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Christoph Knoppik

Department of Economics, University of Regensburg

Universitätsstraße 31, D-93053 Regensburg, Germany

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Abstract

Earlier studies of US wage data from the PSID with a variety of methods have led to mixed results with respect to the existence and extent of downward nominal wage rigidity. Here the kernel-location approach to the analysis of downward nominal wage rigidity in micro data is applied to that data for the first time, in order to non-parametrically estimate counterfactual and factual distributions of annual nominal wage changes, the rigidity function and the average degree of downward nominal wage rigidity. Avoiding several problems of earlier studies by the use of the kernel-location approach, a substantial degree of downward nominal wage rigidity is found, and earlier evidence in favor of the hypothesis of downwardly rigid nominal wages is corroborated, weakening the institutionalist view of downward nominal wage rigidity.

Keywords: US; PSID; Downward Nominal Wage Rigidity; Kernel-location approach.

JEL-classification: E24; J30.

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† PD Dr. Christoph Knoppik, phone: +49 +941 943 2700, e-mail: christoph.knoppik@wiwi.uni-regensburg.de.

Introduction

Earlier studies of downward nominal wage rigidity (DNWR) in US wage data from the panel study of income dynamics (PSID) using a variety of methods have led to mixed results, ranging from finding unhampered nominal wage flexibility to finding almost perfect downward nominal wage rigidity. This not only leaves the question of the existence and extent of downward nominal wage rigidity in the US contended. On a larger scale it has also led some authors to question the conclusiveness of evidence with respect to downward nominal wage rigidity from micro data as a whole, e.g. Rodríguez-Palenzuela, Camba-Mendez and Garcia (2003) in the context of discussing an optimal inflation target for the Euro area. Together with UK evidence in favor of wage flexibility, the inconclusiveness of US evidence has also encouraged the view that it is anglo-saxon labour market institutions that favour nominal wage flexibility, and that structural reforms of continental European labour markets will eliminate any existing downward nominal wage rigidity, see e.g. European Central Bank (2003).

The results from quantitative analyses of PSID data using the symmetry approach of Card and Hyslop (1997), the histogram-location approach of Kahn (1997) and the earnings-function approach of Altonji and Devereux (1999) can be brought to the common denominator of the average degree of rigidity, i.e. the percentage of real wage cuts of a certain magnitude that cannot occur if they require nominal wage reductions.[1] The results range from a degree of rigidity of zero for earners of salaries in Kahn (1997) to a degree of rigidity of almost 100 per cent in Altonji and Devereux (1999). Explanations for the differences include the role of measurement error and other problems of the approaches to the analysis of downward nominal wage rigidity in micro data.

This paper is able to avoid several of these problems by analyzing the data using the kernel-location approach to the analysis of downward nominal wage rigidity in micro data proposed in Knoppik (2003). The kernel-location approach combines kernel density estimation and the identifying principle of joint variation of location and shape of the distribution of per cent annual nominal wage changes. The approach provides partial estimates of median-centered counterfactual and factual distributions of per cent annual nominal wage changes, of the rigidity function and of the degree of downward nominal wage rigidity. The estimator for the distributions is based on a fairly straightforward basic idea, i.e. to suitably weigh the partial period-wise kernel density estimates of median-centered factual and counterfactual distributions in order to obtain overlapping partial estimates of the

[1] The skewness-location approach used in McLaughlin (1994) and in McLaughlin (1999), and the symmetry approach in the variant used by Christofides and Stengos (2001) do not yield quantitative results for the extent of downward nominal wage rigidity.

aggregate factual and counterfactual distributions. These aggregate estimates can then be used to construct measures of downward nominal wage rigidity. Sharing the general advantages of the non-parametric approaches not to impose functional forms on the distributions of wage changes, it provides a quantitative estimate of the degree of downward nominal wage rigidity in the data without imposing a functional form of rigidity, it avoids the problematic symmetry assumption and econometric complications as they are present in the histogram-location approach. A detailed exposition on the workings of the kernel-location approach and its relation to other methods can be found in Knoppik (2003).

The remainder of the paper presents, after a brief discussion of issues of implementation, the estimated counterfactual and factual distributions, and the estimated rigidity function and degree of rigidity. Final remarks draw conclusions from these findings.

Implementation

The choice of kernel and bandwidth are standard questions in kernel density estimation, the role of choice of kernel being downplayed and the role of bandwidth being emphasized in the literature, e.g. in Härdle and Linton (1994). In the present context both choices play a special role because of the discontinuities of the underlying distributions at nominal zero and have to take into account corresponding ‘discontinuity bias’. There are rather sophisticated (and computationally costly) strategies that deal with this type of bias, e.g. the use of variable bandwidth. However, for the question at hand it is sufficient to follow a very basic strategy, that consists of not using the kernel density estimates, where it is affected by ‘discontinuity bias’. The bias is present within a distance of b from the discontinuity, where b is equal to half of the total width of the kernel used. Note that the width of a kernel is not in general equal to two times its bandwidth h, only for the uniform (or rectangular) kernel does $b = h$ hold. This pragmatic solution works well enough, if the loss of overlap between the estimated counterfactual and factual distributions is not too large. Nevertheless, the dependency of the loss of overlap on bandwidth constitutes an argument for a tendency to under-smoothing, in addition to standard arguments to reduce bias in kernel density estimation.

The uniform kernel and a bandwidth of $h = .01$ where used for the analysis presented in the following.[2] Robustness checks with respect to the choice of kernel and the bandwidth where performed; results do change very little. The US wage data used is from the PSID. The T periods are re-indexed in ascending order of the annual medians m_t in the sample. Additional information on the source of data, the construction of the sample and summary statistics are provided in Appendix A.

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[2] Other studies have used similar degrees of under-smoothing on the same data: Card and Hyslop (1997) have used a bandwidth of .005 with the Epanechnikov kernel (without taking into account the discontinuities). Kahn (1997) has used a histogram bin width of .01.

One consequence of the proposed solution to the discontinuity bias is that the analysis has to use effective intervals $I_\tau^g =]-m_{\tau+1}+b, -m_\tau + b[$ and $I_\tau^f =]-m_{\tau+1}-b, -m_\tau - b[$, $\tau = 1 \ldots T$, for the aggregate estimation that are different from the intervals I_τ in Knoppik (2003). The accordingly modified estimators for the counterfactual distribution $g(x)$ and the factual distribution $f(x)$ are:

(1) $$\hat{g}(x) = \sum_{s=\tau}^{T} \frac{1}{T-\tau+1} \hat{g}_s(x) \quad x \in I_\tau^g, \quad \tau = 1 \ldots T-1,$$

and

(2) $$\hat{f}(x) = \sum_{s=1}^{\tau} \frac{1}{\tau} \hat{f}_s(x) \quad x \in I_\tau^f, \quad \tau = 1 \ldots T-1,$$

where $\hat{g}_s$ and $\hat{f}_s$ are the period-wise kernel density estimates of the counterfactual and factual distributions, and weighing is by periods. The modified core interval is $I_c^b = [-m_T + b, -m_1 - b]$, instead of the original core interval $I_c =]-m_T, -m_1[$; it is therefore narrower by $2b$, leaving an overlap of $m_T - m_1 - 2b$.

Estimates

Panels a) and b) of FIGURE 1 show the partial estimates of counterfactual and factual distributions of per cent median-centered nominal wage changes. Counterfactual and factual distribution overlap, roughly over the core interval I_c which is marked by two solid vertical lines at $-m_T$ and $-m_1$. The dotted vertical lines mark the effective intervals I_τ^g and I_τ^f, respectively. The number of periods used in the estimation varies across these intervals, and is reflected in the thickness of the plotted curves which visibly tend to be less smooth over the intervals with few underlying periods and thereby few underlying observations. Specifically, the estimated counterfactual is based on ever fewer periods, going from right to left, and the estimated factual is based on ever fewer periods going from left to right. Appendix B provides plots of estimates from selected individual periods which further illustrate the method of estimation and aggregation.

FIGURE 1

In panel c) of FIGURE 1 estimated median-centered counterfactual and factual distributions of per cent nominal wage changes are plotted together in one diagram which makes the overlap more clearly visible. Because of the avoidance of discontinuity bias, the overlap is confined to the modified core interval I_c^b. Both estimated distributions differ significantly, except at the borders of the modified core interval; curves in thin lines are the $2\hat{\sigma}$-bands of the estimates. This is a clear sign of downward nominal wage rigidity, since the estimated factual distribution (dotted curve) lies below the estimated counterfactual distribution (solid curve), pointing to the thinning effect of downward nominal wage rigidity.

The estimated rigidity function is plotted in panel d) of FIGURE 1 over the range where the two partial estimates overlap, i.e. over I_c^b. The average value of the rigidity function over this interval is equal to .30, i.e. 30 percent of the per cent wage changes that fell into that range did not take place if they required nominal wage reductions. With the exception of the left margin, the values of the rigidity function over the range lie fairly close to the estimated average degree of rigidity, which suggests a uniform degree of downward nominal wage rigidity and therefore supports the proportional model of downward nominal wage rigidity used in Kahn (1997) and Knoppik and Beissinger (2003), rather than the threshold model of Altonji and Devereux (1999). Because of the potential presence of measurement error in the data and its tendency to hide the effects of downward nominal wage rigidity, the estimated average degree of downward nominal wage rigidity of 30 percent for earners of hourly wages should be interpreted as a lower bound for the true degree of rigidity. This value is quite a bit higher than values found by Card and Hyslop (1997) with the symmetry approach, but somewhat lower than the value of around 40% found by Kahn (1997) for earners of hourly wages with the histogram-location approach. These numbers are not directly comparable with the much higher degree of rigidity found in Altonji and Devereux (1999), because of the treatment of measurement error in that study.

Summary, conclusions and outlook

Parts of the counterfactual and factual distribution of per cent median-centered annual nominal wage changes were estimated for US wage data from the PSID. These were then used to estimate the rigidity function and the average degree of downward nominal wage rigidity. The estimated degree of downward nominal wage rigidity was found to be 30%, i.e. over the sample period 30% of real wage changes of a certain magnitude could only take place if they entailed non-negative nominal changes, but not if they required nominal wage reductions. The use of the kernel-location approach avoided a number of problems that have plagued earlier approaches to the analysis of downward nominal wage rigidity in micro data that have been applied to the PSID: The lack of quantitative results in the skewness-location approach, the problematic symmetry assumption in the symmetry approach, the imposed functional form of the rigidity function and problems associated with histogram construction and system estimation.

The form of the rigidity function supports the notion of a uniform degree of downward nominal wage rigidity over wage reductions of different sizes, i.e. the notion of proportional, rather than threshold or menu cost downward nominal wage rigidity. The estimated degree of downward nominal wage rigidity of 30%, despite the attenuating presence of measurement error in the data, supports those earlier studies that have found substantial rigidity. The results constitute one step towards less ambiguous results on downward nominal wage rigidity for

US data. By strengthening the evidence in favor of downward nominal wage rigidity, the results to some degree also weakens the hypothesis of institutional causes of nominal rigidity (vs. the hypothesis of psychological causes). The results therefore make it seem more likely, that downward nominal wage rigidity will continue to exist, even after structural labor market reforms will have been implemented.

Appendix A Wage data from the PSID, 1970-1992

A sample of log-percent wage changes for US earners of hourly wages who were job stayers was constructed following the criteria documented in Kahn (1997). The sample period has been extended to additionally include the years 1989-1992, it now comprises 22 instead of 18 years. The series for hourly wages from the panels study of income dynamics (PSID) that were used are listed in TABLE A.1.

TABLE A.1

Summary statistics of the sample are listed in TABLE A.2. Annual medians range from 3.5 to 11 percent. The total number of observations is equal to 13707, the number of observations per period exceeds 500 in all periods.

TABLE A.2

Appendix B Partial estimates of factual and counterfactual distributions by period

In order to illustrate the sample of data and the kernel-location approach, selected period-wise estimates of median-centered counterfactual and factual distributions of per cent annual nominal wage changes are provided in FIGURE B.1.

FIGURE B.1

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Tables

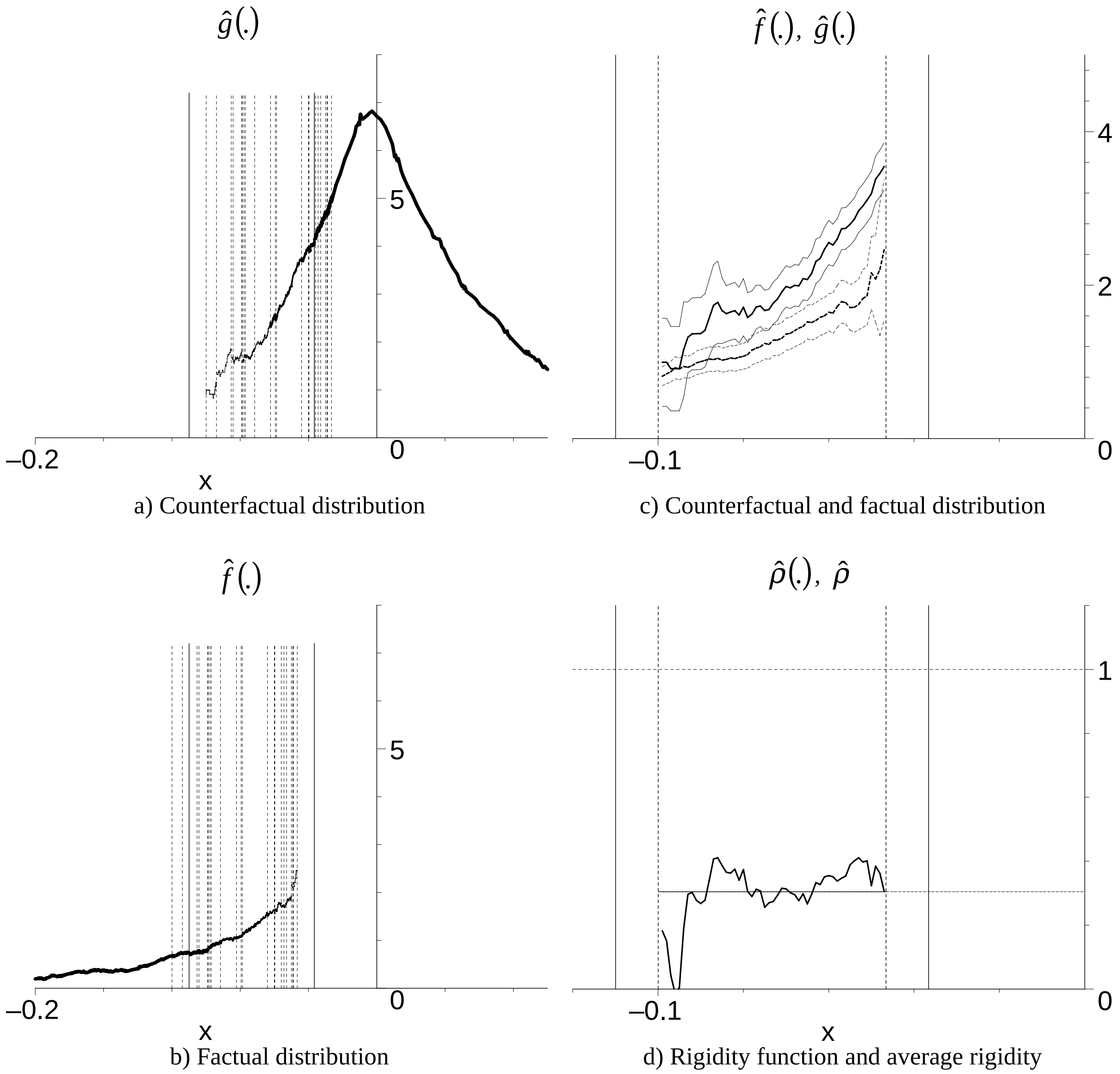
TABLE A.1: Wage Data from the PSID

Year	Series	Year	Series	Year	Series
		1980	V7125	1990	V18107
1971	V2003	1981	V7718	1991	V19407
1972	V2601	1982	V8386	1992	V20707
1973	V3134	1983	V9017		
1974	V3549	1984	V10466		
1975	V4003	1985	V11657		
1976	V4513	1986	V13060		
1977	V5424	1987	V14160		
1978	V5911	1988	V15168		
1979	V6522	1989	V16669		

TABLE A.2: Summary statistics of data

Period-Index	Year	Median	Number of observations: Nominal decreases	Nominal zeros	Nominal increases	All
τ	t	m_τ	N_τ^{neg}	N_τ^{zero}	N_τ^{pos}	N_τ
1	1986	0.0366	96	90	403	589
2	1992	0.0388	109	112	490	711
3	1987	0.0392	83	97	444	624
4	1988	0.0401	93	104	453	650
5	1989	0.0429	88	81	495	664
6	1990	0.0444	94	91	493	678
7	1991	0.0459	99	89	509	697
8	1985	0.0497	73	57	413	543
9	1984	0.0500	82	71	390	543
10	1983	0.0541	83	83	395	561
11	1973	0.0687	73	46	543	662
12	1972	0.0694	83	61	515	659
13	1971	0.0722	75	61	517	653
14	1974	0.0815	71	54	590	715
15	1982	0.0870	51	31	477	559
16	1978	0.0877	49	45	524	618
17	1976	0.0887	45	42	478	565
18	1977	0.0891	38	42	483	563
19	1979	0.0942	50	37	544	631
20	1981	0.0952	40	41	499	580
21	1975	0.1039	63	50	526	639
22	1980	0.1099	31	19	553	603
	Sum					13707
	Minimum	0.0366				
	Maximum	0.1099				
	Mean	0.0677				
	Median	0.0691				

Figures



a) Counterfactual distribution
c) Counterfactual and factual distribution
b) Factual distribution
d) Rigidity function and average rigidity

FIGURE 1: Partial estimates of median-centered distributions and of rigidity functions

See explanation in text.

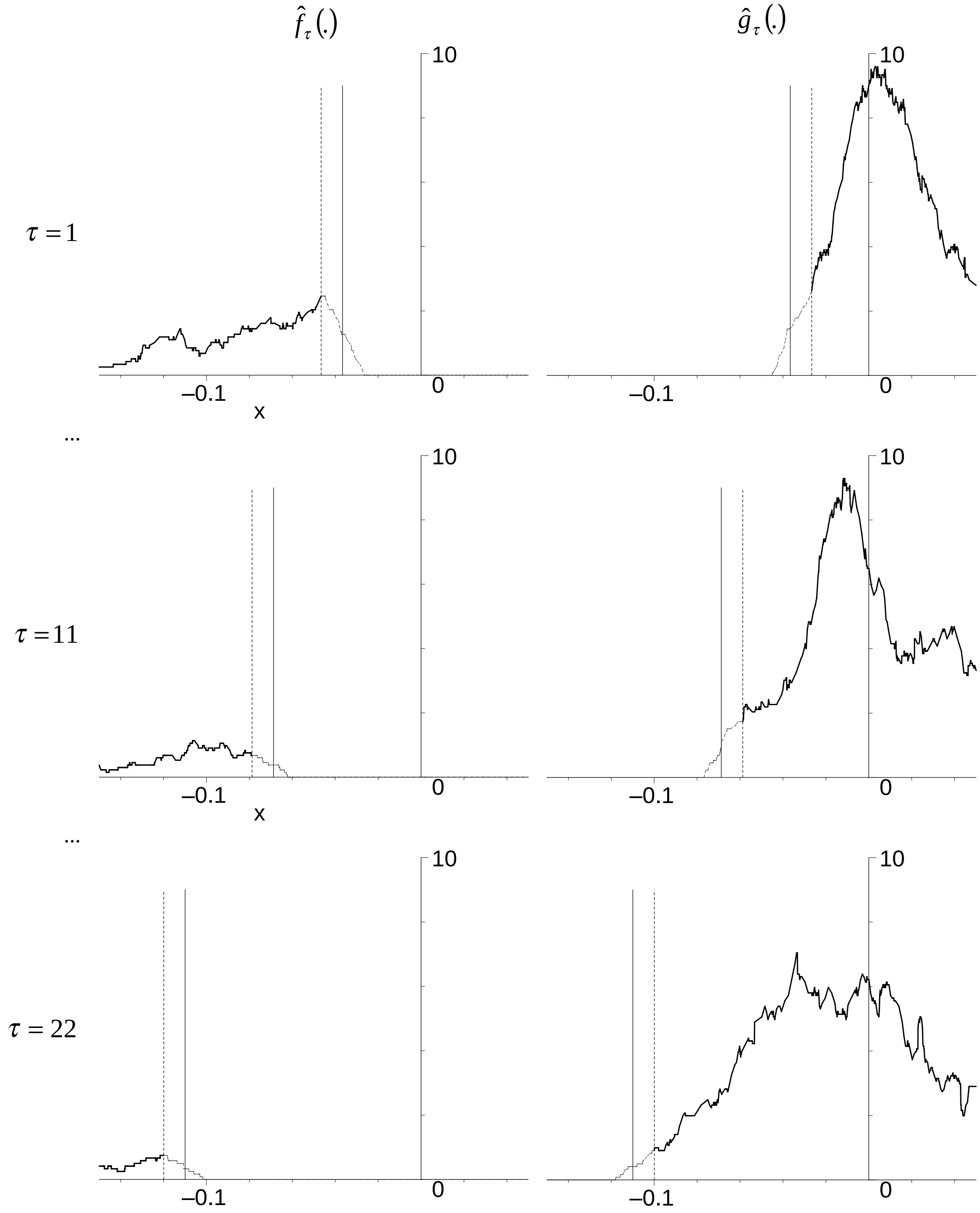


FIGURE B.1: Partial estimates of factual and counterfactual distributions by period

Note: Solid curves indicate partial estimates of distributions, unaffected by ‘discontinuity bias’, while the dotted curves illustrate the effects of that bias. For the factual distributions the unaffected estimates range up to the period median minus a distance b; the period medians $-m_\tau$ are indicated by solid vertical lines, the magnitudes $-m_\tau \pm b$ by vertical dotted lines. For the counterfactual distributions the unaffected estimates range down to the period median plus a distance b . Part of the estimated counterfactual are out of the plotted range.