Minimum Wages and Employment: Replication of Card and Krueger (1994) Using the CIC Estimator

Ropponen, Olli

Helsinki Center of Economic Research

April 2010

Helsinki Center of Economic Research

Discussion Papers

Minimum Wages and Employment: Replication of Card and Krueger (1994) using the CIC Estimator

Olli Ropponen
University of Helsinki and HECER

Discussion Paper No. 289
April 2010

ISSN 1795-0562

HECER – Helsinki Center of Economic Research, P.O. Box 17 (Arkadiankatu 7), FI-00014
University of Helsinki, FINLAND, Tel +358-9-191-28780, Fax +358-9-191-28781,
E-mail info-hecer@helsinki.fi, Internet www.hecer.fi

HECER
Discussion Paper No. 289

Minimum Wages and Employment: Replication of Card and Krueger (1994) using the CIC Estimator*

Abstract

We employ the original Card and Krueger (1994) data and the CIC estimator to re-examine the evidence on the effect of minimum wages on employment. Our main finding is that the controversial result remains valid only for small fast-food restaurants. This finding is accompanied with a new possible explanation.

JEL Classification: C21, J23, J38

Keywords: CIC estimator, employment, minimum wage, nonlinear treatment effect models.

Olli Ropponen

Department of Political and Economic Studies
University of Helsinki
P.O. Box 17 (Arkadiankatu 7)
FI-00014 University of Helsinki
FINLAND

e-mail: olli.ropponen@helsinki.fi

* I thank Pekka Ilmakunnas, Tero Kuusi, Markku Lanne, Sami Napari, Panu Poutvaara, Heikki Pursiainen, Otto Toivanen and Roope Uusitalo as well as the participants of the workshop in Computational Economics and Econometrics in Helsinki in 2009 and the participants of annual meeting of the Finnish Economic Society in 2010 for our discussions.

1 Introduction

New Jersey experienced an increase in the minimum wage on April 1, 1992. David Card and Alan B. Krueger were the first one to use this variation to study the employment effect of an increase in the minimum wage. They chose Pennsylvania, the neighboring state that did not experience any change in the minimum wage that time, to serve as a control group. The data they collected include observations on fast-food restaurants both in New Jersey and in Pennsylvania before and after the minimum wage increase. Card and Krueger's (1994) (CK) controversial result was that an increase in the minimum wage did not decrease, but increased the overall employment.[1] This stimulated a lot of discussion on the overall employment effect of the minimum wage, which is still an open issue.[2] The result was challenged by David Neumark and William Wascher (2000) (NW). They use the administrative

[1]Before CK several controversial non-negative employment effects of an increase in the minimum wage had already been reported. These studies have exploited variation from both federal (Card 1992a, Lawrence F. Katz and Krueger 1992, Stephen Machin and Alan Manning 1994) and state-specific (Card 1992b) increases in the minimum wages.

[2]We refer to a book by Neumark and Wascher (2008) for the literature concerned with minimum wages. Their discussion paper of its chapter 3 concerned with (both theoretical and empirical findings on) the effects of minimum wages on employment (IZA DP No.2570, January 2007) says in the abstract that "...there is a wide range of existing estimates and, accordingly, a lack of consensus about the overall effects on low-wage employment of an increase in the minimum wage". In comparison with this citation the discussion in the book points more towards the negative employment effect. The difference shows that it is still an open issue.

payroll data. Their argumentation points to the direction that the telephone data employed in CK might have led the paper to false inferences. As the result NW report (p. 1390): "...the payroll data indicate that the minimum-wage increase led to a decline in fast-food FTE employment in New Jersey relative to the Pennsylvania control group." This is the very opposite to the CK result. Card and Krueger (2000) use, like NW, a sample from the administrative records. The sample is derived from unemployment-insurance payroll-tax records and is thus not subject to possible survey errors NW claims occurred in the CK data. The result they report (p. 1419): "The increase in New Jersey's minimum wage probably had no effect on total employment in New Jersey's fast-food industry, and possibly had a small positive effect" supports the one in CK. The differing results appearing in NW are considered to be due to the nonrepresentative sample.

Both of these follow up papers as well as most proponents and opponents of the original result have provided additional information via use of new datasets. Another feature most of these studies share is that they are after the *average* or the total employment effect - a single number.[3] Our study differs from these by employing the same dataset as CK, but a different estimator. In addition to a point estimate we provide the whole distribution of the employment effects resulting from the New Jersey minimum wage increase.

[3]Some of these have employed quantile difference-in-differences (QDID) estimation, which is capable for going beyond a single number. It has, however, several disadvantages relative to our estimation technique. See Athey and Imbens (2006) for a detailed discussion.

The capability for doing this arises from using the changes-in-changes (CIC) estimator introduced by Susan Athey and Guido W. Imbens (2006) (AI). The CIC estimator allows for nonlinearities and uses the information on the entire counterfactual distribution instead of just a constant (function).[4]

Section 2 begins by showing how the counterfactual employment levels are constructed for each of the New Jersey fast-food restaurants. Using these we then study the employment effects of an increase in the minimum wage in New Jersey. In section 3 we conclude and provide a new potential explanation for the controversial result.[5]

2 A case study of the fast-food industry

New Jersey experienced an increase in the minimum wage on April 1, 1992. By using this state specific variation we study the employment effects of it both by DID and CIC estimators. The data being employed are the ones introduced in CK.[6] These panel data include observations on fast-food restau-

[4]We refer to AI for a through discussion on the CIC estimator. An excellent review on the development of the literature on program evaluation is provided by Guido W. Imbens and Jeffrey M. Wooldridge (2009).

[5]We have failed to find any paper providing an estimation routine for the CIC estimator in the R-environment and thus provide one in http://www.valt.helsinki.fi/blogs/ropponen. Susan Athey provides one in Matlab language in her homepage. It is employed in the CIC estimation in the supplementary material of AI.

[6]We refer to CK for a throughout discussion about the data. These are available both in http://www.irs.princeton.edu/links/MinimumWage.php and http://econ-www.mit.edu/faculty/angrist/data1/mhe/card.

rants both in New Jersey and in eastern Pennsylvania before and after the minimum wage increase.[7] The total number of observations is 410 and we will use the ones that have all the information on employment variables - like CK does.[8] We follow the footsteps of CK also in choosing the measure for employment level to be the full-time equivalent (FTE) employment. It is calculated as the sum of number of managers, number of full-time workers and half of the part-time workers.[9]

2.1 Construction of the counterfactual employment levels

In the treatment effect estimation we are interested in the effect some "treatment" has on the units being subjected to it. The effect is defined as the difference between the outcome that occurs after the treatment and the one that would have occurred in the absence of it. As the latter is unobserved we have to come up with the counterfactual outcomes. The way these are constructed differ between DID and CIC estimators and due to this difference the CIC estimator is able to provide us information about the treatment effects beyond the standard DID estimator. The CIC estimator is able to pro-

[7]The observations before the increase are collected between January and March 1992 and the ones after the increase on October 1992.

[8]The balanced sample in CK includes 309 observations on fast-food restaurants in New Jersey and 75 in Pennsylvania making the total number of observations 384.

[9]We will treat FTE employment as a continuous variable even if its definition restricts the observed values to be in discrete intervals.

vide observation specific treatment effects which are based on the allowance of a (more) flexible construction of the counterfactual outcomes (than in the case of standard DID estimator). This is illustrated in figure 1.

The CIC counterfactuals are constructed in two steps. The upper graphs of figure 1 illustrate the first and the ones in the middle the second step of the construction of the counterfactual employment level for a New Jersey fast-food restaurant with the FTE employment level of 40 in early 1992 - that is before the minimum wage increase. As the first step we *identify* the quantile this type of New Jersey fast-food restaurant would correspond to if it was in Pennsylvania at that time. The upper left hand side graph plots the empirical cumulative distribution function (ecdf) for FTE employment in Pennsylvania ($\hat{F}_{Y,00}$ by using the notation in AI) and the upper right hand side graph plots the one in New Jersey ($\hat{F}_{Y,10}$) before the increase in the minimum wage. These show that a fast-food restaurant in New Jersey with an employment level of 40 in early 1992 corresponds to quantile of about 0.95 whereas if it was in Pennsylvania it would correspond to quantile of about 0.90.[10] The second step includes the *determination* of the new employment level for the New Jersey fast-food restaurant with FTE employment of 40 in early 1992. It is determined by the evolvement of the employment level of the Pennsylvania quantile identified in the first step. Thus, an evolvement of the employment level of the fast-food restaurant in New Jersey that had 40 full-time equivalent workers before the increase in the minimum wage is

[10] $\hat{F}_{Y,10}(40) \approx 0.95$ and $\hat{F}_{Y,00}(40) \approx 0.90$.

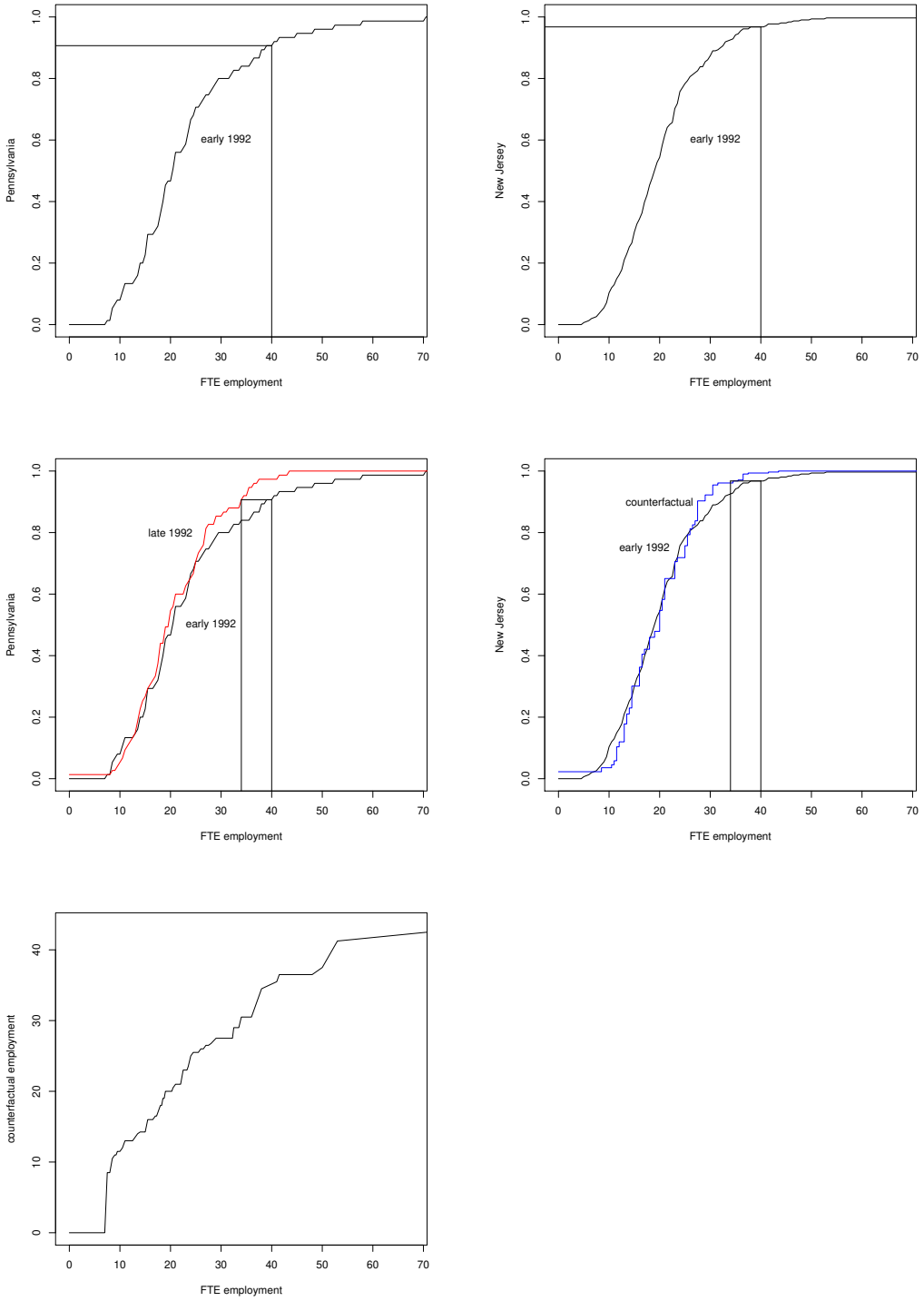

Figure 1: The formation of the counterfactual employment level for New Jersey fast-food restaurant with FTE employment level of 40 in early 1992.

supposed, in the absence of the increase, to follow the evolvement of the 0.90 quantile in Pennsylvania (even if the New Jersey quantile in the ecdf it originally belongs is at about 0.95).[11] The middle graph on the left hand side plots the ecdf's for FTE employment in Pennsylvania both before ($\hat{F}_{Y,00}$) and after ($\hat{F}_{Y,01}$) the New Jersey minimum wage increase. It shows that the employment level of the identified quantile has moved from 40 in early 1992 to 34 in late 1992.[12] This is also taken to be the counterfactual value for the New Jersey fast-food restaurant with FTE employment level of 40 in early 1992. We repeat the described steps for each of the New Jersey fast-food restaurants with FTE employment levels of Y_{10}. Here we first identify the Pennsylvania quantile being followed in determining the counterfactual evolvement in time by calculating $\hat{F}_{Y,00}(Y_{10})$. Then we determine the counterfactual values for the identified quantile by calculating $\hat{F}^{-1}_{Y,01}\hat{F}_{Y,00}(Y_{10})$. The resulting counterfactual employment levels are depicted in the lower right hand side graph in figure 1 together with the ecdf for FTE employment in New Jersey before the minimum wage increase. These are given as a function of initial employment levels in the bottom graph.[13]

[11] In QDID estimation one would use the quantile of about 0.95 in determining the counterfactual employment level.

[12] $\hat{F}^{-1}_{Y,01}\hat{F}_{Y,00}(40) = 34$.

[13] The corresponding graph by using the DID estimator would be a straight line with the slope of of unity.

2.2 Employment effects in New Jersey

In figure 2 we plot the ecdf for New Jersey after the minimum wage increase together with the counterfactual distribution. If the order of the restaurants in the distribution would remain unchanged between early 1992 and late 1992, we would be able to read the employment effects for each of the fast-food restaurants straightforwardly from the figure. Then the employment effect for example for the restaurant with FTE employment level of 40 in early 1992 would be about 6 units, because the counterfactual distribution evolved to 34. The employment effect would in this case simply be the horizontal difference between the late 1992 curve and the counterfactual. For New Jersey the order of the restaurants in the distribution changes and thus this special condition is not met. In addition, we are not only interested in the distributional change, but also in the restaurant specific employment effects.[14] This is accomplished by comparing the true employment outcomes in New Jersey in late 1992 to the counterfactual ones for each restaurant. For example a fast-food restaurant in New Jersey with early 1992 employment level of 40 should have evolved, according to the rule determining the counterfactual, to an employment level of 34 and the employment effect is considered to be the difference between the true outcome of this fast-food restaurant and 34. If the true outcome is, say 25, then the employment effect for that restaurant would be negative with a decrease of 9 units in the FTE employment.

[14]Panel data enable us to study the restaurant specific employment effects, whereas with cross-sectional data we would be restricted to distributional changes only.

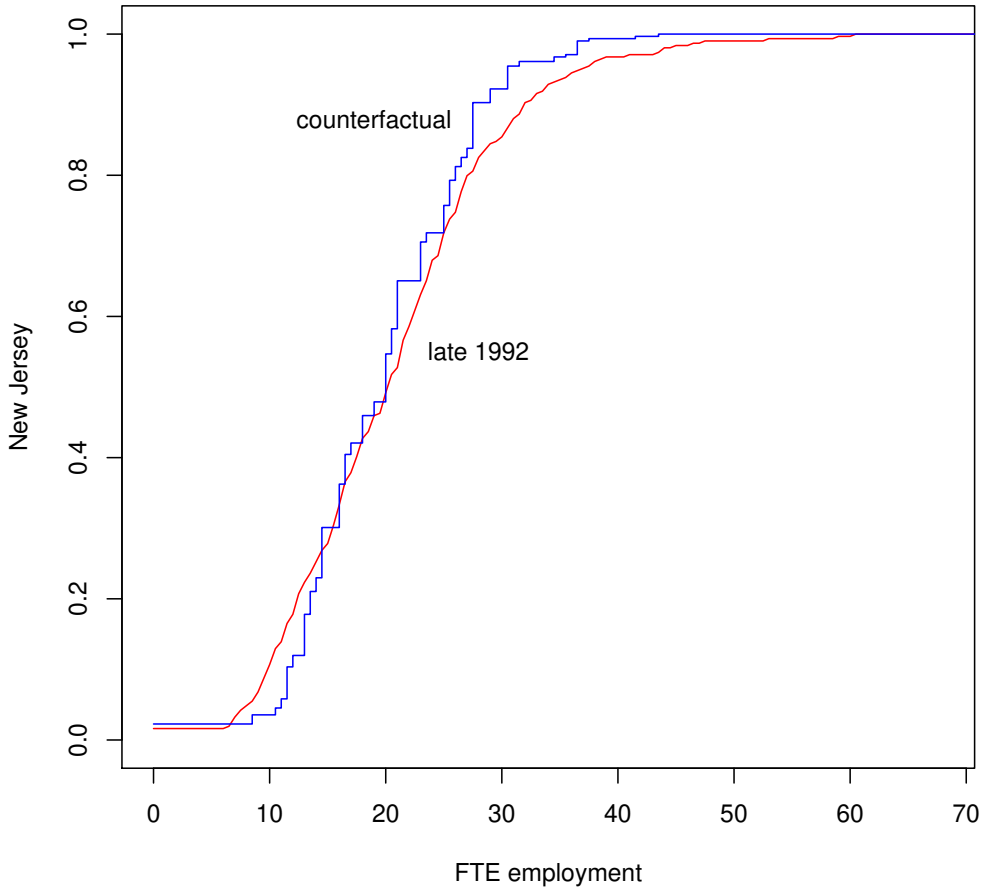

Figure 2: The empirical cumulative distribution for New Jersey after the minimum wage increase together with the counterfactual distribution.

If one was purely interested in changes in the distribution one could just calculate the employment effects for each of the quantiles. This approach is unfortunately somewhat restricted. Suppose that both distributions in New Jersey and Pennsylvania were the same before and after the minimum wage increase, but in New Jersey two fast-food restaurants have changed places in the distribution from early 1992 to late 1992. Quantile-specific employment

effects would in this case be zero for all the quantiles, whereas the fast-food restaurant-specific employment effects would all be zero except for two fast-food restaurants - the ones that change the place in the distribution. One of these is affected positively by the minimum wage increase whereas the other negatively. This does not show up when calculating quantile-specific employment effects. Despite the differences, these two ways result in the same average employment effect.

In figure 3 we plot the employment effects for each of the fast-food restaurants in New Jersey together with the average employment effects using both DID and CIC estimators as well as a smoothed dependence for the conditional average employment effects.[15] The upper horizontal line corresponds to the DID estimate for the change in the mean FTE employment, $\hat{\tau}^{DID} = 2.72$. This corresponds to $\hat{\tau}^{DID} = 2.75$ reported in CK for a balanced sample of restaurants in their table 3. The lower of the horizontal lines corresponds to the average treatment effect implied by the CIC estimator, $\hat{\tau}^{CIC} = 0.90$.[16] This is calculated as the average of the employment effects for the individual fast-food restaurants, marked by asterisks in the figure. As the CIC estimator is able to provide us restaurant specific employment effects it allows us to

[15]The figure shows the results using 301 observations on fast-food restaurants in New Jersey and 75 in Pennsylvania. 8 New Jersey restaurants are excluded from the CK balanced sample in order to meet the identification conditions of the CIC estimator. The period 0 FTE employment levels for the excluded restaurants are not in the domain of period 0 Pennsylvania FTE employment.

[16]The bootstrap standard error is 0.44.

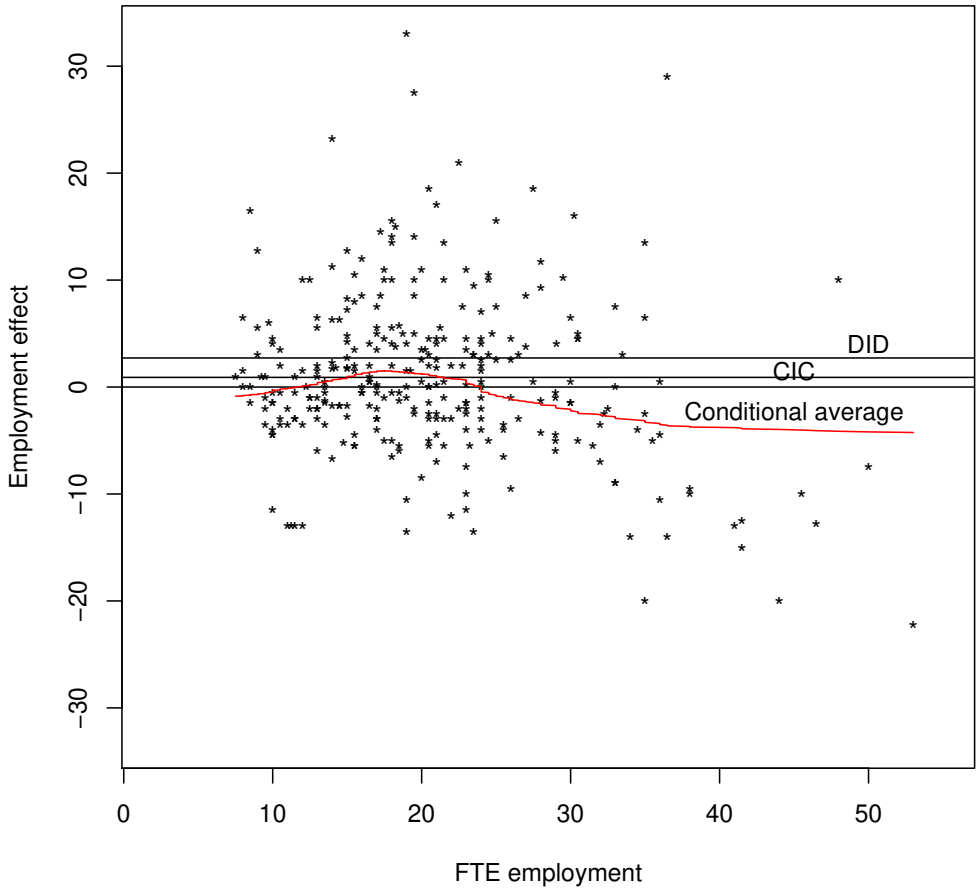

Figure 3: Employment effects for each of the fast-food restaurants in New Jersey together with the average effects both from DID and CIC estimation and the smoothed conditional average employment effect.

study the employment effects in more detail. In our case it allows us to study the conditional average employment effects of the change in the minimum wage. These are calculated here by using the lowess smoothing procedure across the restaurant specific employment effects. The resulting curve is the one that intercepts the horizontal axis at FTE employment levels 11.5 and

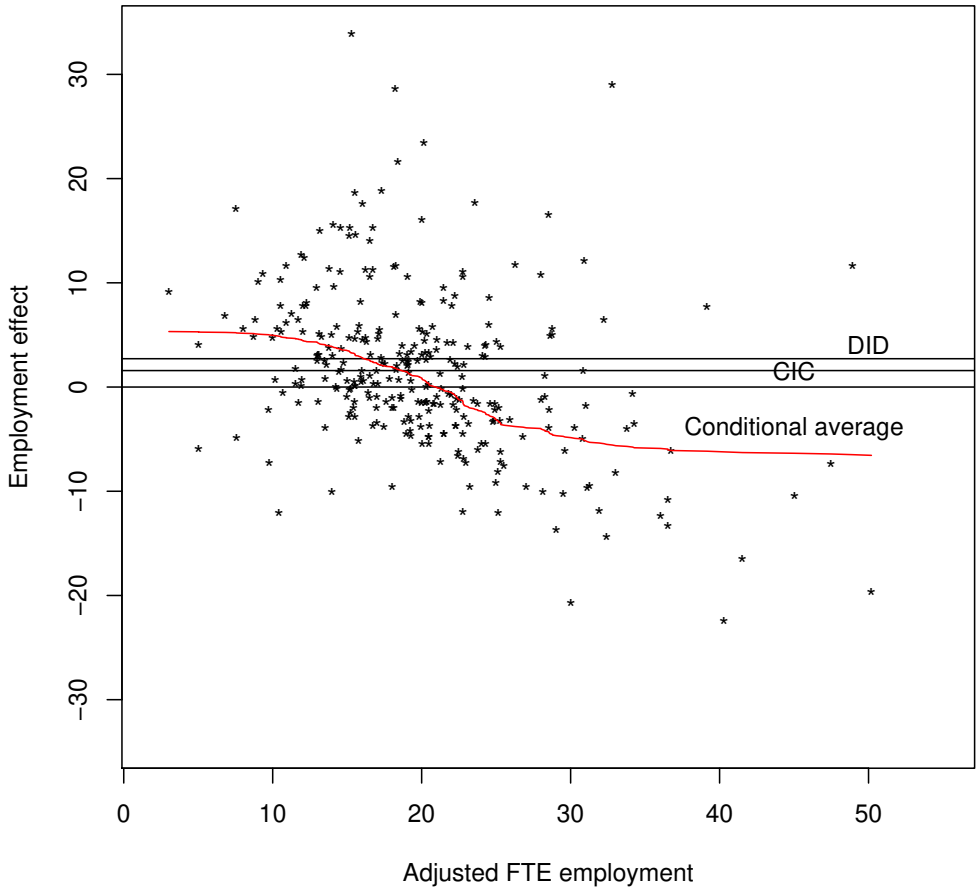

Figure 4: Employment effects for each of the fast-food restaurants in New Jersey together with the average effects both from DID and CIC estimation and the smoothed conditional average employment effect when chain, company ownership and location of the restaurants are controlled.

24. Figure 4 corresponds to figure 3 when controlling for chain, company ownership and location of the fast-food restaurants.[17] Here the conditional average employment effect turns from positive to negative at the employment

[17]Here $\hat{\tau}^{CIC} = 1.58$ with (bootstrap) standard error 0.44.

level of 20.8.

3 Conclusions

David Card and Alan B. Krueger impugned an old consensus on the overall employment effect of the minimum wage in their paper in 1994 (CK). That article as well as their book in 1995 and Reply article in 2000 share the conclusion that it is highly unlikely that the increase in New Jersey's minimum wage in 1992 would have had a negative effect on total employment in its fast-food industry. We have studied the employment effects of the fast-food restaurants conditional on their employment levels using a more flexible estimator than previous authors. These conditional employment effects are estimated to be positive for small and negative for big fast-food restaurants. Thus, the controversial result is overturned for big fast-food restaurants.

Monopsonistic labor market models might provide an explanation for the observed positive employment effect (see e.g. Tito Boeri and Jan van Ours (2008)). These models are ruled out in CK due to their incapability for explaining pricing behavior. We also rule these models out, but for a different reason. One particular implication of the monopsonistic labor market models is that the employment effect is increasing with respect to the employment level. This is in sharp contrast with our results which imply the opposite.

Our results suggest a new explanation, based on location of outlets and a demand side effect. An increase in minimum wage is more likely to have a

positive demand side effect the bigger the fraction of working age population on the minimum wage. Thus, small outlets in poor areas and large in locations (such as malls and by highways) where the majority of customers earn more than the minimum wage would explain the result.

Bibliography

Susan Athey and Guido W. Imbens (2006): Identification and Inference in Nonlinear Difference-in-Differences Models, *Econometrica 74(2), 431-497*

Tito Boeri and Jan van Ours (2008): The Economics of Imperfect Labor Markets, *Princeton University Press, Princeton NJ*

David Card (1992a): Using Regional Variation in Wages To Measure the Effects of the Federal Minimum Wage, *Industrial and Labor Relations Review, 46(1), 22-37*

David Card (1992b): Do Minimum Wages Reduce Employment? A Case Study of California, 1987-89, *Industrial and Labor Relations Review, 46(1), 38-54*

David Card and Alan B. Krueger (1994): Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania, *The American Economic Review, 84(4), 772-793*

David Card and Alan B. Krueger (1995): Myth and Measurement, *Princeton University Press, Princeton NJ*

David Card and Alan B. Krueger (2000): Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania: Reply, *The American Economic Review, 90(5), 1397-1420*

Guido W. Imbens and Jeffrey M. Wooldridge (2009): Recent Development in the Econometrics of Program Evaluation, *Journal of Economic Literature 47(1), 5-86*

Lawrence F. Katz and Alan B. Krueger (1992): The Effect of the Minimum Wage on the Fast Food Industry, *Industrial and Labor Relations Review, 46(1), 6-21*

Stephen Machin and Alan Manning (1994): The Effects of Minimum Wages on Wage Dispersion and Employment: Evidence from the U.K. Wage Councils, *Industrial and Labor Relations Review, 47(2), 319-29*

David Neumark and William Wascher (2000): Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania: Comment, *The American Economic Review, 90(5), 1362-1396*

David Neumark and William Wascher (2008): Minimum Wages, *The MIT Press, Cambridge, Massachusetts, London, England*