Downward Nominal Wage Rigidity in Europe
An Analysis of European Micro Data from the ECHP 1994-2001[*†]

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Abstract

The limited evidence on existence and extent of downward nominal wage rigidity in the European Union is substantially extended by applying modified versions of the Kahn (1997) histogram-location approach to employee micro data from the European Community Household Panel (ECHP) for twelve of the EU's current member states. Estimated aggregate and national degrees of downward nominal wage rigidity point to substantial nominal rigidity.

Keywords: Downward Nominal Wage Rigidity; Micro Data; ECHP; European Union.

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1 Introduction

Whether, to which extent, and why nominal wages are downwardly rigid are widely considered unresolved questions. Their scientific importance derives from their key role for the understanding of the workings of the labor market and their implications for the shape of the long-run Phillips curve. The relevance of downward nominal wage rigidity (DNWR) for economic policy derives from the fact that it may lead to inadvertently high costs of low inflation targets in terms of higher long-term unemployment.

At present, only for some European countries positive or negative evidence on the existence of downward nominal wage rigidity does exist, see Table 1. In several cases the evidence is purely descriptive, it seems contradictory, and almost always it is hard to compare across countries, because of differences in methods and data. This state of recent research has led the European Central Bank to conclude that ‘the importance in practice of downward nominal rigidities is highly uncertain and the empirical evidence is not conclusive, particularly for the euro area’, European Central Bank (2003), p. 5. Two competing views exist with respect to the causes of downward nominal wage rigidity, the psychological view that emphasizes the joint role of fairness considerations and money illusion and the institutionalist view that sees labor market institutions like collective bargaining and employment protection regulation as causes of nominal wage rigidity. Even less evidence is available with respect to this question, but nevertheless the European Central Bank has adopted the institutionalist view, and expects structural labor market reforms to reduce the role of downward nominal wage rigidity; see European Central Bank (2003), p. 6.

Table 1

In this paper we substantially extend the available evidence on the existence and extent of downward nominal wage rigidity in the European Union and the Euro Area. We do so by analyzing the European Community Household Panel (ECHP) with a suitably modified multi-country version of the histogram-location approach. The ECHP, which became available in the full eight wave length only as recently as January 2004, offers a unique opportunity to gain evidence on nominal wage rigidity and its determinants on a European level. At the same time the claim that nominal rigidity vanishes under sustained low inflations can be addressed because of the presence of such a low inflation period in the sample. We use the most widespread quantitative method of analysis, the histogram-location approach introduced by Kahn (1997), as the basis for a new method for cross-country analysis, in order to guarantee a high degree of comparability with earlier results. An additional advantage of this approach is that it is easier to interpret than the best alternative, the earnings-function approach proposed by Altonji and Devereux (1999). The most important drawback of the histogram-location approach, its lack of treatment of measurement problems, should not be too problematic in the context of a uniform cross-country data source, since measured degrees of downward nominal wage rigidity can consistently be interpreted as lower bounds of true nominal wage rigidity across countries.

The remainder of the paper is organized as follows: The next two sections provides a brief explanation of the histogram-location approach and its proposed extensions. These are followed by a section that describes in some detail the ECHP data used. Section five contains a description of the empirical implementation and the results with respect to the existence and extent of downward nominal wage rigidity. Finally, we offer a summary and conclusions.

2 Basic framework of the histogram-location approach

A common concept of all approaches to the analysis of downward nominal wage rigidity in micro data is that there is a counterfactual (and partly unobservable) distribution of rates of individual wage changes that would prevail under wage flexibility, and that nominal rigidity is responsible for the differences in shape between the observable factual distribution and that counterfactual distribution. Most approaches assume the time invariance of the counterfactual distribution and exploit the characteristic joint changes of the location of the counterfactual distribution on the one hand and of the shape of the factual distribution on the other hand. If downward nominal wage rigidity is present and if the location of the distribution changes over time, because of changes in inflation for example, varying portions of the left part of the distribution are affected by downward nominal wage rigidity. This is illustrated in column b) of Figure 1, where higher inflation leads to shifts of the median of the distribution to the right and lets a smaller part of the distribution be affected by downward nominal wage rigidity in the form of thinning and pile-up and vice versa. The variation in shape of the factual distribution can be seen even more clearly if the horizontal shifts in location are eliminated from its graphical representation by subtracting from the data the annual medians before histogram construction. This is demonstrated in column c) of Figure 1.

Figure 1

Since joint variation of location and shape is only present if downward nominal wage rigidity exists, it can be used to show the existence of downward nominal wage rigidity. The histogram-location approach proceeds in two steps to do so: The first step consists of constructing annual histograms of rates of wage changes, centered to some annual measure of location. The resulting factual bin sizes are input for the second step. It consists of formulation and estimation of a model of factual bin sizes based on counterfactual bin sizes and rigidity-induced thinning and pile-up. The approach can be classified as semi-parametric, since on the one hand there is no parametric functional specification of the notional and counterfactual distributions involved, but on the other hand there is a parametric functional specification of the workings of downward nominal wage rigidity in the modeling of thinning and pile-up, implying a rigidity coefficient that captures the extent of downward nominal wage rigidity.

Step 1: Histogram construction

Within the step of histogram construction, three modelling choices have to be made concerning the computation of rates of wage changes, the choice of bin width, and the choice of a measure of location of the annual distributions. First, this analysis is primarily based on year to year percentage changes of individual earnings and not on the log percentages. Note, that because of the non-parametric nature of the histogram-location approach this choice should be of far less consequence than in parametric analyses of distributions of wage changes. Second, it is well known that the appearance of histograms may crucially depend on the bin width selected and that over- and undersmoothing may misrepresent the underlying distribution. Because of the specific sharp features of the distribution under downward nominal wage rigidity, bin width should be smaller than recommended in the usual rules of thumb. Third, a measure of location has to be determined that is used to eliminate the shifts of location from the histograms. Without discussion, the median has been used in earlier studies. While the median appears to be a plausible enough choice at first sight, it is not at all clear that in low inflation years the annual distributions are located far enough to the right to have positive medians. If medians are not far enough to the right, the median does not reflect the changes in location of the distribution, but remain constant at the mass point at zero. In turn, if the median does not reflect the changes in location, the principle of joint variation of location and shape is undermined. In addition, as pointed out by Knoppik and Beissinger (2003), measurement error that distributes the probability mass of the spike at zero may lead to transformations of the distribution that make the median an inappropriate measure of the true shifts in location. Therefore, higher quantiles will be used as alternative measures of location.

The following convention is used in the paper in order to consistently number the histogram bins. Since only the left part of the distributions is of interest, the numbering starts from the location (origin) of the histogram and proceeds to the left, starting with one. Therefore bin r contains relative wage changes that are between r and $r-1$ times the bin width b smaller than the rate of wage change at the location of the histogram.

Step 2: Modeling observed factual bin sizes

Models of factual bin sizes are the core of the second step of the histogram-location approach. The following system of equations constitutes the basic proportional model that explains observed factual bin sizes P_{rt} by unobserved counterfactual bin sizes α_r (assumed time invariant), by bin status (dummy variables DN_{rt}, DZ_{rt}) and by the rigidity coefficient ρ.

(1) $$P_{rt} = \alpha_r \underbrace{\left(1 - \rho DN_{rt}\right)}_{thinning} + \underbrace{\left(\gamma + \rho \sum_{j=r_{\min}}^{r_{\max}} \alpha_j DN_{jt}\right) DZ_{rt}}_{pile\ up} + \mu_{rt} \text{ for } r = r_{\min} \ldots r_{\max} .$$

In each year, each bin can be in one of three states: it may contain only negative observations, indicated by a one in DN_{rt}, it may contain the zero changes, indicated by a one in $D0_{rt}$, or it may contain only positive changes, in which case DN_{rt} and DZ_{rt} are both zero. In this latter case, i.e. if bin *r* is a positive bin in a period *t*, the observed bin size differs from its corresponding counterfactual bin size only by the error term μ_{rt}. If a bin has negative bin status ($DN_{rt} = 1$), a proportion ρ of its counterfactual size will be missing due to rigidity. Finally, if the bin has zero bin status ($DZ_{rt} = 1$) there will be pile-up in addition to the counterfactual bin size from the wage freezes in the negative bins of that period; γ captures the contribution of those negative bins that are too far left to be explicitly modeled. Note that this specification implies convoluted parameter constraints across the equations of the system. The parameter ρ can be interpreted as the degree of rigidity, since it is equal to the (uniform) proportion of nominal wage cuts that are prevented by the existence of downward nominal wage rigidity. It is a measure of the extent of rigidity which is conditional on the occurrence of notional wage cuts. If the estimated degree of downward nominal wage rigidity is significantly positive, the existence of downward nominal wage rigidity has been shown.

Within the second step of the histogram-location approach, choices have to be made with respect to the functional form of downward nominal wage rigidity, and with respect to which bins to include in the system of equations (1). First, the functional form of rigidity is that of the “proportional” model or “model 3” in Kahn (1997), but the menu-cost effects are absent here. In our view, the assumption of “proportional rigidity” as opposed to “threshold rigidity” as used in Altonji and Devereux (1999) and other studies is compatible with existing evidence and at the same time more general in imposing as little functional structure as possible on the data; see Knoppik and Beissinger (2003). Furthermore, no additional dummies to mark small nominal wage changes of either sign were included in the specification, since the data quality (rounding) prevents us from interpreting them as menu-cost effects. Second, from the discussion of the principle of joint variation of location and shape it should be clear that information on the existence of downward nominal wage rigidity cannot be derived from the range of the distribution where either wage changes are always negative or where they are always positive. In order to estimate as few parameters as possible, the range of bins $r = r_{\min} \ldots r_{\max}$ and correspondingly the number of equations $R = r_{\max} - r_{\min} + 1$ can be chosen such that only those bins are included in the analysis which exhibit a change of bin status at least once within the sample period, while the desire for direct comparability of a variety of estimates leads to the adoption of a wider range of bins.[1]

A final consideration concerns both steps of the approach, the construction of histograms and the modelling of bin sizes, and leads to an upper bound for the bin width. It arises from the usually limited variation in annual location in the data.

3 Extensions of the histogram-location approach

This section presents two extensions of the basic framework with implications for both steps. One extension is the formulation of a “closed model” that models the complete left tail of the distribution, unlike the partial basic model (step 2). The other extension adapts the approach to a multi-country framework by formulating a suitable “pooled model” (step 2) and performing appropriate adjustments in the construction of histograms (step 1).

Closed model

In the basic model (1) the part of the distribution to the left of $r_{\max}$ is left out of consideration, except for adding ad hoc the “additional pile-up” parameter γ. However, the extent of the additional pile-up follows directly from the assumed proportional functional form of downward nominal wage rigidity and the construction of location-centered histograms. The latter implies that the counterfactual outer left tail has probability mass of $F(q)-\sum_j \alpha_j$, i.e. is equal to the difference between the percentile used as measure of location and the sum of all modeled counterfactual bin sizes. Therefore, the pile-up from the far left must equal ρ times this difference which can be used to replace γ in system (1),

$$\rho\left(F(q)-\sum_j \alpha_j\right)=\gamma ,$$

and the closed model therefore consists of the following system of equations (2):

$$(2) \qquad P_{rt}=\alpha_r \underbrace{(1-\rho DN_{rt})}_{thinning}+\underbrace{\left(\rho\left(F(q)-\sum_j \alpha_j\right)+\rho\sum_{j=1}^{r_{\max}}\alpha_j DN_{jt}\right)DZ_{rt}}_{pile\ up}+\mu_{rt} \text{ for } r=1\ldots r_{\max} .$$

Note that no explicit equation for the probability mass to the left of $r_{\max}$ is needed or admissible, because of the dependence of the error terms over the closed model. Note also that $r_{\min}$ is set to one.

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1 $r_{\min}=\min(r|h_r>0)$ and $r_{\max}=\max(r|h_r>0)$, where h_r is the absolute frequency of zero bin status over the sample period.

Pooled model

In a cross-country context, three different ways to apply the histogram-location approach to the data can be distinguished. The first option is to build (isolated) *national models,* i.e. to construct national histogram bin sizes and to estimate national models independently of each other from these. The main drawback of this option is that in the cases of several countries the distribution of per cent wage changes does exhibit only very little variation in location over the sample period which tends to make estimation less reliable or to even render it impossible. The second option is to construct aggregate histogram bin sizes and to estimate *aggregate models*. However, different developments over time of the location of the underlying national distributions of per cent wage changes violate the prerequisites for aggregation by giving rise to a time-varying mixture of distributions. The third option is to pool the information on national histogram bin sizes and to estimate *pooled models*. In the pooled models, the limited variation in location of the distributions of per cent nominal wage changes is substituted to some degree by cross-country variation in location. Two versions of pooled models, either with uniform or country-specific degrees of downward nominal wage rigidity are considered.

The pooled model with uniform parameters essentially consists of a version of system (1) that is re-indexed with (bin, country, time) instead of (bin, time) and uses stacked country data on bin sizes and status dummies.

$$P_{rct} = \alpha_r \underbrace{(1-\rho DN_{rct})}_{thinning} + \underbrace{\left(\gamma + \rho \sum_{j=r_{\min}}^{r_{\max}} \alpha_j DN_{jct}\right) DZ_{rct}}_{pile\ up} + \mu_{rct} \quad \text{for } r = r_{\min} \ldots r_{\max} . \tag{3}$$

The pooled model with national parameters is given by system (4), where country dummies DCi_{rct} are used to replace the uniform rigidity coefficient and additional pile-up coefficient in system (1). Specifically, $\sum_i \rho_i DCi_{rct}$ is used to replace ρ, and $\sum_i \gamma_i DCi_{rct}$ replaces γ, to yield:

$$P_{rct} = \alpha_r \underbrace{\left(1-\left(\sum_i \rho_i DCi_{rct}\right) DN_{rct}\right)}_{thinning} + \underbrace{\left(\sum_i \gamma_i DCi_{rct} + \left(\sum_i \rho_i DCi_{rct}\right) \sum_{j=r_{\min}}^{r_{\max}} \alpha_j DN_{jct}\right) DZ_{rct}}_{pile\ up} + \mu_{rct} \tag{4}$$

$$\text{for } r = r_{\min} \ldots r_{\max} .$$

The closed model and the pooled models can be combined, in order take advantage of both modifications simultaneously. However, for use of the pooled models any country differences of the counterfactual have to be eliminated. Centering the national histogram bin sizes takes account of the national differences in location. Additional differences in dispersion can be taken into account by standardizing the distributions as in Holden and Wulfsberg (2004) in the context of their different approach to the analysis of industry wage data.

Standardization of wage changes

The proposed standardization effectively relaxes the assumption of time-invariant counterfactual distribution (up to variation in location). It is replaced by the weaker assumption of time-invariant counterfactual distribution (up to variation in location and some parameter of dispersion). The standardized per cent wage changes Δw^s results from

$$\Delta w^s = \frac{\Delta w - l}{v},$$

with parameter of location l and parameter of dispersion/variability v. The choice of measure of variability in standardization depends on the questions to be addressed. Since Holden and Wulfsberg (2004) are only interested in correct type I errors in their test of the null hypothesis of wage flexibility, it does not matter for their analysis, whether the measure of variability v is affected by downward nominal wage rigidity or not. They choose the interquartile range (IQR) as their preferred measure.

$$v^{IQR} = q^{III} - q^{I}$$

Since we are interested in estimates of the extent of downward nominal wage rigidity, the measure of variability must not be affected by downward nominal wage rigidity. We therefore propose the use of inter percentile ranges (IPR) between the measure of location (also chosen not to be affected by downward nominal wage rigidity) and some higher percentile, e.g. q_{80}:

$$v^{IPR_{80|60}} = q_{80} - q_{60}.$$

In the example, the corresponding standardization is given by

$$\Delta w^s = \frac{\Delta w - q_{60}}{v^{IPR_{80|60}}}.$$

4 Data

Our analysis is based on the European Community Household Panel (ECHP) which is a large-scale annual longitudinal survey providing household and personal information for the member states of the European Union (EU).[2] The ECHP has been centrally designed and coordinated by the Statistical Office of the European Union (Eurostat). It started in 1994 and ended in 2001, thereby comprising eight waves which form the basis of our analysis.[3] The great advantage of the ECHP is the uniform questionnaire asked in the EU-countries which makes the direct comparison of data across countries and over time possible. The ECHP provides information on income, especially earnings and public transfers, and on demographic and socio-

2 See Eurostat (2003) for a short introduction to the ECHP and Peracchi (2002) for a detailed description of the first three waves of the ECHP data.

3 The final wave has only been made available for scientific use in January 2004.

economic characteristics such as labor force behavior, health, education, housing and migration, at both the household and the personal level. To make scientific use of the ECHP data possible, Eurostat constructed an anonymised and user-friendly version of the data (the User's Database; UDB) from the original data (the Production Data Base; PDB). In this process, variables have been reorganized and standardized across waves, no more strictly reflecting the structure of the questionnaire.

In our analysis of the extent of downward nominal wage rigidity we are interested in the per cent earnings change distributions for employees who have a "stable employment relationship" with an employer. The data selection can be summarized as follows: In line with previous analyses in this field of research we restrict the analysis to "job stayers", i.e. employees who stay with the same employer for a certain period of time. For the sample selection we define so-called "standard job stayers" as full-time working employees who did not change the job between two consecutive interviews. The exact definition of standard job stayers is presented in the upper part of Table 2. The analysis based on standard job stayers takes account of all EU countries except Sweden, Luxemburg and the Netherlands.[4] Appendix A explains the data selection in more detail, and contains figures for full-time working employees and standard job stayers for each country.

Table 2

Choices have also to be made about other characteristics that observations included in the subsample should meet. In the lower part of Table 2 the "reference specification" for job stayers (standard or not) is described. Our preferred subsample consists of standard job stayers who meet the requirements of the reference specification. Table 3 summarizes the figures of our preferred subsample. All in all, this subsample consists of 70,239 observations for the remaining 12 EU countries.

Table 3

In the analysis, only a relatively broad measure of monthly or annual (net) earnings can be used. The reason is that in the UDB income components have been defined at a higher level of aggregation than the detailed enumeration given in the PDB. The UDB provides two measures of nominal earnings from work: 1) "current monthly (net and gross) wage and salary earnings" and 2) "total regular net wage and salary earnings" (referring to the year prior to the wave year). For the analysis of the sample of standard job stayers we use the first earnings measure

[4] Due to the lack of longitudinal information, the Swedish data cannot be included in our analysis. The PSELL data for Luxembourg are excluded since these do not contain information on the month of the interview and because information on the year of start of the current job is missing in most cases. In our analysis of standard job stayers the Netherlands also have to be excluded since information on the main monthly activity is missing.

(net monthly earnings), since the stayer concept refers to the spell between interviews whereas the second earnings measure refers to total earnings of the previous calendar year.

Figure 2

Figure 2 plots the distributions of per cent changes of monthly net earnings between two consecutive interview dates in our selected sample. This figure provides some preliminary evidence that the distribution of earnings changes is affected by downward nominal rigidity in all countries. The left tail of the distribution usually appears to exhibit some „deformation“, a spike in the distribution at zero and some thinning in the distribution below zero. However, a purely static descriptive analysis of the shape of the earnings change distribution does not prove the existence of downward nominal wage rigidity, since the thinning of the distribution below zero may simply reflect a peculiar shape of the “notional” (or “counterfactual”) distribution of earnings changes. As has already been explained in Section 2, the existence of downward nominal wage rigidity can only be detected by considering the joint variation of location and shape of the earnings change distribution. In Figure 2, the sixty percent percentile of the earnings change distribution (marked by a thin vertical line) is used as measure for location. For example, in Greece in the mid-nineties the sixty percent percentile lies between 12 and 15 percent because of high inflation. When Greece curbed inflation in order to meet the requirements for the introduction of the Euro, the sixty percent percentile also declined and amounted to only around 3 percent in 2000. This leftward shift of the location of the earnings change distribution is accompanied by a more pronounced pile-up at zero and an increased asymmetry of the distribution due to thinning in the left tail of the distribution. The development over time of inflation and the measure of location in the different countries is graphed in Figure 3.

Figure 3

5 Empirical Implementation and Results

In this section we present estimated national and aggregate degrees of rigidity from closed pooled models as discussed in section 3. Weighted least squares (WLS) estimates are used throughout because of the reasons discussed in section 2. The reference specification entails the standard stayer specification and the standard selection of observations, as discussed in section 4. In addition the following choices have been made: a bin width based on a bin width of two percentage points, but scaled by the measure of dispersion; as a measure of location $l_{t,i} = q_{60,t,i}$; as a measure of dispersion for standardization the interpercentile range $v^{IPR_{80|60}}$. Variation in alternative specifications presented below is over the stayer concept, where one wider and one narrower concept are used, over the basis for binwidth, which is varied to

$b = .015$ and $b = .025$, and over the measure of location, which is varied to $l_{t,i} = q_{50,t,i}$, $l_{t,i} = q_{55,t,i}$, and $l_{t,i} = q_{65,t,i}$.

National estimated degrees of rigidity for the reference specification are summarized in the first column of Table 4, providing the estimated rigidity coefficients ρ and the corresponding *t*-values. These estimates are based on the pooled model of equation (4) in a closed version. There are highly significant positive degrees of rigidity in all of the twelve countries. While in a majority of seven cases the rigidity coefficient lies between 25 and 50 percent, there are also four cases with lower and one case with even higher degree of rigidity, within an overall range of 7 percent (Spain) to 66 percent (Italy). This picture is corroborated by the alternative specifications that generally exhibit rather little variation in the estimated degree of downward nominal wage rigidity. Only in the case of Spain are there two instances of insignificant estimates based on alternative specifications. Appendix B presents and discusses isolated national estimates and their problems.

Table 4

EU wide estimated degrees of rigidity based on the pooled model of equation (3) in a closed version and based on the data of twelve EU countries are shown in the lower part of Table 4. The standard specification and alternative specifications result in highly significant estimated rigidity coefficients between 32 and 37 percent.

Because of the reporting errors typical for survey data, and because of the effects of these on the observable distribution of per cent wage changes discussed in Knoppik and Beissinger (2003), we interpret these results as constituting lower bounds of true degrees of downward nominal wage rigidity in the respective countries or areas.

6 Summary, Conclusions, and Outlook

This paper analyzes existence and extent of downward nominal wage rigidity in the European Union, which is a question of great significance, both from a theoretical and from a policy perspective. Up until now, evidence on existence and extent of downward nominal wage rigidity in Europe has been limited to only a few countries and, if available, has been hard to compare because different data sources and methodologies have been used. The available evidence has now been substantially extended by the first-time econometric analysis with respect to these questions using employee micro data from the European Community Household Panel (ECHP) for twelve of the EU's current member states. Extended versions of Kahn's histogram-location approach have been applied to this data to obtain pooled national and EU wide estimates of the degree of downward nominal wage rigidity. Both, national and EU wide estimates, support the view that downward nominal wage rigidity is a rather widespread phenomenon within the European Union and the Euro Area.

In the literature, psychological or institutional factors are put forward as possible causes of downward nominal wage rigidity. In a companion paper we strive to resolve the contradicting views on the role of institutions as determinants of downward nominal wage rigidity.

Appendix A: Data Selection

In the first wave of the ECHP in 1994 a sample of about 60,000 nationally representative households with approximately 130,000 individuals aged 16 years and over were interviewed in the then 12 Member States. Austria, Finland and Sweden joined the ECHP-project in 1995, 1996 and 1997, respectively. In Belgium and the Netherlands, the ECHP data were derived from the beginning from already existing national panels, namely the Panel Study of Belgium Households (PSBH) and the Dutch Socio-Economic Panel (ISEP). In Germany, Luxembourg and the UK, the first three waves of the ECHP ran parallel to existing national panels, namely the German Socio-Economic Panel (GSOEP), the Luxembourg's Social Economic Panel (PSELL), and the British Household Panel Survey (BHPS). In 1997 (i.e. the fourth wave of the ECHP) the original ECHP surveys were stopped in these countries. Instead, it was decided to integrate ex-post-harmonized national panels into the ECHP. Comparable data were derived from the GSOEP and BHPS back from 1994 onwards, and for the PSELL back from 1995 onwards. Consequently, two sets of data are available for the years 1994 to 1996 for Germany and the UK, and 1995-1996 for Luxembourg. From 1997 onwards data for Sweden is available from the Swedish Living Conditions Survey. However, the Swedish data only contains cross-section information, i.e. individuals are not followed through time. For nine countries (Austria, Denmark, Finland, France, Greece, Ireland, Italy, Portugal and Spain), the ECHP survey ran independently of existing national surveys.

Our analysis focuses on employees working full-time, thereby excluding self-employed and part-time employees from the sample. In the upper part of Table A1 the figures for full-time working employees are depicted for each year for the "long series" of each country. Due to the lack of longitudinal information, the Swedish data cannot be used in our analysis. The PSELL data for Luxembourg are excluded in our study, since these do not contain information on the month of the interview and because information on the year of start of the current job is missing in most cases. Without Sweden and Luxembourg, we are left with 330,404 observations for full-time working employees if only the "long series" of each country is taken into account.

Table A1

In the lower part of Table A1 figures for the "short series" for Germany, Luxembourg and the United Kingdom can be found, which are based on the original ECHP surveys conducted in these countries in the first three years of the ECHP-project. Taken together, the "short series" contain 22,285 observations for full-time working employees.

In our preferred specification we only consider a subsample of full-time working employees, denoted as standard job stayers, see Table 2. Table A2 provides the numbers of standard job stayers for each wave and country, except Sweden, Luxemburg and the Netherlands. As is explained in section 4, the Netherlands cannot be included in the analysis of our preferred specification since information on the monthly activity calendar is missing.

Table A2

Appendix B: Isolated national models

In this appendix we present estimated isolated national models for the twelve countries. In each case the systems described by equation (1) cover bins from 1 to $r_j^{\max}$. Weighted least squares (WLS) estimates are used throughout because of the reasons discussed in section 2. Since national data exhibit differences not only with respect to the variation in location, but also with respect to the level of location, the optimal specification differs for different countries in particular as regards the choices of bin width and measure of location. Hence, starting from a reference specification with binwidth $b = .01$, and location $l_{t,i} = q_{60,t,i}$, binwidth is varied to $b = .015$ and $b = .02$, and location is varied to $l_{t,i} = q_{50,t,i}$, $l_{t,i} = q_{55,t,i}$, and $l_{t,i} = q_{65,t,i}$. These alternative estimates provide more reliable estimates where they entail superior choices of binwidth and measure of location, and in addition comprise a test of robustness.

The first column of Table B1 summarizes the national estimates for the reference specification providing the estimated rigidity coefficients ρ and the corresponding *t*-values. There are positive degrees of rigidity in nine of the twelve countries. Seven countries, Denmark, Belgium, Italy, Greece, Portugal, Austria, and Finland, exhibit statistically significant rigidity coefficients of in the range from 57 to 89 percent. Only in three countries no rigidity is found, viz. France, Ireland, and the United Kingdom.

Table B1

For those countries with sufficient variation of location between their annual distributions wider binwidths can be used. Corresponding estimates can be found in columns (2) and (3) of Table B1. The table makes also clear that for France, Portugal, Germany, and the United Kingdom, there is not sufficient variation of location to estimate the national models for wide binwidths, shedding light on the reliability of the reference estimates in column (1). These are least reliable for that group of countries, since only for the smallest binwidth is there just enough variation in location for the models to be identified. Note that it is this group of countries the two lowest and three of the five lowest estimates of rigidity were obtained.

For those countries with location of their annual distributions sufficiently far to the right, lower percentiles could have been used as measures of location, in particular the median. Corresponding estimates can be found in columns (4) and (5) of Table B1. However, panel b) of Figure 3 shows that in the case of the median for Denmark, Belgium, Italy, Greece, Austria, and Germany, the assumption is violated that the measure of location is greater than zero (and therefore likely to not have been affected by rigidity). Therefore, even if estimates could be obtained in the majority of cases, these should be treated with caution.

If insufficient variation in location and appropriate choice of measure of location are taken into account, the alternative specifications with respect to binwidth and measure of location corroborate the findings of the reference specification. While the estimates for France, Germany, and the UK are rather uncertain, because of the small amount of variation of location in these countries, the overall impression from isolated national estimates confirms the results from pooled models.

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Figures

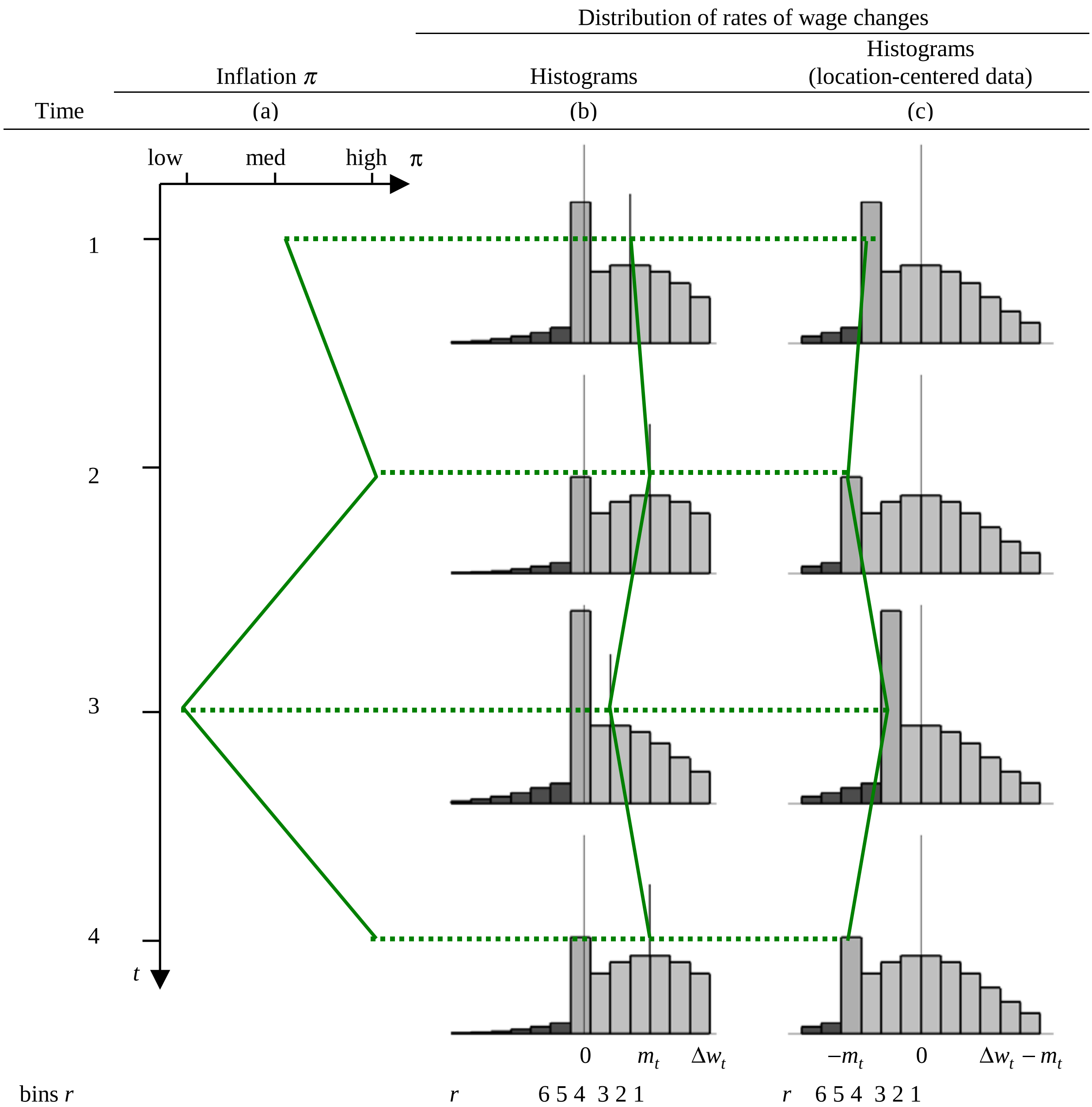


FIGURE 1: PRINCIPLE OF JOINT VARIATION OF LOCATION AND SHAPE

Notes: Variation in inflation (and other determinants of wage changes) leads to variation in location of the distribution of wage changes in column b); the smaller vertical line to the right of the vertical axis indicates annual medians m_t. Downward nominal wage rigidity leads to variation of shape in the left part of the distribution of wage changes.

Variation of shape is even more clearly visible after controlling for location as in column c) by subtracting annual medians from the data and choosing zero as the origin of the histogram.

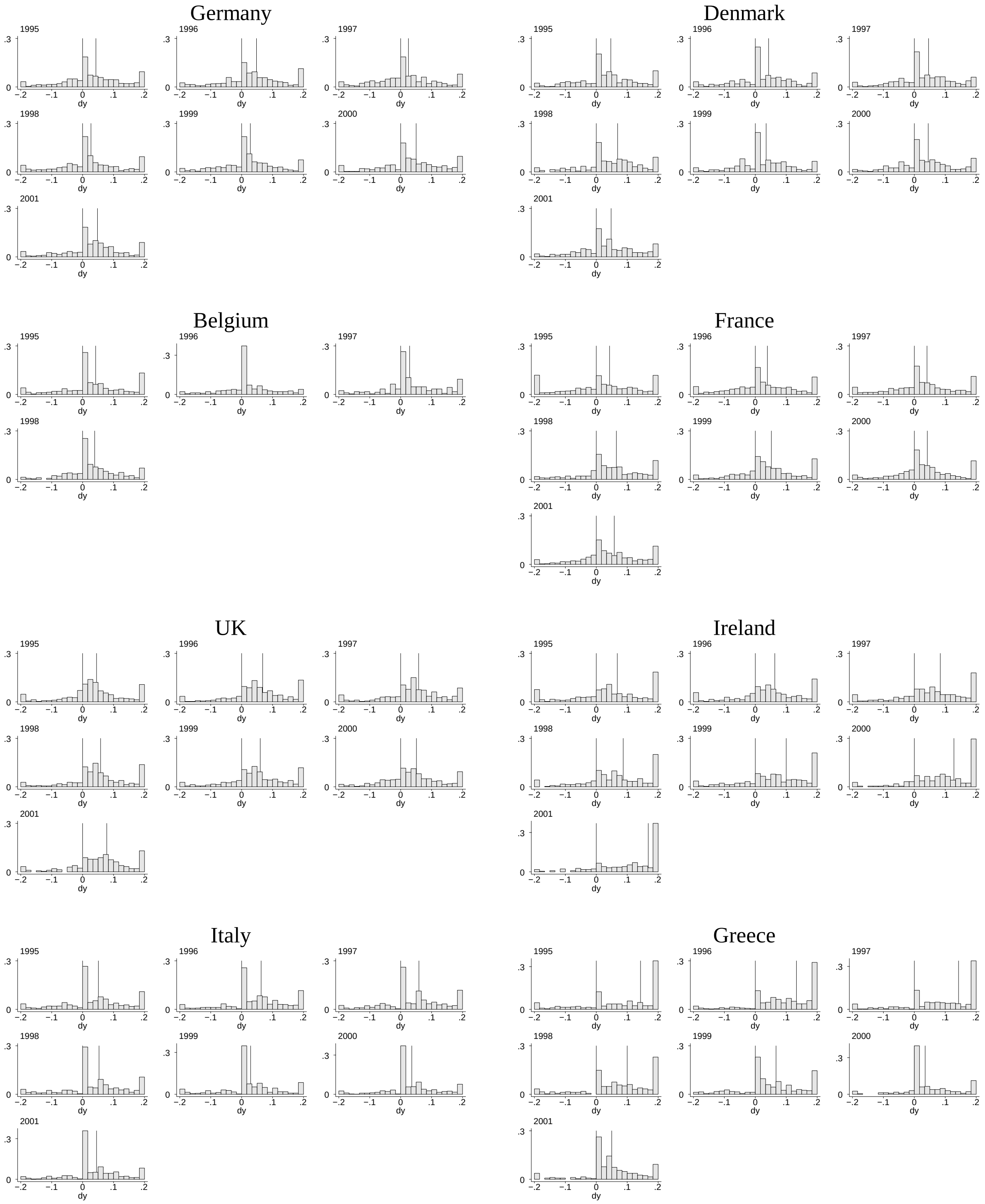


Figure 2 continued on next page

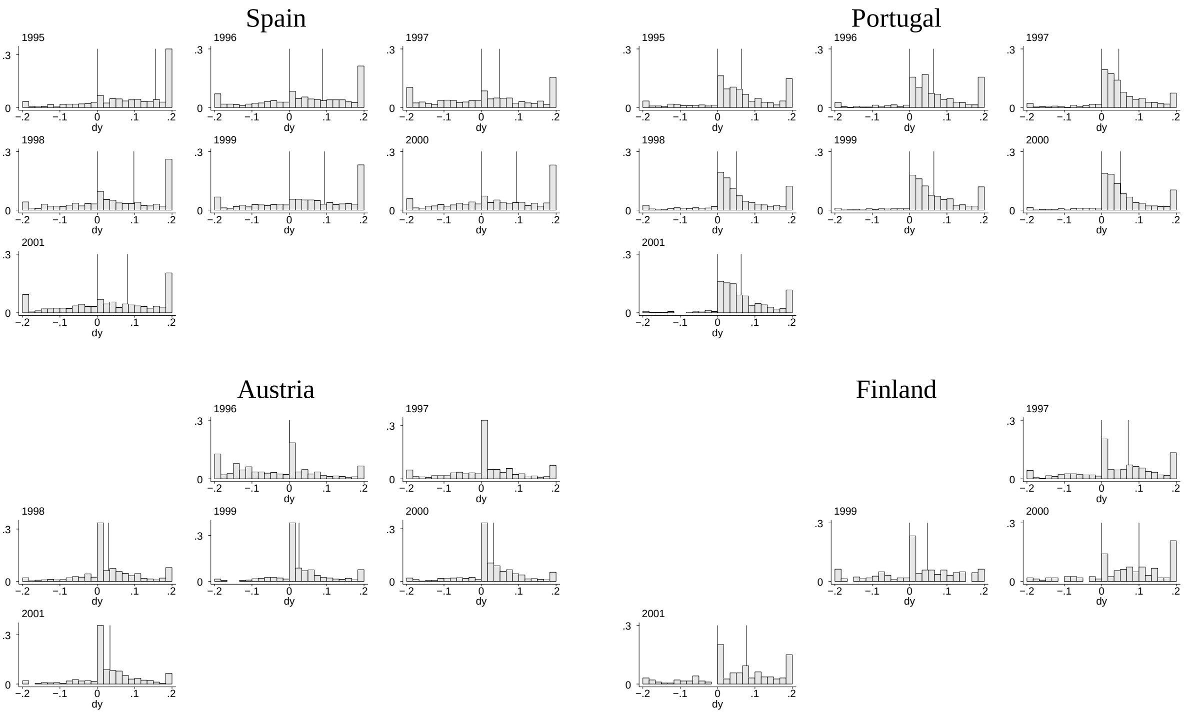
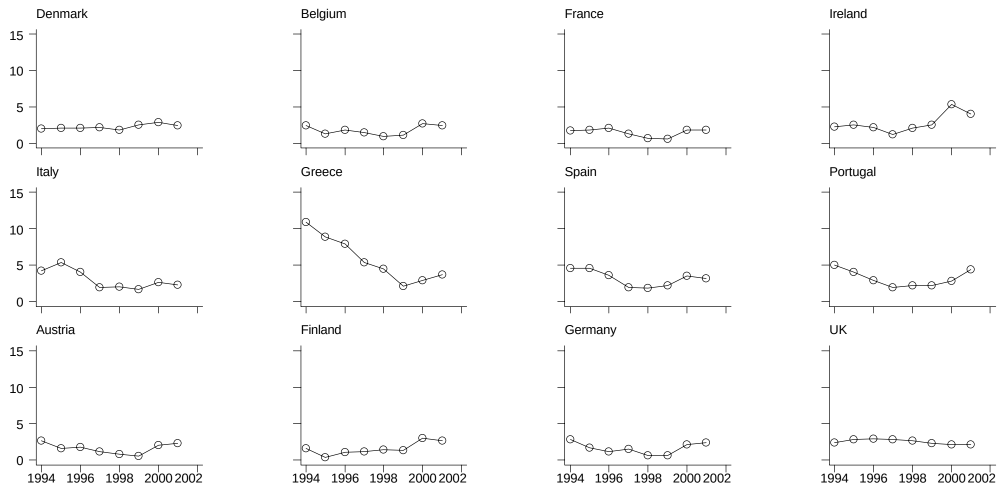


FIGURE 2: HISTOGRAMS OF PER CENT WAGE CHANGES BY COUNTRY AND YEAR

Notes: See text. Exact percentages, bin width $b = .016$, location $l_{t,i} = q_{60,t,i}$. Changes smaller and larger than -20 and +20 percent are included in the left- and rightmost bins, respectively.

a) Inflation



b) Location/Medians

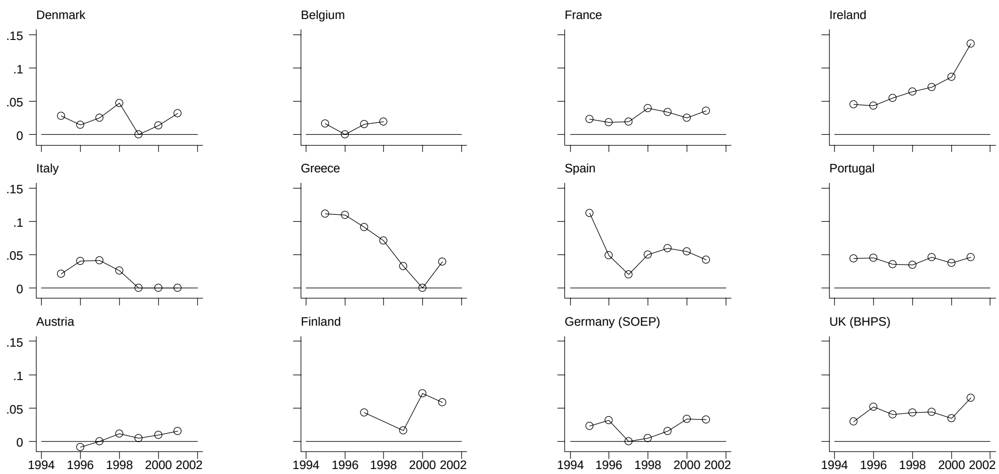


FIGURE 3: LOCATION OF DISTRIBUTIONS OF PER CENT WAGE CHANGES AND INFLATION BY COUNTRY AND YEAR

Notes: See text. Measure of location: median.
Source(s): own computations, OECD.

Tables

TABLE 1: MICRO DATA STUDIES OF DOWNWARD NOMINAL WAGE RIGIDITY OF EUROPEAN COUNTRIES

Europe	**EU**	**Euro Area**	**Country**	**Study**	**Approach**[(a)]
			BEL	Borghijs (2001)	DEA
			DEU	Beissinger and Knoppik (2001)	HLA
				Decressin and Decressin (2002)	HLA
				Fehr, Goette and Pfeiffer (2002)	EFA
				Knoppik and Beissinger (2003)	EFA
				Knoppik and Dittmar (2002)	HLA
			FRA	Goux (1997)	DEA
			ITA	Dessy (1999)[(b)]	n. k.
				Devicienti (2003)	EFA
			GBR	Nickell and Quintini (2001)	DEA
				Smith (2000), Smith (2002)	DEA
			SWE	Ekberg (2003)	SLA
			EU	Dessy (2002b)	DEA
			CHE	Fehr and Goette (2000)	EFA

Notes:

(a) This table covers all European studies independently of the approach used: DEA (descriptive analysis), SYA (symmetry approach), SLA (skewness-location approach), HLA (histogram-location approach), EFA (earnings-function approach).

(b) According to Kramarz (2001), p. 209.

TABLE 2: DETAILS OF THE PREFERRED SAMPLE SELECTION[a)]

	Definitions
"standard job stayers"	• Employees working full-time[b)] • job has not been changed between two consecutive interviews • interviews are at least 8 months and at most 16 months apart • monthly activity calendar is checked in order to secure that the respective person has been in paid employment in each month between interviews[c)] • at most 3 days absence from work in the last 4 weeks (not counting holiday weeks) due to illness or other reasons
"reference specification"	• only male employees • age between 21 years and 65 years • employment in industry or services (i.e. agriculture is excluded) • permanent employment contract • number of working hours did not change between interviews

Notes:

a) Our preferred sample selection relates to standard job stayers who meet the requirements of the reference specification. In the analysis it is also checked how the results change if the sample selection deviates from the preferred specification.

b) Employees working at least 30 hours and at most 60 hours per week in the main job.

c) The calendar information in the ECHP on the main monthly activity always refers to the year preceding the respective wave year. In order not to loose the data of the final wave, we do not require a calendar check for the final wave (the year 2001) in our preferred sample selection.

TABLE 3: STANDARD JOB STAYERS IN THE REFERENCE SPECIFICATION FOR EACH YEAR AND COUNTRY [a)]

Country[b)]	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**[c)]	**Σ**
Austria		——	441	805	757	704	456	811	3,974
Belgium	——	640	566	570	510	12	10	486	2,794
Denmark	——	667	564	488	389	423	390	479	3,400
Finland [d)]			——	699	2	242	238	305	1,486
France	——	1,703	1,563	1,218	1,031	939	934	1,067	8,455
Germany	——	1,530	1,528	1,482	1,323	1,276	1,317	1,399	9,855
Greece	——	763	631	492	440	565	351	378	3,620
Ireland	——	720	670	626	558	448	311	450	3,783
Italy	——	1,789	1,638	1,426	1,273	1,332	1,255	1,391	10,104
Portugal	——	1,134	1,012	1,157	1,168	1,182	901	1,334	7,888
Spain	——	1,224	1,087	1,027	1,005	1,007	1,014	1,183	7,547
UK	——	947	974	929	927	877	819	935	6,408
Σ	——	11117	10674	10,919	9,383	9,007	7,996	11,143	70,239

Notes:

[a)] The definition of standard job stayers and the features of the reference specification are explained in Table 2. For cells marked with a cross the respective wave is not available. Standard job stayers cannot be identified in cells marked with a line, since information on the preceding year is not available.

[b)] Sweden and Luxembourg have to be excluded from the analysis throughout the paper. Since for the Netherlands the calendar information on the main monthly activity is completely missing, this country is not included in the analysis of standard job stayers.

[c)] We leave the year 2001 in the sample of standard job stayers though the monthly activity calendar cannot be checked for the final wave. This explains the rise in observations for the last wave.

[d)] In Finland the spell between interviews exceeded the upper limit of 16 months for most observations in 1998.

TABLE 4: ESTIMATED NATIONAL AND AGGREGATE RIGIDITY COEFFICIENTS

	Reference specification	**Alternative stayer concept**		**Alternative binwidth**		**Alternative location**		
stayer spec.	standard	wide	narrow	standard	standard	standard	standard	standard
basis binwidth	.020	.020	.020	.015	.025	.020	.020	.020
location	q_{60}	q_{60}	q_{60}	q_{60}	q_{60}	q_{50}	q_{55}	q_{65}
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Germany	0.28	0.28	0.27	0.31	0.26	0.27[(a)]	0.28	0.31
	(9.42)	(10.60)	(9.39)	(12.90)	(7.81)	(9.14)	(8.97)	(12.90)
Denmark	0.35	0.39	0.34	0.41	0.32	0.32[(a)]	0.33	0.41
	(12.49)	(15.07)	(10.96)	(17.12)	(9.96)	(10.65)	(10.52)	(17.08)
Belgium	0.47	0.46	0.48	0.48	0.45	0.44[(a)]	0.45[(a)]	0.48
	(13.47)	(13.69)	(12.41)	(14.68)	(11.43)	(11.10)	(11.36)	(13.64)
France	0.23	0.24	0.24	0.21	0.22	0.24	0.23	0.21
	(7.54)	(9.10)	(8.20)	(8.75)	(6.69)	(8.01)	(7.36)	(8.05)
UK	0.14	0.15	0.12	0.10	0.17	0.18	0.17	0.12
	(5.32)	(6.42)	(5.17)	(4.86)	(5.37)	(6.11)	(5.76)	(4.74)
Ireland	0.18	0.14	0.11	0.14	0.20	0.19	0.19	0.12
	(7.03)	(5.95)	(4.08)	(6.09)	(6.77)	(6.54)	(6.15)	(5.10)
Italy	0.66	0.68	0.62	0.70	0.57	0.56[(a)]	0.58	0.64
	(22.38)	(26.79)	(19.67)	(27.98)	(17.06)	(18.83)	(18.77)	(23.33)
Greece	0.43	0.43	0.46	0.45	0.43	0.50[(a)]	0.48	0.44
	(16.86)	(17.64)	(10.43)	(20.53)	(15.17)	(16.18)	(14.80)	(18.41)
Spain	0.07	0.08	0.07	0.07	0.04	0.07	0.04	0.10
	(2.60)	(3.53)	(2.91)	(3.02)	(1.18)	(2.17)	(1.26)	(4.39)
Portugal	0.41	0.40	0.40	0.38	0.46	0.48	0.42	0.37
	(15.13)	(16.48)	(16.36)	(17.28)	(15.20)	(15.85)	(13.52)	(16.40)
Austria	0.45[(a)]	0.49[(a)]	0.43[(a)]	0.50[(a)]	0.42[(a)]	0.47[(a)]	0.48[(a)]	0.50[(a)]
	(16.36)	(18.21)	(15.0)	(21.67)	(13.36)	(13.61)	(14.77)	(18.96)
Finland	0.46	0.43	0.47	0.45	0.42	0.36	0.41	0.48
	(12.99)	(15.80)	(11.65)	(16.17)	(11.23)	(8.77)	(9.55)	(14.41)
EU	.36	.36	.32	.37	.34	.33	.33	.34
	(25.17)	(26.06)	(21.95)	(28.30)	(22.59)	(21.30)	(20.22)	(26.10)

Notes: The table contains estimated national and aggregate rigidity coefficients ρ_j from closed pooled models (*t*-values in parentheses). The reference specification with basis binwidth $b = .02$ (see text), location $l_{t,i} = q_{60,t,i}$, and standard stayer specification has been varied in alternative specifications with respect to the stayer specification (wide, narrow), with respect to basis binwidth (.015, .025) and with respect to location (q_{50}, q_{55}, q_{65}). Also see text.

[(a)] Assumption of measure of location greater than (nominal) zero at least in one year violated, see also Figure 3.

TABLE A1: FULL-TIME WORKING EMPLOYEES IN THE EIGHT WAVES OF THE ECHP (1994-2001) [a)]

Country	Source[b)]	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**Σ**
Austria [c)]	ECHP	X	2,715	2,647	2,559	2,406	2,277	2,113	2,020	**16,737**
Belgium	ECHP	2,465	2,242	2,180	2,082	1,963	1,858	1,786	1,679	**16,255**
Denmark	ECHP	2,685	2,576	2,369	2,241	2,094	2,018	1,935	1,934	**17,852**
Finland[c)]	ECHP	X	X	3,238	3,194	3,121	3,061	2,543	2,519	**17,676**
France	ECHP	4,974	4,732	4,715	4,274	3,572	3,484	3,527	3,648	**32,926**
Germany	GSOEP	5,254	5,337	5,143	4,922	4,609	4,612	4,484	4,277	**38,638**
Greece	ECHP	2,603	2,587	2,383	2,281	2,183	2,016	2,056	2,183	**18,292**
Ireland	ECHP	2,975	2,532	2,235	2,147	2,013	1,825	1,498	1,309	**16,534**
Italy	ECHP	4,877	4,937	4,937	4,477	4,333	4,046	4,012	3,762	**35,352**
Luxemburg [c) d)]	PSELL	X	——	——	——	——	——	——	——	——
Netherlands	ECHP	3,141	3,347	3,357	3,276	3,267	3,291	3,371	3,361	**26,411**
Portugal	ECHP	3,771	4,062	4,121	4,168	4,203	4,219	4,269	4,270	**33,083**
Spain	ECHP	4,564	4,181	4,096	3,968	3,868	3,892	3,869	3,839	**32,277**
Sweden [c) d)]	ECHP	X	X	X	——	——	——	——	——	——
United Kingdom	BHPS	3,407	3,366	3,469	3,603	3,669	3,643	3,643	3,571	**28,371**
	Σ	**40,716**	**42,614**	**44,861**	**43,192**	**41,301**	**40,242**	**39,106**	**38,372**	**330,404**

										Σ
Germany [c)]	ECHP	3,778	3,569	3,409	X	X	X	X	X	**10,756**
Luxemburg [c)]	ECHP	834	800	779	X	X	X	X	X	**2,413**
United Kingdom [c)]	ECHP	3,613	2,991	2,512	X	X	X	X	X	**9,116**
	Σ	**8,225**	**7,360**	**6,700**	X	X	X	X	X	**22,285**

Notes:

[a)] The figures refer to employees working at least 30 hours and at most 60 hours per week in the main job.

[b)] Source: ECHP: original ECHP data; GSOEP, PSELL, BHPS: data are merged to the ECHP by using the respective national panel.

[c)] For cells marked with a cross the respective wave is not available.

[d)] The data for Luxemburg (PSELL) and Sweden are excluded since they cannot be used in the analysis.

TABLE A2: STANDARD JOB STAYERS IN EACH YEAR AND COUNTRY [a)]

		1994	1995	1996	1997	1998	1999	2000	2001	Σ
Austria	ECHP		——	688	1,266	1,140	1,092	707	1,303	**6,196**
Belgium	ECHP	——	1,091	971	939	845	801	737	840	**6,224**
Denmark	ECHP	——	1,283	1,151	1,013	845	1,014	874	1,088	**7,268**
Finland[b)]	ECHP			——	1,439	4	1,126	1,109	1,330	**5,008**
France	ECHP	——	3,043	2,768	2,188	1,845	1,713	1,711	1,996	**15,264**
Germany	GSOEP	——	2,571	2,576	2,455	2,333	2,217	2,205	2,404	**16,761**
Greece	ECHP	——	1,285	1,085	871	775	1,015	622	758	**6,411**
Ireland	ECHP	——	1,141	1,066	1,009	943	744	515	761	**6,179**
Italy	ECHP	——	2,772	2,583	2,303	1,996	2,086	2,004	2,375	**16,119**
Netherlands	ECHP	——	——	——	——	——	——	——	——	——
Portugal	ECHP	——	2,287	2,105	2,348	2,415	2,473	2,393	2,859	**16,880**
Spain	ECHP	——	2,113	1,925	1,837	1,733	1,759	1,817	2,163	**13,347**
United Kingdom	BHPS	——	1,637	1,723	1,672	1,694	1,617	1,480	1,726	**11,549**
	Σ	——	**19,223**	**18,641**	**19,340**	**16,568**	**17,657**	**16,174**	**21,332**	**128,935**

Notes:

[a)] The characteristics of “standard job stayers” are summarized in the upper part of Table 2. As is explained in the notes to Table 2, the calendar on the main monthly activity cannot be checked for the final wave. We nevertheless leave the year 2001 in the sample of standard job stayers. This explains the rise in observations for the last wave. Since for the Netherlands the monthly calendar information is completely missing, this country is not included in the analysis of standard job stayers.

[b)] In Finland the spell between interviews exceeded the upper limit of 16 months for most observations in 1998.

TABLE B1: ESTIMATED ISOLATED NATIONAL RIGIDITY COEFFICIENTS

	Reference Specification	**Alternative Binwidth**		**Alternative Location**		
binwidth	.010	.015	.020	.010	.010	.010
location	q_{60}	q_{60}	q_{60}	q_{50}	q_{55}	q_{65}
	(1)	(2)	(3)	(4)	(5)	(6)
Germany	.195	.044	- (a)	.114(b)	-.141	.064
	(1.52)	(0.19)		(0.93)	(-0.7)	(0.63)
Denmark	.597	.637	.601	.613(b)	.489	.588
	(10.04)	(7.56)	(5.87)	(6.57)	(7.39)	(7.77)
Belgium	.894	.612	.407	- (a) (b)	.486(b)	.827
	(4.75)	(4.67)	(2.16)		(1.23)	(4.44)
France	-.222	.125	- (a)	.253	.075	-.054
	(-0.57)	(0.62)		(1.46)	(0.33)	(-0.21)
UK	-.126	-.239	- (a)	-.085	.084	.013
	(-1.31)	(-2.06)		(-1.01)	(2.05)	(0.24)
Ireland	-.112	-.116	-.095	.096	-.166	-.147
	(-1.33)	(-1.88)	(-1.32)	(2.05)	(-2.77)	(-1.46)
Italy	.805	.796	.887	.446(b)	.669	- (c)
	(4.52)	(4.09)	(2.87)	(3.05)	(3.66)	
Greece	.655	.688	.640	.686(b)	.649	.606
	(14.18)	(16.23)	(13.93)	(11.56)	(13.48)	(13.89)
Spain	.112	.015	-.014	.138	.018	.194
	(1.9)	(0.33)	(-0.29)	(3.83)	(0.58)	(2.68)
Portugal	.574	- (a)	- (a)	- (a)	- (a)	.374
	(3.29)					(1.37)
Austria	.975(b)	.266(b)	.849(b)	- (a) (b)	.791(b)	.882(b)
	(3.37)	(0.68)	(8.84)		(5.75)	(5.43)
Finland	.676	.481	.522	.726	.187	.993
	(6.18)	(8.45)	(7.6)	(19.07)	(0.98)	(36.07)

Notes: The table contains estimated national rigidity coefficients ρ_j (*t*-values in parentheses). The reference specification 'b010' (col. 1) with bin width $b = .01$, location $l_{t,i} = q_{60,t,i}$, and exact percentages has been varied in alternative specifications with respect to binwidth (b015, b020) and with respect to location (l50, l55, l65). Systems were chosen to cover bins from one to r_j^{max} for each country j. Also see text.

(a) Estimation not feasible for this specification because of insufficient variation in location, $r_j^{max} - r_j^{min} \le 1$.

(b) Assumption of measure of location greater than (nominal) zero violated, see also Figure 3.

(c) No convergence achieved.