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Valtion taloudellinen tutkimuskeskus
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Abstract

This note adds to the discussion originating from David Card and Alan B. Krueger (1994; CK) and David Neumark and William Wascher (2000; NW). It re-evaluates their results by using the semiparametric difference-in-differences estimator introduced by Alberto Abadie (2005). The re-evaluation suggests that the original results on the average employment effect in CK and NW are fairly robust, although the NW results are slightly diluted when taking into account the differences in the distributions of the observed covariates.

Key words: employment, minimum wage, nonlinear treatment effect models

JEL classification numbers: C21, J23, J38

Tiivistelmä

Tutkimuksessa arvioidaan minimipalkkojen vaikutusta työllisyyteen. Tämä tehdään käyttämällä semiparametrista difference-in-differences (DID) -estimointimenetelmää alkuperäisten Card ja Krueger (1994) ja Neumark ja Wascher (2000) pikaruokaravintola-aineistojen analysointiin. Tulokset osoittavat, että alkuperäiset, keskenään kilpailevat tulokset keskimääräiselle työllisyysvaikutukselle ovat melko pysyviä, vaikka Neumarkin ja Wascherin tulokset laimenevatkin hieman, kun otetaan huomioon erilaisuus havaittujen muuttujien jakaumissa.

Asiasanat: työllisyys, minimipalkka, epälineaariset kausaaliset mallit

JEL-luokittelu: C21, J23, J38

1 Introduction

This note adds to the discussion originating from David Card and Alan B. Krueger (1994; CK) and David Neumark and William Wascher (2000; NW). The original articles employ separate datasets on fast-food restaurants and draw very different conclusions on the average employment effect of the minimum wage increase: CK report a positive effect and NW report a negative effect. This note uses the semiparametric difference-in-differences (DID) estimator introduced by Alberto Abadie (2005) to address the question of whether the differences in the original datasets can explain the differences in their conclusions.

The four chains of the fast-food restaurants represented in the CK and NW data are Burger King (BK), Kentucky Fried Chicken (KFC), Wendy's and Roy Rogers (RR). Some of these are company-owned (CO), whereas others are not company-owned (NCO).

The employment responses to the minimum wage increase might differ between different chains as well as between CO and NCO restaurants. The differences might arise, for instance, due to differences in the attitudes or practices between chains or due to different amounts of freedom in choosing the employment level in CO and NCO restaurants. The differences between the distributions of observed characteristics (chain and company-ownership) of the treated and untreated combined with the relation between these observed characteristics and the reaction to the change (in the minimum wage) may result in features that remain unobserved when using the conventional DID or changes-in-changes (CIC) estimator. This study re-evaluates the over-

all employment effect of the minimum wage by taking into account the differences between the distributions of the observed characteristics in New Jersey and Pennsylvania fast-food restaurants in CK and NW datasets.

Table 1 shows the numbers of observations on CK fast-food restaurants according to the company-ownership and the chain in New Jersey and Pennsylvania as well as in the whole balanced sample.[1] It shows some differences in the distributions of the observed covariates. For instance, in New Jersey (treatment group), there are 39% $\left(\frac{39-28}{28} = 0.39\right)$ more NCO KFC restaurants compared to CO KFC restaurants, whereas in Pennsylvania (control group) there are 50% *less*. The behavior of CO KFC restaurants may differ from that of NCO KFC restaurants. Therefore, these differences in the distribution of observed covariates might result in false inference when using, say, the conventional DID estimator, because the identifying assumptions it uses might turn invalid and the results might be driven by some particular types of restaurants that are over-represented in the data.

Table 2 shows the corresponding numbers for the NW data. Like for CK data, there are some differences in the distributions of the observed covariates in the NW data as well. For example, in New Jersey there are 43% more NCO restaurants compared to CO restaurants. In Pennsylvania, there are 24% less NCO restaurants compared to CO restaurants. In addition, we observe that there are more zeros in table 2, which represents NW data, compared to table 1, which represents CK data.

[1]The balanced sample includes observations on fast-food restaurants with no missing information on employment variables.

2 Analysis of Employment Effects

The conventional DID estimator requires that in the absence of the treatment the average outcomes for the treatment and control groups would have followed parallel paths over time. In order to use milder assumptions and more realistic counterfactual outcomes, we use the semiparametric DID estimator, introduced by Abadie (2005), that allows for the differences in the observed characteristics to create non-parallel paths between treated and controls.[2] The CIC estimator is capable to provide nonlinear and non-parallel paths only with respect to the *outcome variable*, but is restricted, unlike the semi-

[2]In order to identify the average treatment effect by the semiparametric DID estimator we need two assumptions:

Assumption 1 $E[Y^0(1) - Y^0(0)|X, D = 1] = E[Y^0(1) - Y^0(0)|X, D = 0]$,

where $Y^0(0)$ and $Y^0(1)$ are the outcomes of interest before and after the treatment in the absence of the treatment, X is a vector of observed covariates and $D \in \{0, 1\}$ is an indicator for being in the treatment group.

Assumption 2 $P(D = 1) > 0$ *and with probability one* $P(D = 1|X) < 1$.

Assumption 1 states that the conditional averages of differences between before and after, conditional on the observed characteristics, X, would have been the same for treated and untreated in the absence of the treatment, which means that the conditional averages would have followed parallel paths in the absence of the treatment. The (unconditional) averages are, however, allowed to differ from the parallel paths. Assumption 2 guarantees that there are observations which have received the treatment and that there are observations in each subset among control group, which together mean that the support for the propensity score, $P(D = 1|X)$, for treated is a subset of the support of the propensity score for untreated. For a throughout discussion on the estimator, see Abadie (2005).

parametric DID estimator, to parallel paths for treated and untreated with respect to the observed characteristics.[3]

The average treatment effect for the treated is given by:

$$E[Y^1(1) - Y^0(1)|D = 1] = E\left[\frac{Y(1) - Y(0)}{P(D = 1)} * \frac{D - P(D = 1|X)}{1 - P(D = 1|X)}\right], \quad (1)$$

where $Y(0)$ and $Y(1)$ are the values of the variable of interest, in our case the employment levels, before and after the treatment, D is an indicator for being in the treatment group, $P(D = 1)$ gives the probability for being in the treatment group and $P(D = 1|X)$ is the propensity score, that is the conditional probability for receiving the treatment, conditional on the observed covariates, X. An estimator for the average treatment effect is the one where we replace the theoretical quantities with the empirical counterparts. The estimator works by weighting observations in order to impose the same distribution of covariates for treated and untreated.

2.1 Adjusting for Chain Differences

Table 3 provides the percentages of the CK and NW fast-food restaurants in each chain in New Jersey, Pennsylvania and in the whole data. It shows that there are relatively less BK and Wendy's fast-food restaurants in New Jersey than in Pennsylvania in both datasets. The opposite holds for KFC and RR restaurants. Next, we will find out whether the original results change

[3]Olli Ropponen (forthcoming) has studied the employment effects of the minimum wage by using the CIC estimator. He shows that the CIC estimator implies a positive average employment effect for the CK data and a negative average employment effect for the NW data.

as we take into account the differences in the relative amounts of fast-food restaurants in New Jersey and Pennsylvania. The result CK report for the average employment effect, by using the same sample as we do, is 2.75 full-time equivalent (FTE) employment.[4] For the NW data the corresponding estimate is -0.68 FTE employment.

The probability for being subject to the minimum wage increase in the CK sample is $P(D=1) = P(NJ) = \frac{309}{384}$ (see table 1). Equation 1 and this probability imply that each difference $Y(1)-Y(0)$ among New Jersey restaurants is multiplied by a factor of $\frac{1}{P(NJ)} = \frac{384}{309}$ independently of the chain the observation belongs.[5] The propensity scores in the CK sample are $P(D = 1|BK) = P(NJ|BK) = \frac{126}{159}$, $P(NJ|KFC) = \frac{67}{79}$, $P(NJ|Wendy's) = \frac{39}{52}$ and $P(NJ|RR) = \frac{77}{94}$. For Pennsylvania observations, the factors are chain-dependent: $-\frac{384}{309} * \frac{126}{33}$ for BK, $-\frac{384}{309} * \frac{67}{12}$ for KFC, $-\frac{384}{309} * \frac{77}{17}$ for Wendy's and $-\frac{384}{309} * \frac{39}{13}$ for RR restaurants.[6] The factors for Pennsylvania restaurants are negative as these belong to the control group. As we compare the changes in employment levels of New Jersey restaurants to the corresponding changes among Pennsylvania restaurants, positive value for $Y(1) - Y(0)$ for Pennsylvania restaurant (i.e. increase in the employment in the control group) gives negative contribution for the estimate of the employment effect for the treated. The factor for the BK restaurants in Pennsylvania is $-\frac{126}{33}$ times the

[4] As a measure for the employment we use, following CK, the full-time equivalent (FTE) employment, which makes a part-time worker to correspond to half of a full-time worker.

[5] $\frac{D-P(D=1|X)}{1-P(D=1|X)} = 1$, when $D = 1$.

[6] For example for BK restaurants in Pennsylvania we have: $\frac{1}{P(NJ)} * \frac{D-P(NJ|BK)}{1-P(NJ|BK)} = \frac{384}{309} * \frac{0-\frac{126}{159}}{1-\frac{126}{159}} = -\frac{384}{309} * \frac{126}{33}$.

one for New Jersey restaurants. As the number of BK restaurants in New Jersey (126) is about four times the one in Pennsylvania (33), the contribution (weight) of a single BK fast-food restaurant in Pennsylvania corresponds to about four times that of the one in New Jersey. For the other chains the adjustment and interpretations are performed in a similar manner.

Calculating the empirical counterpart of equation 1 gives us the estimated average employment effect for New Jersey fast-food restaurants, when adjusting for the differences in the distributions of chains. The estimate using CK data is 2.50 with the bootstrap standard error of 1.28 ($t = 1.95$). Thus, the point estimate for the average employment effect, when using CK data and adjusting for the chains, is positive and of the same order of magnitude, as is the original result. For the NW data the corresponding estimate is -0.30 with the bootstrap standard error of 0.50.[7] This result is, in absolute terms, less than half of the original one and not statistically significant. Thus, the NW result loses its statistical significance, when adjusting for the differences in the distribution of chains.

2.2 Adjusting for Company-Ownership Differences

In the CK data, 35.0 percent of New Jersey restaurants and 34.7 percent of Pennsylvania restaurants are company-owned. The difference is not very large and therefore the original result is probably not changed much when taking

[7]When calculating the average employment effect using NW data we have to discard 10 KFC restaurants, because there are none of them in Pennsylvania and therefore the identifying assumption 2 would not be satisfied otherwise. Thus, this result is derived by using 225 NW observations.

this difference into account. The propensity scores are now $P(NJ|CO) = \frac{108}{134}$ and $P(NJ|NCO) = \frac{201}{250}$. The resulting estimate for the average employment effect is 2.75, which is with two decimals the same than in CK. As there is not much to adjust due to small differences between the distributions of company-ownership, the result stays the same. The bootstrap standard error is 1.35 and thus the estimated employment effect is positive with five percent significance level when taking the differences in the company-ownership into account.

In the NW data, 41.1 percent of New Jersey restaurants and 56.9 percent of Pennsylvania restaurants are company-owned.[8] The estimate for the average employment effect is -1.29 with the standard error of 0.70 ($t = 1.84$). Thus, the original NW result is close to doubled when adjusting for the company-ownership. Therefore, the fact that there are different fractions of company-owned fast-food restaurant in New Jersey and Pennsylvania is something that matters for the results, yet would remain unobserved when using, say, the conventional DID estimator. The result is statistically significant with ten percent significance level.

2.3 Adjusting for both Chain and Company-Ownership Differences

Next we adjust for the differences in the joint distribution of chain and company-ownership. Table 4 shows the percentages of different types of restaurants in New Jersey, in Pennsylvania and in the whole sample for both

[8]The propensity scores are now $P(NJ|CO) = \frac{67}{108}$ and $P(NJ|NCO) = \frac{96}{127}$.

CK and NW data. Some differences are observed in the joint distributions between New Jersey and Pennsylvania.

In the CK data, there are no company-owned BK restaurants in Pennsylvania. Therefore, in order to meet the identification conditions, we exclude both New Jersey and Pennsylvania CO BK restaurants when calculating the average employment effect for the CK data. NCO BK restaurants and CO Wendy's restaurants are clearly over-represented in the control group. The opposite holds for NCO KFC restaurants. The propensity scores are $P(NJ|KFC, CO) = \frac{28}{36}$, $P(NJ|Wendy's, CO) = \frac{4}{10}$, $P(NJ|RR, CO) = \frac{52}{64}$, $P(NJ|BK, NCO) = \frac{102}{135}$, $P(NJ|KFC, NCO) = \frac{39}{43}$, $P(NJ|Wendy's, NCO) = \frac{35}{42}$ and $P(NJ|RR, NCO) = \frac{25}{30}$. As CO BK restaurants are excluded both in New Jersey and in Pennsylvania, we have $P(NJ) = \frac{285}{360}$.[9] The estimate for the average employment effect is 2.08 with the bootstrap standard error of 1.27 ($t = 1.65$). Thus, adjusting for the differences in the joint distribution of the chain and the company-ownership in the CK data gives us positive point estimate for the average employment effect. This is statistically significant with ten percent significance level.

For NW data, other than CO RR and NCO BK restaurants must be excluded both in New Jersey and Pennsylvania in order to meet the identification conditions of the estimator. Therefore, we exclude 42 observations and use 193 remaining ones. Both CO RR and NCO BK restaurants are over-represented in the control group. Adjusting for the differences in the joint distribution of the chain and the company-ownership gives us an estimate of

[9]There are 24 excluded company-owned BK restaurants in New Jersey.

-0.50 for the average employment effect with the standard error of 0.46.[10] Thus, the point estimate is negative, yet statistically insignificantly different from zero.

3 Conclusions

We have employed Card and Krueger (1994) and Neumark and Wascher (2000) data to re-evaluate their results on the overall employment effect of the minimum wage using more flexible estimator than originally employed. The point estimates for the average employment effect using the CK data remain positive all the time when adjusting for the differences in both the marginal distributions and the joint distribution of observed characteristics and is sometimes statistically significant at five percent significance level and sometimes not. For NW data the corresponding point estimates are all negative, yet not statistically significant with five percent significance level.

According to our results, the difference between the conclusions implied by the CK data and the NW data still exists. Therefore, the difference between the distributions in the observed characteristics is not capable for explaining the differences between the CK and NW results. Both the semiparametric DID estimates and the CIC estimates, studied by Ropponen (forthcoming), suggest that the original results on the average employment effect in CK and NW are fairly robust, although the NW results are slightly diluted when taking into account the differences in the distributions of the observed characteristics.

[10]The propensity scores are $P(NJ|BK, NCO) = \frac{63}{94}$, and $P(NJ|RR, CO) = \frac{67}{99}$.

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Table 1: Number of observations, Card and Krueger (1994) data

	New Jersey			Pennsylvania			All		
chain	CO	not CO	total	CO	not CO	total	CO	not CO	total
BK	24	102	126	0	33	33	24	135	159
KFC	28	39	67	8	4	12	36	43	79
Wendy's	4	35	39	6	7	13	10	42	52
RR	52	25	77	12	5	17	64	30	94
total	108	201	309	26	49	75	134	250	384

Table 2: Number of observations, Neumark and Wascher (2000) data

	New Jersey			Pennsylvania			All		
chain	CO	not CO	total	CO	not CO	total	CO	not CO	total
BK	0	63	63	0	31	31	0	94	94
KFC	0	10	10	0	0	0	0	10	10
Wendy's	0	16	16	9	0	9	9	16	25
RR	67	7	74	32	0	32	99	7	106
total	67	96	163	41	31	72	108	127	235

Table 3: Percentages of different chains

CK data				NW data			
chain	New Jersey	Pennsylvania	All	chain	New Jersey	Pennsylvania	All
BK	40.8	44.0	41.4	BK	38.7	43.1	40.0
KFC	21.7	16.0	20.6	KFC	6.1	0.0	4.3
Wendy's	12.6	17.3	13.5	Wendy's	9.8	12.5	10.6
RR	24.9	22.7	24.5	RR	45.4	44.4	45.1
total	100.0	100.0	100.0	total	100	100	100

Table 4: Percentages of different types of restaurants

CK data					NW data				
chain	CO/NCO	NJ	PA	All	chain	CO/NCO	NJ	PA	All
BK,	CO	7.8	0.0	6.3	BK,	CO	0.0	0.0	0.0
KFC,	CO	9.1	10.7	9.4	KFC,	CO	0.0	0.0	0.0
Wendy's,	CO	1.3	8.0	2.6	Wendy's,	CO	0.0	12.5	3.9
RR,	CO	16.8	16.0	16.7	RR,	CO	41.1	44.4	42.1
BK,	NCO	33.0	44.0	35.2	BK,	NCO	38.7	43.1	40.0
KFC,	NCO	12.6	5.3	11.2	KFC,	NCO	6.1	0.0	4.3
Wendy's,	NCO	11.3	9.3	10.9	Wendy's,	NCO	9.8	0.0	6.8
RR,	NCO	8.1	6.7	7.8	RR,	NCO	4.3	0.0	3.0
total		100	100	100	total		100	100	100

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