Nonparametric Evidence on Extent and Functional Form of Downward Nominal Rigidity in Germany: An Application of the Kernel-Location Approach

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Abstract

Applying the kernel-location approach proposed by Knoppik (2007) to the regional file of the German IAB employment statistics (IABS), we find significant downward nominal rigidity in West-German earnings over the period 1975-2001. The reliability of our results is strengthened by the fact that the kernel-location approach does not rely on restrictive assumptions with respect to either the functional form of the counterfactual distribution or the functional form of downward nominal wage rigidity.

Keywords: Downward Nominal Wage Rigidity; Kernel-Location Approach; German IAB employment statistics (IABS); Kernel Density Estimation.

JEL-classification: E24; J30.

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1 Introduction

Wage rigidity is usually considered to be the main culprit for the malfunctioning of the labor market and has therefore always been of great concern for macroeconomists and labor economists alike. Different types of wage rigidity, however, have different implications for economic policy. Real wage rigidity prevents the downward adjustment of real wages, but nominal wages are flexible and move in line with the general price level. This type of wage rigidity is blamed for the existence of long-run equilibrium unemployment, which can be lowered by reforms of labor market institutions, but not by monetary policy. Symmetric nominal wage rigidity caused, for example, by staggered wage contracts, is only relevant in the short run. This type of wage stickiness may be an important mechanism behind the business cycle, and determines the short-term trade-off between inflation and unemployment relevant for monetary policy. This paper, however, is concerned with existence and extent of downward nominal wage rigidity (DNWR), which prevents the decline of nominal wages except when firms are under considerable financial strain. This type of wage rigidity changes the shape of the long-run Phillips curve, which for low inflation is no longer vertical but negatively sloped, as shown by Akerlof, Dickens and Perry (1996). If the chosen inflation target is too low, monetary policy is no longer neutral in its effect on long-run equilibrium unemployment, but leads to unemployment in excess to structural unemployment caused by real wage rigidities. Empirical evidence with respect to DNWR is a necessary prerequisite for a cost-benefit analysis of low inflation targets adopted by many central banks.

This paper applies a novel approach to the analysis of DNWR in micro data, the so-called kernel-location approach, which has been proposed by Knoppik (2007). This approach, like other econometric approaches for the analysis of DNWR, has to solve the problem, how the distribution of desired wage changes (i.e. the counterfactual distribution) and the degree of nominal wage rigidity can be deduced from the observed wage change distribution (i.e. the factual distribution). As is explained in more detail below, it is a great advantage of the kernel-location approach over other approaches that it does not rely on assumptions with respect to either the functional form of the counterfactual distribution or the functional form of nominal wage rigidity.

Our paper applies the kernel-location approach to the regional file of the German IAB Employment Statistics (IABS-R) from 1975 up to 2001. Since Germany is the largest economy in the Euro area, the results are of some importance for the monetary policy of the European Central Bank. The IABS-R is a two percent random sample drawn from German social security records, which represent one of the most important data sources for labor market research in Germany. The great advantage of the IABS is the high reliability of the earnings data due to plausibility checks that are performed by the social security institutions and legal sanctions for misreporting. Measurement error due to erroneous reporting is therefore not a problem in our analysis, in contrast to studies based on compensation data from household surveys. Furthermore, earnings in the IABS are a broad measure of compensation including most types of fringe benefits and therefore yield a comprehensive picture of the rigidity or flexibility of compensation.

The remainder of the paper is organized as follows: Section 2 explains the basic idea of the Kernel-Location Approach and Section 3 describes the data used in the analysis. Section 4 develops the estimators for the factual and counterfactual distribution, the wage rigidity function and the average degree of DNWR. Section 5 deals with the empirical implementation of the approach and presents our estimation results, which are also compared to results in the literature. Section 6 provides a summary and some conclusions.

2 Basic idea of the Kernel-Location Approach

The kernel-location approach combines kernel density estimation and the identifying principle of joint variation of location and shape of the distribution of percent annual nominal wage changes.[1] A counterfactual distribution that would prevail in the absence of DNWR and a factual distribution that may be influenced by DNWR are distinguished. The rigidity is thought to lead to a thinning over the range of negative nominal wage changes, and a corresponding pile-up at zero, so that both distributions differ for non-positive wage changes if nominal wage rigidity does exist. Only in this case, changes in the location of the distribution of nominal changes lead to characteristic changes in shape. The approach provides partial estimates of median-centered counterfactual and factual distributions of percent annual nominal wage changes. The estimator for the distributions is based on the idea to suitably weigh partial period-wise estimates of median-centered factual and counterfactual distributions in order to obtain overlapping partial estimates of the aggregate factual and counterfactual distributions. These aggregate estimates can then be used to construct measures of downward nominal wage rigidity.

The general advantage of non- or semi-parametric approaches in the empirical analysis of downward nominal wage rigidity in micro data is to avoid functional assumptions that parametric approaches have to make. However, there are also some drawbacks. The skewness-location approach of McLaughlin (1994) yields no quantitative information on the extent of DNWR in the data. For the symmetry approach of Card and Hyslop (1997), the applicability of the key assumption of symmetry has frequently been denied, e.g. by McLaughlin (1999) for US PSID data. Finally, while the histogram-location approach of Kahn (1997) makes no

1 This introduction to the approach follows an update of Knoppik (2003).

assumptions on the functional form of the wage change distribution, it does stipulate a functional form for the rigidity, which is itself under debate in the literature, see e.g. Knoppik and Beissinger (2003). The new non-parametric approach to the analysis of downward nominal wage rigidity in micro data used in this paper shares the general advantages of the non-parametric approaches, but it avoids the problematic symmetry assumption and it provides a quantitative estimate of the degree of DNWR in the data without imposing a functional form of rigidity.

3 Data

The data used in this paper is the Regional File of the Employment Statistics from the Institute of the Employment Research (IABS-R). It is a two percent random sample drawn from German Social Security records, which is collected from employers, who are legally obliged to provide information on paid earnings and various individual characteristics of their employees.[2] IABS-R covers a longer time span than other currently available German micro-data with official status, containing information over a period of 27 years, from 1975 up to 2001.

For the purposes of this analysis we consider only male workers and salaried employees, who have a stable employment relationship, i.e. are full-time employed and of prime age (25-54), staying at the same employer for two consecutive years or more. Furthermore we constrict our analysis to employees in the western part of Germany, because there are still large structural differences in the labor market between the eastern and the western part of Germany. The analysis is also restricted to skilled and unskilled employees. This is due to the fact that the earnings variable in the IABS-R is right-censored at the contribution assessment ceiling (‘Beitragsbemessungsgrenze’). Therefore if (monthly) earnings are higher than this threshold, actual earnings will be unknown.[3] Since for employees whose earnings are censored the growth rate of earnings cannot be computed correctly, the censored records are removed from the dataset. However this leads to a substantial change in the skill structure of the sample. Because the high-skilled employees are no longer properly represented in the sample, they are completely removed from the dataset and our analysis is therefore confined to unskilled and skilled employees. Finally, we consider only employees in manufacturing and services. Hence employees working in the following sectors were excluded: agriculture, mining, energy, the government sector and private organizations.

2 For an introductory description of the IABS-R see Hamann (2004).

3 Up to 01.04.1999 earnings was also truncated from below due to the lower social security threshold. In the present context this point is not a problem since the analyses is restricted to full-time workers and employees who exceed this limit almost with probability one.

The gross daily earnings variable in the IABS-R is a broad measure of compensation including most types of fringe benefits. In the following, downward wage rigidity is strictly speaking the downward nominal rigidity of total compensation.

Summary statistics of the samples of workers and salaried employees are listed in TABLE A.1 and TABLE A.2. Annual medians range from 2.1 to 8 percent for salaried employees and from 1.4 to 7 percent for workers. The total number of observations is equal to 130000, the number of observations per period equal to 5000 in each period.

4 Kernel density estimators of factual and counterfactual distribution

The task of formulating estimators of the factual and counterfactual distribution is made more transparent if the data as organized in ascending order of the annual medians m_t in the sample.

Organization of data

Let $\tilde{x}_{it}$ denote the observed percent wage changes in the data, where index i runs over the cross-section dimension and index t over the time dimension. N denotes the total number of observations, N_t is the number of observations from period t. The median of observations $\tilde{x}_{it}$ from period t is denoted by m_t and median-centered observations can then be defined as[4]

(1) $$X_{it} \equiv \tilde{x}_{it} - m_t \,.$$

As in the example, it is useful to re-index observations in the time dimension, such that periods with higher time-index τ have higher medians,

(2) $$m_\tau > m_{\tau'} \Leftrightarrow \tau > \tau' \,.$$

The re-indexed annual medians of uncentered observations can be used to define the following intervals I_2 to I_T.

(3) $$I_{\tau+1} = \left]-m_{\tau+1}, -m_\tau\right[,\ \tau = 1 \ldots T-1 \,.$$

I_2 to I_T divide the 'core interval' between $-m_T$ and $-m_1$ that is defined by the lowest and the highest period-median in the sample; $I_C =]-m_T, -m_1[$. In addition, intervals to the right and to the left of the core interval can be defined, $I_1 =]-m_1, \infty[$ and $I_{T+1} =]-\infty, -m_T[$. While in any period there are only negative nominal changes in I_{T+1} and only positive nominal changes in I_1, signs of nominal wage changes do change over time in the intervals within the

4 Alternative measures of location could be used, e.g. higher quantiles.

core interval I_c. Specifically, in period τ there are positive nominal changes in all $I_s, s \le \tau$ and negative nominal changes in all $I_s, s > \tau$.

TABLE A.1 and TABLE A.2 in appendix A provide summary statistics of the samples used for estimation and the same time illustrate the organization of the data.[5]

Basic estimators

For each period τ, parts of the factual and counterfactual distribution can be estimated for the two disjunctive parts of the domain divided by $-m_\tau$:[6]

(4) $$\hat{f}_\tau(x) = \frac{1}{N_\tau} \sum_{X_{i\tau} < -m_\tau} K_h(x - X_{i\tau}) \quad x < -m_\tau \quad \tau = 1 \ldots T\,;$$

(5) $$\hat{g}_\tau(x) = \frac{1}{N_\tau} \sum_{X_{i\tau} > -m_\tau} K_h(x - X_{i\tau}) \quad x > -m_\tau \quad \tau = 1 \ldots T\,.$$

$K_h(.)$ denotes a kernel with bandwidth h.

These partial estimates of period factual and period counterfactual distributions can be aggregated over the available years to yield estimates of the factual and counterfactual distributions over the core interval I_c. For each interval within the core interval, I_j, $j = 2 \ldots T$, aggregation over years is only over those periods that do provide information on the distribution in question. E.g., information on the factual distribution in interval I_2 comes only from period $\tau = 1$, whereas information on the counterfactual distribution in interval I_2 comes from periods $\tau = 2 \ldots T$. Appropriate weighing is also decisive and may be based on numbers of observations, as in equations (6) and (7), or may be based on numbers of periods.[7] The aggregate estimators using all periods are:

(6) $$\hat{f}(x) = \sum_{\tau=1}^{j-1} \frac{N_\tau}{Q_{j-1}} \hat{f}_\tau(x) \quad x \in I_j, \quad j = 2 \ldots T$$

(7) $$\hat{g}(x) = \sum_{\tau=j}^{T} \frac{N_\tau}{R_j} \hat{g}_\tau(x) \quad x \in I_j, \quad j = 2 \ldots T$$

with

5 Knoppik (2007) provides a graphical illustration.

6 The material in this section follows Knoppik (2007) for the estimators and Knoppik (2005) for the variance of the estimates.

7 Period based weighing can be thought of as an approximation of the observations based weighing for panels where the N_τ do not change much over time. In such cases $N_s/Q_\tau \cong 1/\tau$ and $N_s/R_\tau \cong 1/(T - \tau + 1)$.

(8) $$Q_\tau = \sum_{s=1}^{\tau} N_s \text{ and } R_\tau = \sum_{s=\tau}^{T} N_s \text{ for } \tau = 1\ldots T .$$

Q_τ is the number of all observations of periods that only have negative nominal observations in $I_{\tau+1}$, R_τ is the number of all observations of periods that only have positive nominal observations in I_τ.

Variance of estimated distributions

The changing number of observations behind the aggregate estimates over the different intervals necessitates a modified way to compute the variance of the estimates. The variance of a standard kernel density estimate is given by[8]

(9) $$Var\left[\hat{f}_h(x)\right] \approx \frac{1}{Nh} \nu_2(K) f(x) \text{ with } \nu_2(K) = \int K(u)^2 du ,$$

The necessary modification is the use of the total number of observations from all periods involved in the estimation in the interval I_j in question. These numbers of observations are given by Q_{j-1} and R_j, leading to variances for the different parts of the factual of

$$Var\left[\hat{f}_h(x)\right] \approx \frac{1}{Q_{j-1}h} \nu_2(K) \hat{f}(x) \text{ for } x \in I_j ,\ j = 2\ldots T$$

and for the different parts of the counterfactual of

$$Var\left[\hat{g}_h(x)\right] \approx \frac{1}{R_j h} \nu_2(K) \hat{g}(x) \text{ for } x \in I_j ,\ j = 2\ldots T .$$

As usual, in applications the estimated distributions have to be used instead of the true distributions.

Discontinuity unbiased estimators

Because of the discontinuity of the distributions at nominal zero (i.e. at $-m_\tau$), in the application of estimators (4) to (7) some of the probability mass is spilled over the borders of the intervals and lost for estimation. It follows, that the estimates within the intervals are affected by a 'discontinuity bias', i.e. biased downward in the neighborhood of the interval borders, which represent the discontinuities. This observation gives the choice of kernel and bandwidth a special role in the present context. The use of variable bandwidth is a sophisticated, but also computationally costly strategy that might be used in order to deal with this type of bias.

8 See Härdle and Linton (1994).

However, for the question at hand it is in most cases sufficient to follow an alternative strategy that consists of not using the kernel density estimates over ranges, where these are known to be affected by discontinuity bias. The discontinuity bias is only present within a distance of b from the discontinuity, where b is equal to half of the total width of the kernel used. For the uniform (or rectangular) kernel $b = h$, but this does not hold for other kernels.

The direct consequence of this solution to the discontinuity bias is that the analysis has to use 'effective intervals' for the aggregate estimation that are different from the intervals I_τ. Different effective intervals are needed for the estimation of the factual and the counterfactual.

$$I^f_{\tau+1} =]-m_{\tau+1} - b, -m_\tau - b[\,,\ \tau = 1 \ldots T-1;$$

$$I^g_{\tau+1} =]-m_{\tau+1} + b, -m_\tau + b[\,,\ \tau = 1 \ldots T-1.$$

Accordingly, the modified core interval $I^b_c = [-m_T + b, -m_1 - b]$ is now $2b$ smaller than the original core interval $I_c =]-m_T, -m_1[$. The overlap between the estimated counterfactual and factual is reduced to $m_T - m_1 - 2b$. The proposed pragmatic solution will work well enough, if this loss of overlap 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 modified, discontinuity unbiased aggregate estimators for the counterfactual distribution $g(x)$ and the factual distribution $f(x)$ are:

(10) $$\hat{f}(x) = \sum_{\tau=1}^{j-1} \frac{N_\tau}{Q_{j-1}} \hat{f}_\tau(x) \quad x \in I^f_j, \quad j = 2 \ldots T$$

(11) $$\hat{g}(x) = \sum_{\tau=j}^{T} \frac{N_\tau}{R_j} \hat{g}_\tau(x) \quad x \in I^g_j, \quad j = 2 \ldots T$$

The computation of the variance of these estimates has to be adjusted accordingly. If the difference between the two estimates is significant, this indicates downward nominal wage rigidity; measures of the extent of downward nominal wage rigidity will be discussed next.

In this section two measures of downward nominal wage rigidity are proposed, the estimated rigidity function, and the average degree of DNWR on the other.

Rigidity function and extent of rigidity

The rigidity function is a concept introduced in Beissinger and Knoppik (2001). It captures the possibly size-dependent thinning effect at wage reductions of different sizes as the percent difference between the counterfactual and factual distributions. In the present context, the two estimated distributions are used to obtain an estimate of the rigidity function $\hat{\rho}(x)$ over the core interval.

(12) $$\hat{\rho}(x) = \frac{\hat{g}(x) - \hat{f}(x)}{\hat{g}(x)} \text{ for } -m_T < x < -m_1 .$$

By not imposing a functional form on the rigidity function $\rho(x)$, the kernel-location approach allows to shed some light on the ongoing debate on the type of rigidity, i.e. threshold, proportional, or menu cost, see Knoppik and Beissinger (2003).

The second measure proposed is the average degree of downward nominal wage rigidity. Two necessary integrals for its construction are:

$$\Delta G \equiv \int_{-m_T}^{-m_1} \hat{g}(z)dz, \qquad \Delta F \equiv \int_{-m_T}^{-m_1} \hat{f}(z)dz.$$

The estimated average degree of downward nominal wage rigidity can then be defined as

(13) $$\hat{\rho} = \frac{\Delta G - \Delta F}{\Delta G},$$

it measures the proportion of wage cuts prevented by downward nominal wage rigidity.

5 Implementation and estimates

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 do play a role because of the discontinuities of the underlying distributions at nominal zero and the need to take into account the corresponding 'discontinuity bias' as discussed in section 0. The uniform kernel and a bandwidth of $h = .01$ where used for the analysis presented in the following.[9]

Rows a) and b) of FIGURE 1 show the partial estimates of counterfactual and factual distributions of percent median-centered nominal wage changes in two columns for salaried employees and workers respectively. The estimates of factual and counterfactual distribution overlap over the core interval I_c^b. The dotted vertical lines mark the intervals I_τ^g and I_τ^f, respectively. The number of periods used for the aggregate estimates varies across these intervals, and is reflected in the thickness of the plotted curves which in addition tend to be less smooth over the intervals with few underlying periods and thereby few underlying observa-

9 Robustness checks with respect to the choice of kernel and the bandwidth where performed; results do change very little.

tions. Specifically, the estimated counterfactual distributions are based on ever fewer periods, going from right to left, and the estimated factual distributions are 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 row 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 over the interval I_c^b more clearly visible. Both estimated distributions differ significantly; curves in thin lines are the $2\hat{\sigma}$-bands of the respective estimates. This result 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.

Extent and type of DNWR

The estimated rigidity function for both types of employees is plotted in row d) of FIGURE 1 over the range where the two partial estimates overlap, i.e. over the interval I_c^b. The average value of the rigidity function over this interval is close to .28 for salaried employees and to .13 for workers, i.e. 28 percent (respectively 13 percent) of the wage changes that fell into that range did not take place if they required nominal wage reductions. With few exceptions, the values of the rigidity function over the range lie fairly close to the estimated average degree of rigidity (represented by a horizontal line in FIGURE 1), 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 (2000).

Comparisons with literature

Empirical studies of downward wage rigidity in German micro data have led to a range of results with respect to the extent of downward nominal wage rigidity. Possible explanations of these discrepancies include the different types of data and approaches used in these analyses. Our quantitative results are comparable to those of Knoppik and Beissinger (2005) and Dickens, Goette, Groshen, Holden, Messina, Schweitzer, Turunen and Ward (2006), who have undertaken multi-country studies based on different empirical approaches and, partly, different types of data sources. Other studies for Germany use variants of the earnings-function approach introduced by Altonji and Devereux (2000). This parametric approach permits the explicit consideration of potential measurement errors in the data within the model. The earnings-function approach comes in different variants and with a corresponding spectrum of results. Using the proportional variant of the model Knoppik and Beissinger (2003) as well as Blaes (2006) found more downward nominal wage rigidity for Germany than in the present paper. Other studies with German data such as Fehr, Goette and Pfeiffer (2002), Bauer, Bonin and Sunde (2003) and Corneließen and Hübler (2006) have applied a version of the earnings-function approach, which is extended by the additional consideration of real or contractual wage rigidity. These studies tend to find relatively low degrees of downward nominal wage rigidity.

6 Summary, conclusions, and outlook

In this paper, the kernel-location approach developed recently by Knoppik (2007) is applied to the regional file of the German IAB Employment Statistics (IABS-R) for the period 1975-2001 in order to determine the extent and the functional form of downward nominal wage rigidity (DNWR) in Germany. Since the earnings data in the IABS-R are a broad measure of compensation including most types of fringe benefits, our results refer to the rigidity or flexibility of total compensation. The estimated degree of DNWR for salaried employees was found to be about 28 percent, i.e. over the sample period 28 percent of desired cuts in nominal earnings could not be enacted due to downward nominal wage rigidity. For workers the degree of DNWR is lower and amounts to 13 percent over the sample period. The estimated rigidity function suggests a uniform degree of DNWR for earnings reductions of different sizes and therefore supports the proportional model of DNWR used in Kahn (1997) and Knoppik and Beissinger (2003), rather than the threshold model of Altonji and Devereux (2000).

In comparison to other approaches to the analysis of DNWR in micro data, the kernel-location approach enjoys important advantages, which in our view make the results very robust and reliable. In particular, the kernel-location approach neither relies on restrictive assumptions with respect to the functional form of the counterfactual distribution, nor on assumptions about the functional form of downward nominal wage rigidity. In contrast to the earnings-function approach of Altonji and Devereux (2000), the kernel-location approach takes no account of measurement error in the earnings data. This, however, is not a problem in the IABS-R whose earnings data is arguably free of measurement error.

When comparing our results with previous results for Germany, one has to bear in mind that our results refer to total compensation and not to hourly wages. As has been argued by Knoppik and Beissinger (2003), the degree of downward nominal rigidity in hourly wages is significantly higher than rigidity in total compensation. Our results for salaried employees are nearly the same as the results reported in Beissinger and Knoppik (2001) using the histogram-location approach with a proportional wage rigidity function. The results for workers are now lower, which may be due to the longer sample period and the downward trend in yearly hourly wages. By and large, the present paper corroborates our earlier findings of significant DNWR in Germany and, by the novel approach applied, constitutes one step towards less ambiguous results on DNWR in Germany.

Appendix A Wage data from the IABSR 1975-2001

The samples of log-percent earnings changes for German workers and salaried employees were constructed according to the data selection documented in section 3. The sample period comprises 26 years. Summary statistics of the samples are listed in TABLE A.1 and TABLE A.2. Annual medians range from 2.1 to 8 percent for employees and from 1.4 to 7 percent for workers. The total number of observations is equal to 130000, the number of observations per period equal to 5000 in each period.

TABLE A.1

TABLE A.2

Appendix B Selected partial estimates of factual and counterfactual distributions by period

Figure B.1

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Figures

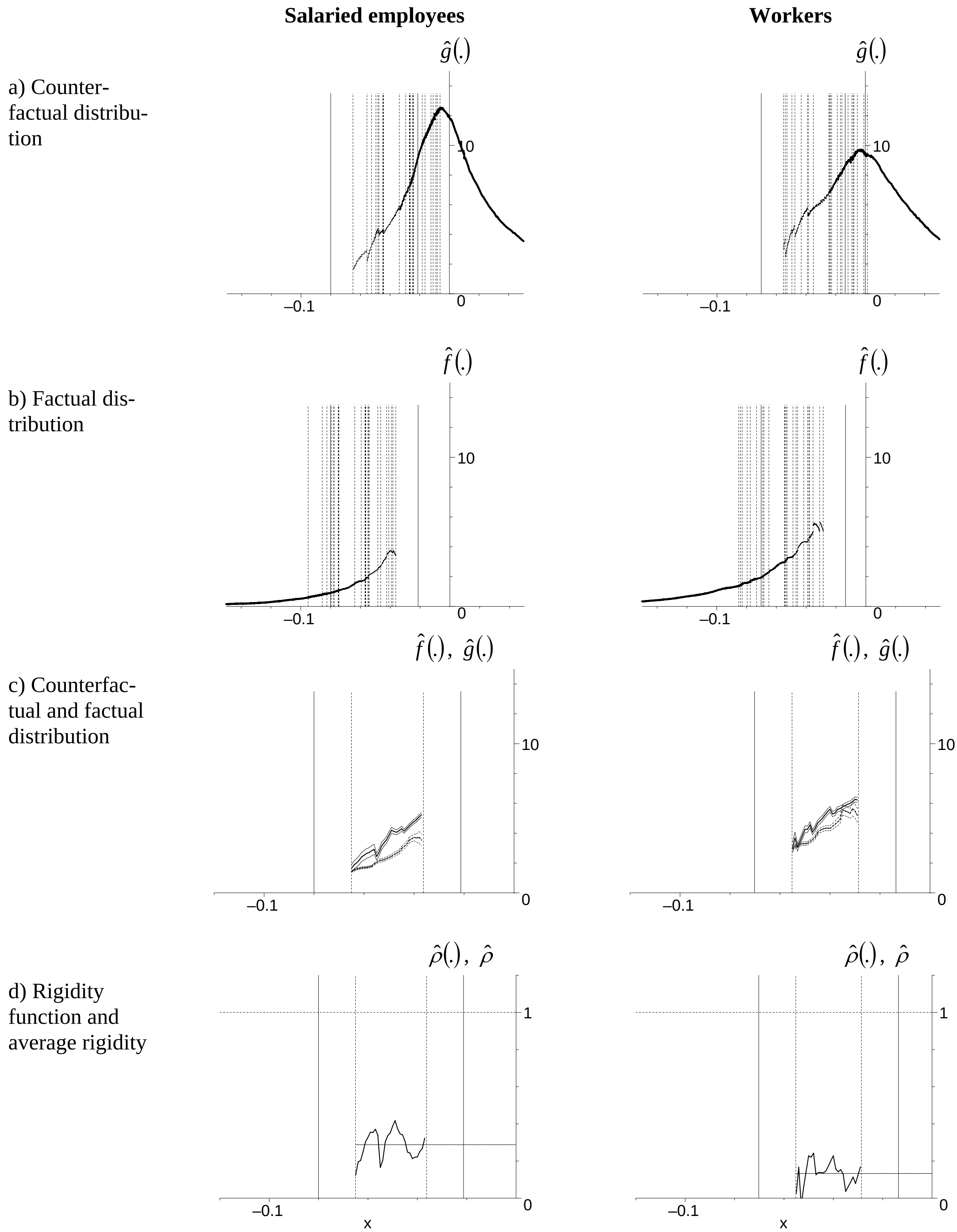

Figure 1: *AGGREGATE PARTIAL ESTIMATES OF DISTRIBUTIONS AND OF RIGIDITY FUNCTIONS*

Rows a) and b) show the aggregate partial estimates of counterfactual and factual distributions of percent median-centered nominal wage changes. Differences in smoothness and thickness of the lines reflect the fact that observations from different numbers of periods contribute to the estimates. Row c) plots the aggregate estimates over the range of overlap and adds $2\hat{\sigma}$ -bands. Row d) contains the estimated rigidity function and the estimated average rigidity. See also discussion in text. Technical note: 5000 observations / year.

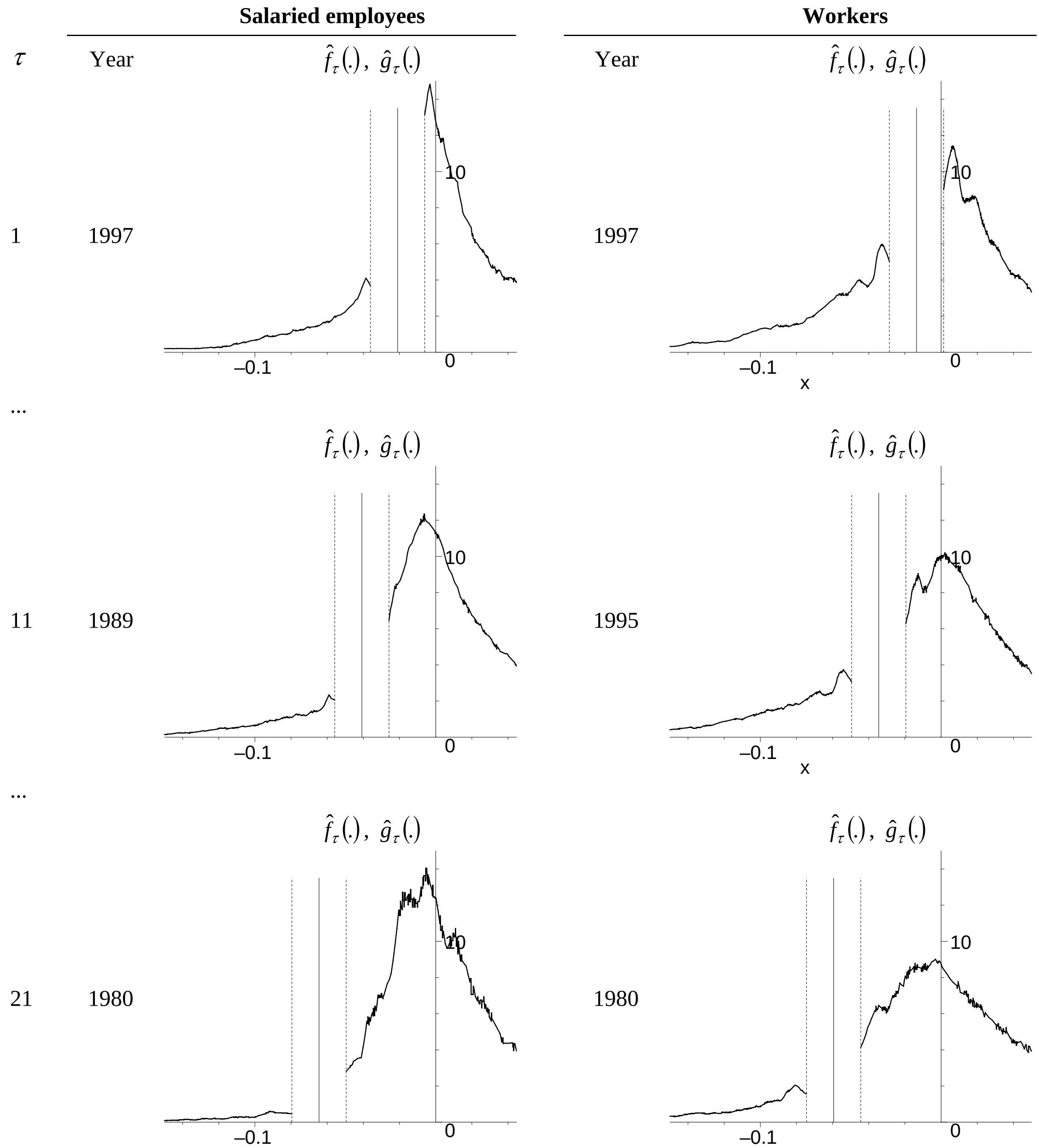

Figure B.1: *PARTIAL ESTIMATES OF FACTUAL AND COUNTERFACTUAL DISTRIBUTIONS BY PERIOD*

Note: Solid curves indicate partial estimates of distributions, unaffected by 'discontinuity 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. Technical note: 5000 observations / year.

Tables

Table A.1: SUMMARY STATISTICS FOR SALARIED EMPLOYEES

			Number of observations			
Period-Index	**Year**	**Median**	**Nominal de-creases**	**Nominal ze-ros**	**Nominal in-creases**	**All**
τ	t	m_τ	N_τ^{neg}	N_τ^{zero}	N_τ^{pos}	N_τ
1	1997	0.0211	868	568	3564	5000
2	1998	0.0233	774	552	3674	5000
3	1996	0.0235	876	520	3604	5000
4	2000	0.0256	790	484	3726	5000
5	2001	0.0274	715	415	3870	5000
6	1994	0.0277	668	524	3808	5000
7	1999	0.0324	691	398	3911	5000
8	1988	0.0339	487	410	4103	5000
9	1987	0.0392	392	407	4201	5000
10	1985	0.0397	383	366	4251	5000
11	1995	0.0408	552	347	4101	5000
12	1986	0.0414	381	381	4238	5000
13	1989	0.0417	352	363	4285	5000
14	1983	0.0420	313	313	4374	5000
15	1993	0.0445	515	265	4220	5000
16	1982	0.0488	267	261	4472	5000
17	1981	0.0583	189	224	4587	5000
18	1990	0.0588	252	232	4516	5000
19	1992	0.0599	336	229	4435	5000
20	1978	0.0632	145	231	4624	5000
21	1979	0.0645	135	185	4680	5000
22	1980	0.0645	148	175	4677	5000
23	1984	0.0645	240	286	4474	5000
24	1991	0.0671	272	221	4507	5000
25	1976	0.0690	136	236	4628	5000
26	1977	0.0800	105	151	4744	5000
Sum						130000
Minimum		0.0211				
Maximum		0.0800				
Mean		0.0463				
Median		0.0418				

Table A.2: SUMMARY STATISTICS OF DATA FOR WORKERS

			Number of observations			
Period-Index	**Year**	**Median**	**Nominal de-creases**	**Nominal ze-ros**	**Nominal in-creases**	**All**
τ	t	m_τ	N_τ^{neg}	N_τ^{zero}	N_τ^{pos}	N_τ
1	1997	0.0136	1517	638	2845	5000
2	1996	0.0165	1443	527	3030	5000
3	1998	0.0203	1225	593	3182	5000
4	1994	0.0227	1200	556	3244	5000
5	2000	0.0227	1133	528	3339	5000
6	2001	0.0235	1052	499	3449	5000
7	1999	0.0260	1100	507	3393	5000
8	1988	0.0303	906	562	3532	5000
9	1983	0.0328	799	581	3620	5000
10	1987	0.0345	849	510	3641	5000
11	1993	0.0345	1018	387	3595	5000
12	1989	0.0377	662	447	3891	5000
13	1982	0.0385	813	528	3659	5000
14	1985	0.0385	708	537	3755	5000
15	1995	0.0396	793	337	3870	5000
16	1986	0.0400	721	481	3798	5000
17	1984	0.0408	722	467	3811	5000
18	1981	0.0500	583	426	3991	5000
19	1978	0.0541	551	461	3988	5000
20	1992	0.0541	598	265	4137	5000
21	1990	0.0594	473	244	4283	5000
22	1976	0.0645	465	448	4087	5000
23	1991	0.0645	443	225	4332	5000
24	1980	0.0674	375	265	4360	5000
25	1977	0.0690	380	358	4262	5000
26	1979	0.0690	323	265	4412	5000
Sum						130000
Minimum		0.0136				
Maximum		0.0690				
Mean		0.0409				
Median		0.0385				