinc: num  NA NA 0.37 0.1 0.15 0.07 0.1 0.25 0.25 0.15 ...
 $ nregs    : int  3 4 3 2 2 2 3 6 2 4 ...
```

TABLE 1—SAMPLE DESIGN AND RESPONSE RATES

	All	Stores in: NJ	PA
Wave 1, February 15 – March 4, 1992:			
Number of stores in sample frame:[a]	473	364	109
Number of refusals:	63	33	30
Number interviewed:	410	331	79
Response rate (percentage):	86.7	90.9	72.5
Wave 2, November 5 – December 31, 1992:			
Number of stores in sample frame:	410	331	79
Number closed:	6	5	1
Number under rennovation:	2	2	0
Number temporarily closed:[b]	2	2	0
Number of refusals:	1	1	0
Number interviewed:[c]	399	321	78

[a]Stores with working phone numbers only; 29 stores in original sample frame had disconnected phone numbers.

[b]Includes one store closed because of highway construction and one store closed because of a fire.

[c]Includes 371 phone interviews and 28 personal interviews of stores that refused an initial request for a phone interview.

TABLE 2—MEANS OF KEY VARIABLES

Variable	Stores in: NJ	PA	t[a]
1. *Distribution of Store Types (percentages):*			
a. Burger King	41.1	44.3	−0.5
b. KFC	20.5	15.2	1.2
c. Roy Rogers	24.8	21.5	0.6
d. Wendy's	13.6	19.0	−1.1
e. Company-owned	34.1	35.4	−0.2
2. *Means in Wave 1:*			
a. FTE employment	20.4	23.3	−2.0
	(0.51)	(1.35)	
b. Percentage full-time employees	32.8	35.0	−0.7
	(1.3)	(2.7)	
c. Starting wage	4.61	4.63	−0.4
	(0.02)	(0.04)	
d. Wage = $4.25 (percentage)	30.5	32.9	−0.4
	(2.5)	(5.3)	
e. Price of full meal	3.35	3.04	4.0
	(0.04)	(0.07)	
f. Hours open (weekday)	14.4	14.5	−0.3
	(0.2)	(0.3)	
g. Recruiting bonus	23.6	29.1	−1.0
	(2.3)	(5.1)	
3. *Means in Wave 2:*			
a. FTE employment	21.0	21.2	−0.2
	(0.52)	(0.94)	
b. Percentage full-time employees	35.9	30.4	1.8
	(1.4)	(2.8)	
c. Starting wage	5.08	4.62	10.8
	(0.01)	(0.04)	
d. Wage = $4.25 (percentage)	0.0	25.3	—
		(4.9)	
e. Wage = $5.05 (percentage)	85.2	1.3	36.1
	(2.0)	(1.3)	
f. Price of full meal	3.41	3.03	5.0
	(0.04)	(0.07)	
g. Hours open (weekday)	14.4	14.7	−0.8
	(0.2)	(0.3)	
h. Recruiting bonus	20.3	23.4	−0.6
	(2.3)	(4.9)	

Notes: See text for definitions. Standard errors are given in parentheses.
[a]Test of equality of means in New Jersey and Pennsylvania.

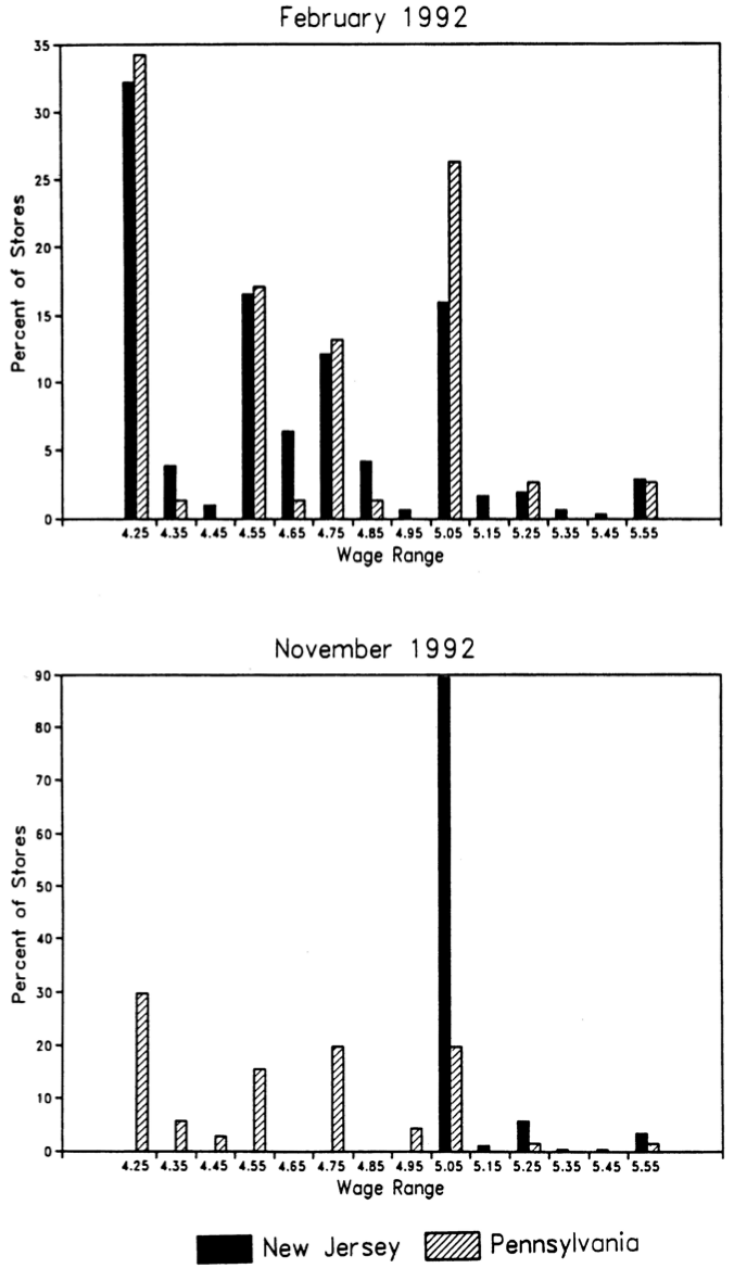

FIGURE 1. DISTRIBUTION OF STARTING WAGE RATES

Formulas

Table 3:

$$\Delta E_i = a + \mathrm{b}\mathrm{X}_i + c\mathrm{NJ}_i + \epsilon_i$$

Table 4:

$$\Delta E_i = a + \mathrm{b}'\mathrm{X}_i + c'\mathrm{GAP}_i + \epsilon_i$$

$$
\begin{aligned}
\mathrm{GAP}_i &= 0 \qquad \text{for stores in Pennsylvania} \\
&= 0 \qquad \text{for stores in New Jersey with} \\
&\qquad\qquad W_{1i} \geq \$5.05 \\
&= (5.05 - W_{1i}) / W_{1i} \\
&\qquad\qquad \text{for other stores in New Jersey.}
\end{aligned}
$$

GAP_i is the proportional increase in wages at store i necessary to meet the new minimum rate. Variation in GAP_i reflects both the New Jersey–Pennsylvania contrast and differences within New Jersey based on reported starting wages in wave 1. Indeed, the value of GAP_i is a strong predictor of the actual proportional wage change between waves 1 and 2 ($R^2 = 0.75$), and conditional on GAP_i there is no difference in wage behavior between stores in New Jersey and Pennsylvania.[15]

TABLE 3—AVERAGE EMPLOYMENT PER STORE BEFORE AND AFTER THE RISE IN NEW JERSEY MINIMUM WAGE

Variable	Stores by state			Stores in New Jersey[a]			Differences within NJ[b]	
	PA (i)	NJ (ii)	Difference, NJ − PA (iii)	Wage = $4.25 (iv)	Wage = $4.26–$4.99 (v)	Wage ≥ $5.00 (vi)	Low–high (vii)	Midrange–high (viii)
1. FTE employment before, all available observations	23.33 (1.35)	20.44 (0.51)	−2.89 (1.44)	19.56 (0.77)	20.08 (0.84)	22.25 (1.14)	−2.69 (1.37)	−2.17 (1.41)
2. FTE employment after, all available observations	21.17 (0.94)	21.03 (0.52)	−0.14 (1.07)	20.88 (1.01)	20.96 (0.76)	20.21 (1.03)	0.67 (1.44)	0.75 (1.27)
3. Change in mean FTE employment	−2.16 (1.25)	0.59 (0.54)	2.76 (1.36)	1.32 (0.95)	0.87 (0.84)	−2.04 (1.14)	3.36 (1.48)	2.91 (1.41)
4. Change in mean FTE employment, balanced sample of stores[c]	−2.28 (1.25)	0.47 (0.48)	2.75 (1.34)	1.21 (0.82)	0.71 (0.69)	−2.16 (1.01)	3.36 (1.30)	2.87 (1.22)
5. Change in mean FTE employment, setting FTE at temporarily closed stores to 0[d]	−2.28 (1.25)	0.23 (0.49)	2.51 (1.35)	0.90 (0.87)	0.49 (0.69)	−2.39 (1.02)	3.29 (1.34)	2.88 (1.23)

Notes: Standard errors are shown in parentheses. The sample consists of all stores with available data on employment. FTE (full-time-equivalent) employment counts each part-time worker as half a full-time worker. Employment at six closed stores is set to zero. Employment at four temporarily closed stores is treated as missing.

[a]Stores in New Jersey were classified by whether starting wage in wave 1 equals $4.25 per hour ($N = 101$), is between $4.26 and $4.99 per hour ($N = 140$), or is $5.00 per hour or higher ($N = 73$).

[b]Difference in employment between low-wage ($4.25 per hour) and high-wage (≥ $5.00 per hour) stores; and difference in employment between midrange ($4.26–$4.99 per hour) and high-wage stores.

[c]Subset of stores with available employment data in wave 1 and wave 2.

[d]In this row only, wave-2 employment at four temporarily closed stores is set to 0. Employment changes are based on the subset of stores with available employment data in wave 1 and wave 2.

TABLE 4—REDUCED-FORM MODELS FOR CHANGE IN EMPLOYMENT

Independent variable	Model (i)	(ii)	(iii)	(iv)	(v)
1. New Jersey dummy	2.33 (1.19)	2.30 (1.20)	—	—	—
2. Initial wage gap[a]	—	—	15.65 (6.08)	14.92 (6.21)	11.91 (7.39)
3. Controls for chain and ownership[b]	no	yes	no	yes	yes
4. Controls for region[c]	no	no	no	no	yes
5. Standard error of regression	8.79	8.78	8.76	8.76	8.75
6. Probability value for controls[d]	—	0.34	—	0.44	0.40

Notes: Standard errors are given in parentheses. The sample consists of 357 stores with available data on employment and starting wages in waves 1 and 2. The dependent variable in all models is change in FTE employment. The mean and standard deviation of the dependent variable are −0.237 and 8.825, respectively. All models include an unrestricted constant (not reported).

[a]Proportional increase in starting wage necessary to raise starting wage to new minimum rate. For stores in Pennsylvania the wage gap is 0.

[b]Three dummy variables for chain type and whether or not the store is company-owned are included.

[c]Dummy variables for two regions of New Jersey and two regions of eastern Pennsylvania are included.

[d]Probability value of joint F test for exclusion of all control variables.

Table 4

	Model 1	Model 2	Model 3	Model 4	Model 5
New Jersey Dummy	2.277	2.282			
	(1.456)	(1.457)			
Initial Wage Gap			17.052**	16.363*	13.879*
			(6.153)	(6.537)	(7.051)
Num.Obs.	351	351	351	351	351
AIC	2519.9	2524.4	2515.8	2521.1	2524.1
BIC	2531.5	2551.4	2527.4	2548.1	2566.6
RMSE	8.69	8.65	8.64	8.61	8.55
Controls for chain and ownership	no	yes	no	yes	yes
Controls for region	no	no	no	no	yes

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

References I

Card, D. and Krueger, A. B. (1993). Minimum wages and employment: A case study of the fast food industry in New Jersey and Pennsylvania.