Wage Flexibility and Employment Performance: A Microdata Analysis of Different Age-Education Groups in German Industries[†]

Thomas Beissinger[*] and Joachim Moeller[*‡]

[*] *Department of Economics, University of Regensburg*
Universitaetsstr. 31, D-93040 Regensburg, Germany

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Abstract

The paper analyses the hypothesis that structural unemployment in Germany has risen because rigid relative wages hindered the necessary adjustments in the face of a substantial shift in demand against the unskilled. Observing that the descriptive evidence is inconclusive, we develop a theoretical framework with imperfect competition on the labor market that enables us to investigate the wage and employment dynamics for narrowly defined age-by-education-by-industry cells. Using a large micro data set, we present SUR cross-section estimates of the employment and wage equations derived from this model. Our results indicate that wages of male workers did respond to relative labor demand shifts, and this reaction was strong enough to prevent corresponding changes in the employment structure. For female workers, however, the evidence is more supportive to a rigidity explanation of their poor labor market performance.

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[‡]Corresponding author: Prof. Dr. Joachim Moeller, Department of Economics, University of Regensburg, Universitaetsstr. 31, D-93040 Regensburg, Germany, phone: (..49) (941) 943-2550, fax: (..49) (941) 943-2735, e-mail: Joachim.Moeller@wiwi.uni-regensburg.de.

1 Introduction: Unemployment and poverty as two sides of the same coin?

In view of a sustained increase of the unemployment rate in the European OECD countries, reaching eleven percent in 1996, Europe has to deal with gloomy labor market prospects. The unemployment figures are in sharp contrast to the corresponding U.S. data showing no upward trend and in recent years even a steady decline. As Europe and the United States differ considerably with regard to the institutional framework, many economists come to the conclusion that obsolete regulations lie at the root of the unemployment problem in most of the European countries. Although this argument seems plausible, it has to be explained, why the European unemployment problem was less severe in former decades. For some observers *changes* in European labor market institutions led in the wrong direction in the last 25 years or so.[1] Others argue that institutions did not change substantially but that the European welfare states had not been able to cope with the economic turbulences since the mid-seventies.[2] Especially Germany, once envied its "Wirtschaftswunder" is now blamed for the "Wirtschaftsblunder" since half-hearted labor market reforms did not foster greater wage flexibility.[3]

Because of the intuitive appeal of the rigidity explanation of European unemployment it comes as no surprise that especially wage inflexibility is a major theme on the European economic policy agenda. To capture the extent of (real) wage rigidity prevailing in an economy, several empirical studies estimate aggregate wage equations and explain the extent to which the real wage responds to aggregate unemployment by institutional settings.[4] In spite of the plausibility that rigidity arguments might have at first glance, however, empirical studies at the aggregate level reveal no simple relationship between the institutional framework and the unemployment record.[5]

In some recent papers, therefore, the focus has shifted to a different concept of wage rigidity concerning the adaptability of relative wages to asymmetric labor demand and supply shocks for different groups of workers. As a prerequisite for this kind of flexibility society has to accept

[1] See Siebert (1997) for a recent statement of this view.

[2] This position is explicitly expressed, for example, by Ljungqvist and Sargent (1997). Implicitly it lies behind the theoretical and empirical work of Layard *et al.* (1991) as well.

[3] See the Economist from February 7th, 1998, p. 17.

[4] The most prominent example is the work of Layard *et al.* (1991).

[5] See, for instance, Nickell (1997).

a higher inequality of the earnings distribution. Adherents of radical labor market reforms point to the higher wage dispersion in the United States as compared to most OECD countries which, in their opinion, can serve as a model for others. Indeed there is no doubt about the United States having experienced higher increases in the dispersion of both individual earnings and total household income than most of the developed countries since the seventies.[6] Admittedly, the earnings dispersion increased as well in many other countries during the eighties, but only in the United Kingdom the trend towards more inequality was similarly pronounced.[7] At the same time, the United States have outperformed the other industrialized countries with respect to employment growth.

Due to these facts the "two-sides-of-the-same-coin" hypothesis, as originally formulated by Krugman (1994) has found widespread acceptance.[8] This hypothesis states that an economy in face of a relative demand shift favoring skilled labor could choose between *Skylla* and *Carybdis*. Some countries as the United States have opted for "more inequality" and working poor, others, as most of the European countries, for "more unemployment", especially among the unskilled.[9] As a reflection of this, the American policy debate is mainly on the profound issues of equity and social cohesion raised by declining living standards at the low end of the wage distribution, while the European debate is on mass unemployment.

With respect to Germany there exists some *prima facie* evidence in favor of the Krugman hypothesis. The German wage distribution is often characterized as a bulwark against the trend towards higher wage dispersion that is observed in most of the developed countries. For example, Gottschalk and Smeeding in a recent survey claim that only Italy and Germany form a small group of countries that experienced no measurable increase in earnings inequality during the 1980's.[10] Whereas - according to OECD (1996) findings - the earnings dispersion in Italy has

[6] See Gottschalk and Smeeding (1997) and OECD (1993, 1996) for a survey of cross-national comparisons of earnings and income inequality. The vast literature documenting the changes in earnings inequality in the United States in the 1970's and 1980's is reviewed in Levy and Murnane (1992).

[7] According to OECD (1996) the United States and the United Kingdom also stand out as the only countries where a marked trend towards higher earnings inequality has continued during the nineties.

[8] See also Freeman (1995) for a clear statement of that view and Howell *et al.* (1998) for a critical assessment of the empirical literature evaluating the Krugman hypothesis.

[9] Behind the Krugman hypothesis implicitly lies the idea that all industrialized countries were affected by the same kind of relative shifts in labor demand, that outweighed shifts in relative supply. However, some studies show that the increasing inequality in the United States is not only due to relative demand shifts but to a considerable part also to the reduction in the real minimum wage and the decline in union density. See for instance Fortin and Lemieux (1997).

[10] Gottschalk, Smeeding (1997, p. 652).

increased in recent years due to substantial labor market reforms, Germany seems to remain the only country in which the earnings distribution has continued to become even more compressed. As a consequence, a recent IMF study does not hesitate to offer the following explanation of Germany's poor labor market performance: "... the main reason for the observed segmentation [between those who work and those who have been excluded from the labor market, the authors] is the German system of centralized collective bargaining, which, in combination with generous social benefits, has resulted in a compression of the wage structure between firms as well as between skill levels"[IMF (1995), p. 170].

A closer look at the evidence reveals that no consensus about the prevailing trends of the wage dispersion in Germany exists, however. Partly, the results seem to depend on the data source employed. The OECD findings of a wage compression in Germany since the eighties are based on the German Socio-Economic Panel.[11] Using data from the Employment Register of the Federal Labor Office, the so-called "IAB-Beschaeftigtenstichprobe" (IAB-BST for short), Steiner, Wagner (1996) come to the end that the development of the wage distribution is rather flat, while Bellmann, Moeller (1995) and Moeller (1995) find evidence of an increasing overall dispersion.

In any case, since the careful analysis of Blau and Kahn (1996) it can be taken as an established fact that wage inequality in Germany and other European countries in *the lower tail of the distribution* is quite smaller than in the United States. These authors find that institutional features, such as high rates of unionization and collective bargaining coverage, can explain a large part of these differences. They also present evidence that inequality in the upper tail of the distribution as measured by log percentile ratios is not markedly different between European countries and the United States. With respect to Germany, recent studies reveal that significant changes took place beneath the relatively calm surface of the overall wage dispersion. For example, Fitzenberger (1996) and Fitzenberger, Franz (1997) show that – compared to a medium category – the wages of unskilled and highly skilled workers increased from the late seventies to the end of the eighties. From the end-seventies to the mid-eighties, Moeller (1998) finds evidence of wage compression in the lower part of the distribution, especially for unskilled male workers. This tendency is reversed in the second half of the decade. In contrast to

[11] For the eighties, the study of Abraham and Houseman (1995) on earnings inequality in Germany relies on the Socio-Economic Panel as well.

the U-shaped development in the low-wage segment, wage inequality in the upper tail of the distribution has been steadily increasing during the eighties. Moreover, wage-function estimates indicate that within-group dispersion has been widening, especially for workers with medium and higher qualification.

Attempts to evaluate the Krugman hypothesis more carefully have also to consider the relative employment records of different groups. The evidence on this field appears to be not very clear-cut as well. On the one hand, Blau and Kahn (1996) find that employment/population ratios for the unskilled tend to be lower in those countries where the earnings distribution is compressed. For Germany, empirical findings suggest that unemployment among the unskilled is an essential part of the unemployment story.[12] Based on econometric estimates of a translog cost function and the corresponding share equations, Fitzenberger, Franz (1997) come to the conclusion that a higher dispersion in the lower tail of the wage distribution would foster a more equal distribution of unemployment among skill groups. On the other hand, Nickell, Bell (1995, 1996) have argued against the two-sides-of-the-same-coin hypothesis pointing to the fact that relative demand shifts against the unskilled explain only a modest proportion of the overall rise in unemployment in Europe. This position is corroborated by the OECD (1996) study showing no significant tendency for employment to be lower and unemployment to be higher for inexperienced or low-skilled workers in countries with relatively few low-paid jobs available.

Because of the contradictory evidence it seems worthwhile to re-examine the facts. Confining our analysis to Germany[13] we seek to find new evidence on this relative wage flexibility debate using the IAB-BST. After describing this large micro data source in more detail in section 2, we present some descriptive evidence with respect to the labor market performance of different age-education groups in section 3. Section 4 refers to recent approaches in the literature being relevant for the evaluation of the two-sides-of-the-same-coin hypothesis and describes some own empirical results. We proceed in two steps. Building on the work of Nickell, Bell (1995, 1996) we first deal with the question whether the observed labor market developments can mainly be attributed to relative demand shocks as implied by the Krugman hypothesis. By adopting an approach suggested by Card, Kramarz and Lemieux (1996), we then try to find evidence on the wage and employment responses to idiosyncratic shocks. In order to obtain a high-

[12] See for instance Buttler, Tessaring (1993) and Steiner, Wagner (1997).

[13] Throughout the paper Germany refers to West Germany prior to unification in 1990.

resolution picture of wage/employment relations we group the population into a variety of cells, distinguished not only by gender, education and age as in the aforementioned study, but also by industry. The core of our paper is presented in section 5 where we develop and estimate a theoretical model that enables us to investigate the two-sides-of-the-same-coin hypothesis more explicitly. Using a framework with imperfect competition, industry-specific labor demand and wage setting are considered simultaneously. As a by-product, this approach also allows us to estimate the elasticity of substitution between skilled and unskilled labor. The paper ends with a summary and conclusions in section 6.

2 Data

The main data employed in our study are from the so-called IAB-Beschaeftigtenstichprobe (IAB-BST), which was made available for scientific use only in 1996.[14] The IAB-BST is a representative 1%-sample drawn from the Employment Register of the Federal Employment Services for 1975–1990. It also contains information about persons receiving unemployment benefits. It should be stressed that this large micro data source is especially suitable for disaggregated studies of the wage and employment structure. The social insurance procedure introduced in 1973 compels employers to report at least once a year all earnings above a certain minimum for those employees who are subject to a health or unemployment insurance or who are participating in a pension scheme. It can be argued that the quality of the data is comparatively high. There are legal sanctions for misreporting, and classification into industries is performed by experts of the Federal Employment Services. As shown by comparisons with Microcensus data, the register practically covers all dependent employment in the private sector, i.e. almost 80 per cent of total employment in the Federal Republic of Germany. The remaining 20 percent consist of civil servants, self-employed, unpaid family workers and people who are not eligible for social security because their earnings and/or working-time are too low. Altogether the IAB-BST includes nearly 5.8 million data records that contain information of 427,018 individuals.

A certain drawback of the data set under consideration is that it is truncated to the left (because of the exclusion of minor employment) and censored to the right (because of the

[14] See Bender *et al.* (1996) for a detailed description of the IAB-BST.

contribution assessment ceiling in the social security system).[15] The former should cause no trouble because we are considering full-time employed males and females only, a group for which social insurance is compulsory.[16] On the other hand, censoring on the right side of the earning scale is a severe problem that - if not considered explicitly - could lead to wrong conclusions.

As a first step for our analysis we chose all persons from the IAB-BST who were in that sample on the 1st of July in the years 1980, 1984, 1985 and 1990.[17] From the resulting subsamples we select all German full-time workers who are at least 18 years and at most 55 years old. With respect to age we divide workers into seven groups: persons aged 18-25, 26-30, 31-35, 36-40, 41-45, 46-50, 51-55. Workers older than 55 are excluded because labor market participation of this age group was influenced by different policy measures within the observation period.[18]

Throughout the paper, employees are classified into three qualification groups:

1. *unskilled*: persons with a lower schooling level and no further occupational qualifications completed; this group includes lower secondary school (*Hauptschule*) and intermediate secondary school (*Realschule*) graduates who did not complete an apprenticeship or graduate from a full-time vocational school;

2. *skilled*: persons with an occupational qualification, which might be either a completed apprenticeship or graduation from a vocational school;

3. *graduates*: persons holding a secondary school leaving certificate (*Abitur*) and a degree for university or polytechnics type of higher education (this refers to "Fachhochschule" in the German system).[19]

For the division into age and education groups the number of recipients of unemployment benefits are computed from the same data source. Due to the aforementioned restrictions and the

[15] For persons whose earnings exceed this ceiling the actual amount of earnings is unknown. Members of this group appear with the contribution assessment ceiling (*Beitragsbemessungsgrenze*) in our data set.

[16] The limits of so-called "minor employment" are so low that a full-time employee exceeds this limit almost with probability one.

[17] The respective figures are: 216,666 persons in 1980, 218,924 persons in 1984, 220,854 persons in 1985 and 230,548 persons in 1990. If individuals had more than one employment contract at the same time we considered only the first.

[18] Additionally we find it reasonable to exclude all cases where earnings fall below twice the limit of minor employment because it is very likely that they represent data errors.

[19] In our classification we neglect the following categories of the IAB-BST: individuals with and without vocational training holding a secondary school leaving certificate, but no degree for university or polytechnics type of higher education.

exclusion of records with missing values for the interesting variables, we are left with 128,266 persons in 1980, 129,236 persons in 1984, 128,293 persons in 1985 and 132,804 persons in 1990.

3 Some descriptive results

Table 1 gives some basic information about changes in the structure of employment in Germany in the eighties. Firstly, it can be observed that the workforce becomes more qualified. From 1980 to 1990 the share of the unskilled in total employment fell from 20.4% to 16.4% for males and from 31.1% to 22.0% for females.[20] The share of skilled workers slightly increased for men, and markedly for women. For both genders, highly qualified workers were the winners of the profound change in the employment structure. During the eighties male graduates increased their proportion by almost half of the share they had in 1980 (from 6.1 to 9.0 percent). Starting from a lower level, female graduates doubled their share within a decade. These observations correspond well with the global trend towards a higher skill intensity of production.[21]

Secondly, it has to be noted that unemployment rates are highest among the unskilled for both genders. Except for the high unemployment rate of female graduates, the unemployment rate falls with the qualification of the group considered. Also with regard to *changes* of the unemployment rate, the unskilled seem to be in a relatively bad position. For instance, from 1980 to 1990 the unemployment rate for unskilled men increased by 6.3 percentage points from 3.3% to 9.6%, whereas the unemployment rates for skilled workers and graduates increased only by 1.6 and 0.8 percentage points, respectively.[22] This evidence seems to corroborate the two-sides-of-the-same-coin hypothesis. It has to be emphasized, however, that from 1980 to 1990 the unemployment rates of *all* skill groups have risen. Therefore, also macroeconomic shocks being neutral with respect to skill have to play a role in an explanation of the German unemployment problem.

[20] On the other hand the share of the male unskilled unemployed persons in total unemployment increased from 37% to 39% whereas the share of the female unskilled unemployed decreased from 40% to 36%.

[21] As evidence of the United States see for instance Johnson (1997). A further discussion of the German qualification trends can be found in Fitzenberger, Franz (1997) and Steiner, Mohr (1998).

[22] The same unfavourable picture for the unskilled emerges if proportional changes instead of percentage-point increases are considered. Whereas the unemployment rate of the male unskilled nearly tripled from 1980 to 1990, the unemployment rate of the skilled only doubled. For the graduates the unemployment rate in 1990 was merely 1.7 times as high than in 1980. The only exception is the high proportional increase for female graduates. For this group, however, the figures have to be interpreted with some caution because of small cell sizes.

Thirdly, a closer look at the data reveals that within the time period considered the development was quite uneven. From 1980 to 1985 unemployment of unskilled men dramatically increased and their unemployment rate quadrupled. Also for unskilled women, the unemployment rate sharply increased in that period. Surprisingly, however, the situation for the unskilled obviously improved from the mid-eighties to the (unification boom) year 1990. One has to conclude that it is crucial to take the business cycle into account in any interpretation of skill-specific labor market developments.

As a next step we examine the unemployment trends for the three different skill groups more closely by differentiating between seven age groups (see *table 2*). In general, unemployment rates are highest for younger workers. This is especially true for the unskilled in 1980 and 1985 where unemployment rates of the lowest age groups are about three times those of the highest. In our sample, more than one out of four male unskilled workers aged 18 to 25 was unemployed in 1985. With an unemployment rate of 21.6 percent, the labor market situation for young unskilled female workers was only slightly better.

What seems surprising are the profound changes in the age structure of unemployment, especially for men. Unemployment in the lowest age group fell substantially in the second half of the decade. By contrast, unemployment of the higher age groups did not change very much. Comparing the years 1990 and 1980 and considering especially unskilled and skilled workers it has to be stressed that percentage-point increases in unemployment rates are very similar across age groups and sometimes higher for older workers.[23] In proportional terms the increase in the unemployment rates of older workers is therefore even more pronounced. This finding seems to be at odds with the two-sides-of-the-same-coin hypothesis, since older (i.e. more experienced) workers in the United States belong to the winners of the development of relative wages in the eighties.[24]

Table 3 contains information about the employment developments in manufacturing and services by gender, age and skill group. To keep things manageable, age cells 1 and 2, 3 to 5 and 6 and 7 were grouped together. As an interesting fact, younger workers of all categories had a better performance in manufacturing than in the service sector. With respect to male workers,

[23] It could be suspected that this result is due to institutional changes with regard to older workers. It should be noted, however, that for that reason workers older than 55 years are already excluded from our sample.

[24] Although for unskilled female workers unemployment remained quite high in the lowest age groups, there is evidence that younger workers had a better performance in the second half of the decade as well.

the lowest age category of each skill group increased its employment share in manufacturing but not in the service sector from 1980 to 1990. For female unskilled and skilled workers the employment share of younger workers decreased in manufacturing, but the decline in services was even more pronounced.[25] This helps to explain the relatively stubborn unemployment rate of younger female workers that did not fall very much from 1985 to 1990. By contrast, male and female workers with higher experience increased their employment share especially in the service sector.

Summarizing the evidence so far: On the one hand, the labor market performance of younger workers and employees with lower skills is worse than the employment performance of other groups. This seems to corroborate the two-sides-of-the-same-coin hypothesis, because the same groups of workers are suffering from heavy declines in relative wages in the United States.[26] On the other hand, the employment prospects for the unskilled are not uniformly deteriorating across age groups, industries and time. In the next section, therefore, we try to get more evidence for or against the two-sides-of-the-same-coin hypothesis.

4 First evidence on the Krugman hypothesis

4.1 Relative versus neutral shifts in labor demand

According to the Krugman hypothesis the higher (*percentage-point-*) increases of unskilled unemployment rates in Germany have to be regarded as the consequence of relative labor demand shifts in combination with rigid relative wages. In this context, many authors stress technological change as the key factor driving changes in relative demand, but some economists also focus on increasing competition from less developed countries.[27] Since it is argued that relative labor demand shifts also explain most of aggregate unemployment, these explanations obviously are at odds with macroeconomic explanations of the unemployment problem focusing for instance on aggregate fluctuations in the demand for goods.

It is therefore an interesting question whether the change in the distribution of unemployment rates is due to relative or neutral labor demand shocks. Certainly, a relative demand shift against

[25] Again the figures for female graduates have to be interpreted with caution because of small cell sizes.

[26] See for instance Bound and Johnson (1992).

[27] See Wood (1994) among others. For an analysis of the impact of trade on the German labor market see Fitzenberger (1996).

the unskilled that exceeds the relative supply shift in the same direction will typically raise the unemployment rate of the unskilled and reduce that of higher qualified labor. But because the unemployment rate has risen for all skill groups, the evidence can only be explained if one also refers to adverse labor demand shocks being neutral with regard to skill and superimposed on the relative shocks. The first-round consequence of a neutral shock is a equiproportionate fall in employment for each skill group at *given* relative wages. As Nickell, Bell (1995, 1996) argue, this amounts more or less to equal *percentage-point* increases in unemployment rates by skill, i.e. the proportional increase in unemployment is higher for skilled workers. Assuming that wages are related to unemployment in a log-linear fashion, Nickell and Bell show, however, that in a second round the relative wage of skilled workers decreases pushing the unemployment effects by skill away from equal percentage-point increases towards *equiproportionate* increases.

According to this argument we can expect the unemployment consequences of neutral shocks to lie somewhere between equal *percentage-point* and *equiproportionate* increases. Hence we compute the contribution of neutral and relative demand shifts to the overall rise in unemployment for both the extreme cases along the lines of Nickell and Bell (1996).[28] As a rough approximation we suppose that the size of the neutral shock is captured by the rise in unemployment of a reference group.[29] Then we calculate the neutral shift either as an equal percentage-point or as an equiproportionate shift of the unemployment rates for all groups. Since the remainder of the increase in unemployment for less skilled workers is due to the relative demand shock, we are able to determine the impact of the relative demand shock.

Table 4 describes the percentage contribution of relative factor demand shifts to the overall rise in unemployment from 1980 to 1990. We present the calculations in two versions with skilled workers and, alternatively, graduates as a reference group. Using the medium skill category for this purpose, we find that between 1/5 and about 1/3 of the total change in male unemployment can be attributed to non-neutral shifts in labor demand. For female workers the difference between both variants of the estimates is smaller, ranging from about 1/3 to 1/4. Since the unemployment performance of male graduates is the best of all groups considered, percentage contributions of non-neutral shifts in labor demand to the rise in overall unemployment are higher

[28] In the parameterized model of Nickell and Bell (1995) the unemployment consequences of a neutral shock are fairly close to equiproportional changes. If wages are rigid, however, changes in unemployment can be expected not to differ very much from equal-percentage-point increases.

[29] We neglect therefore the fall in unemployment of the reference group generated by the relative shock.

with this group as a reference. For male workers we then get a proportion roughly between 1/2 and 2/3. For female workers these figures turn out to be negative, because the labor market performance of the highest qualification group is worse than for the medium group.

As becomes evident from *table 4*, the proportion of the overall rise in unemployment attributed to relative shifts in labor demand depends heavily on the assumptions made in the calculations. In any case, our results support the general view of Nickell, Bell (1996) in so far as a substantial portion of the observed increase in German unemployment is due to *neutral* shifts in labor demand. Skill-biased technical progress or competition from low-wage countries are not the only – and presumably not the dominant – explanations of the weak labor market performance in Germany. Even if we strongly favor the relative-demand-shock hypothesis by choosing graduates as the reference group, we get the result that this sort of shocks contributed only between 47 and 68 percent to the overall rise in male unemployment. Furthermore, the importance of neutral shocks is strengthened if "ladder" and "ranking" effects are taken into account, i.e. the fact that the skilled can do many of the unskilled jobs and during recessions firms may therefore "hoard" skilled workers.[30]

4.2 Wage and employment responses to idiosyncratic shocks: Results of former studies

The use of a large micro data source offers the possibility to group the population into a variety of cells, for example by gender, education and age. This leads to a high-resolution picture of wage/employment relations in the economy that allows to investigate the two-sides-of-the-same-coin hypothesis more carefully. This strategy has been developed by Card, Kramarz and Lemieux (1996) and adopted by Krueger and Pischke (1997).[31] Krugman's diagnosis implies that the relative demand for more skilled labor has risen substantially. In a market-oriented economy as the U.S. this development should show up in the wage structure. Accordingly, Card *et al.* (1996) point to the overwhelming empirical evidence that wages of more highly-paid workers in the United States tended to rise more quickly (or to fall more slowly) during the 1980's. Since pay differentials are mainly due to education and labor market experience, the

[30] This labor hoarding occurs because the human capital of skilled workers, particularly of the firm specific type, increases their attachment to firms. See also Blanchard (1995) for this argument.

[31] Steiner, Wagner (1997, 1998) use the same strategy in a different context.

authors suggest to use the level of wages for a particular skill-age group in the early 1980's as a predictor for the relative demand shocks faced by that group over the following decade. In other words: The initial wage level can serve as a proxy for non-neutral shifts in labor demand. Since these shifts are supposed to favor highly-skilled labor, one would have to expect a positive relationship between the wage of a specified group of workers in the base period and the growth rate of wages in the absence of labor market restrictions. As has been shown by Card *et al.* (1996) and confirmed by Krueger, Pischke (1997), this result is obtained for the United States. Wage rates across age-education cells in a base year (say at the beginning of the eighties) are positively correlated with corresponding growth rates in a subsequent time span (the eighties). Of course, such a finding implies divergence of the wage distribution across cells.

As an implication of the two-sides-of-the-same-coin hypothesis, the same demand forces as in the U.S. are at work in Europe. If institutional rigidities can be understood as sluggish adjustment to market forces (and not as a reversal of the wage hierarchy with respect to productivity), the initial wage level can serve as a proxy variable for labor demand shifts in a European context as well. If labor market restrictions, however, hindered the wage distribution from fully adjusting to the market evaluation of workers, one would expect only a weak relationship, if any, between the skill level and wage growth. What Card *et al.* (1996) find for France, and Krueger, Pischke (1997) for Germany is indeed that wage growth is more or less independent of the initial wage level. If this evidence could be confirmed, an essential part of the Krugman story would be verified. For the other side of the coin to be valid, one would have to expect quantities (employment) to adjust instead of prices (wages, respectively). Hence there should be a significant positive relationship between the skill level and the relative employment performance of different groups in a typical European economy. As a puzzling fact, this is not what Card *et al.* and Krueger, Pischke observe. Apparently, no relationship can be detected. The latter authors conclude that labor market rigidities are not sufficient to explain the German unemployment problem. They suggest looking at product market rigidities as well.

One problem with the empirical analysis of Krueger, Pischke (1997) is that the data source the authors used for Germany does not permit a fine definition of skill-age categories of workers. Hence their results for Germany should be interpreted with some caution. As will be shown in the following section, some of the Krueger, Pischke findings have to be modified if a more suitable data base is utilized.

4.3 Description of our method and graphical evidence

A further aspect concerns the sectoral disaggregation of the available data. As has been documented in section 3, the employment performance of different skill-age groups varies substantially in the main sectors of the economy. Obviously, the industry affiliation matters which has been neglected in former studies.

For the empirical analysis we aggregate the micro-level data of the IAB-BST into age-by-education-by-industry cells. More specifically, we consider two skill groups, seven age groups and 30 industries including the primary sector as well as manufacturing and services.[32] Since participation behavior and other factors are different with respect to gender, we analyze education-by-age-by-industry cells for men and women separately. This yields a maximum of 2 x 7 x 30 = 420 cells for every gender. For each cell, the log median gross daily wage and the number of workers are calculated. Cells consisting of less than 30 persons were excluded from the estimation. For corresponding education-by-age (not industry) cells, the number of recipients of unemployment benefits is computed from the same data source. We then determine total labor supply for education-by-age groups by summing up the incumbent workforce and the unemployed.

Before turning to a more elaborated approach in section 5, we first describe the basic patterns in the cell-level data. To that end, changes in log wages and log employment rates are plotted for every education-by-age-by-industry cell against the initial wage for men and women separately. Let L_{it} denote total labor supply of skill-age group i and N_{ijt} employment of that group in industry j. By considering employment *rates* (N_{ijt}/L_{it}) instead of employment, we take changes in the workforce into account.[33] In the figures for the changes in wages we additionally include a reference line (dashed) denoting the nominal wage growth that would have been required to maintain a constant real wage.

As shown in the upper part of *figure 1*, a (statistically significant) positive relationship exists

[32]Since the censoring problem appears to be very severe for high qualification groups, the analysis was confined to unskilled and skilled workers as defined in section 2. For these groups the censoring problem is irrelevant for female workers and almost negligible for male workers if only the median wage or lower deciles are considered. For the year 1980 only one and for 1984 and 1990 only two cells have to be excluded because the median wage is censored. All exceptions concern experienced skilled workers in the sector *Office and Data Processing Machines*. Moreover we aggregated the 95 categories of the IAB-BST to 30 industries, see *Table A* in the appendix. With some minor exceptions, the aggregation used here corresponds to a suitable aggregation of the industry classification in the national account statistics.

[33]In Card *et al.* (1996) and Krueger, Pischke (1997) *employment to population* ratios are used instead of employment rates. Since at least for male workers labor supply is rather inelastic, the difference between the two approaches is not substantial.

between the decade-long growth of male wages and the initial wage in 1980.[34] We hence find evidence that relative wages in Germany did change as a response to a shift in relative labor demand. This result is at odds with that of Krueger, Pischke (1997). On the other hand (and in accordance with the findings of the these authors) the lower part of *figure 1* shows that no significant relationship can be detected between the initial wage and changes in the log employment rate.[35] It has to be concluded that wages for male workers in Germany did adjust to non-neutral shocks, while employment did not. This is just the opposite to what one would expect for a country with substantial rigidities if the two-sides-of-the-same-coin hypothesis was true. As a surprising fact, the patterns for Germany are rather similar to what former studies have found for the U.S.

However, there exists the possibility that our results with respect to wages are statistical artifacts due to a change in earning reports. In the IAB-BST, wages include fringe benefits that cannot be separated from "normal" earnings. Since the way fringe benefits are reported in this data source was altered between 1983 and 1984, one could expect a structural break in the earnings data. Steiner and Wagner (1996), however, point to fact that except for graduates, which are excluded here, the median and lower deciles of the earnings distribution are not affected. Since we are using the median as a measure for earnings, it is not likely that the results presented so far are biased. Nevertheless, we show the corresponding figures from 1984 to 1990 as well. As can be seen from the upper part of *figure* 2, a highly significant positive relationship between wage growth and initial wages is apparent also for the shorter time period.[36] Therefore, the evidence strongly supports the view that the wage dispersion across education, age and industries has been increasing for male workers in Germany during the eighties. Moreover, for the time period 1984 to 1990, we find a relationship between the initial wage and employment growth that appears to be even slightly (but not significantly) negative. Considering the descriptive empirical evidence presented in section 3, this finding seems to reflect the fact that employment of low-paid groups responds to labor market impulses in a more elastic way. As the second half of the eighties were characterized by an upswing of the business cycle, employment of relatively low-paid workers (which had suffered from a substantial blow in the early eighties) recovered

[34] To check the statistical significance an employment-weighted regression was performed. The coefficient of the initial wage is 0.19 with a t-statistic of 8.1.

[35] The coefficient of the corresponding variable in the weighted regression is 0.11 with a t-statistic of 1.1.

[36] A corresponding weighted regression gives a coefficient of 0.05 with a t-statistic of 3.1.

more strongly than those of other groups. This again points to the fact that an analysis of the relative wage/employment performance of different labor market groups should carefully consider influences of the business cycle.

Figure 3 and *figure 4* show the corresponding relationships for females. As a marked difference to the findings for males, no significant relationship shows up between wage changes and the initial wage in the estimation for the 1980 to 1990 sample. For the shorter time period, the slope of the regression line is even negative.[37] For the employment figures we find a weak positive coefficient in the estimation for the longer sample, but evidently no significant relationship for the shorter one.[38] If one takes the findings for female workers in the upper part of *figure 3* and *figure 4* as evidence of wage rigidity or even wage compression contrary to market forces, one is left with the problem that there is no indication of a strong corresponding employment response that would have to be expected in that case.[39] One should bear in mind, however, that the evidence does not necessarily point to rigid wages. Consider, for example, the case where demand for highly qualified labor increases markedly, but the skill composition of the workforce changes in the same proportion. Then, there is no need neither for wages nor for employment rates to respond to those impulses. In other words: One would obtain a flat relationship for wages and employment with respect to an indicator of relative labor demand shocks even if wages were perfectly flexible.

In any case, the graphical evidence presented so far should not be over-interpreted because it is based on a highly simplified approach. Among others, changes in sectoral prices, the composition of output and labor supply are not fully taken into account. The omission of relevant variables could be highly misleading. This motivates us to investigate the wage and employment responses in a more systematic way.

[37] The coefficient in the weighted regression is -0.07 with a t-statistic of -4.9.

[38] The coefficients are 0.13 and -0.01 with t-statistics of 1.6 and -0.1 for the 1980 to 1990 and 1984 to 1990 estimation, respectively.

[39] As mentioned above, the results for the shorter estimation period could be biased because of the effects of business cycle.

5 Wages and employment in an imperfect competition framework

5.1 A theoretical model

Our theoretical framework starts with the assumption that production on the industry level can be described by a CES function using different types of labor inputs that are distinguished by education and age:

$$Y_{jt} = \left(\sum_i C_{ijt} N_{ijt}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}, \tag{1}$$

where Y_{jt} denotes the output of industry j at time t, N_{ijt} the i different age-education groups in industry j, and σ the elasticity of substitution. A change in the parameter C_{ijt} alters the relative efficiency of different groups of workers (due to an technological innovation, for instance). We assume perfect competition in the product market. If the nominal wage rate of skill group i including non-wage labor costs is denoted by W_{ijt} and the producer price level by P_{jt}, the first order conditions for every industry are[40]

$$Y_{jt}^{\frac{1}{\sigma}} N_{ijt}^{-\frac{1}{\sigma}} C_{ijt} = \frac{W_{ijt}}{P_{jt}}. \tag{2}$$

Therefore, the (logarithmic) equation for labor demand can be written as follows[41]

$$n_{ijt} = y_{jt} + \sigma c_{ijt} - \sigma \left(w_{ijt} - p_{jt} \right). \tag{3}$$

As a result of efficiency wages or union bargaining, consumer real wages W_{ijt}^c / P_t^c are determined as a mark-up on the expected outside option. The latter is a weighted average of the wage level elsewhere in the economy and the level of unemployment benefits, with the employment and unemployment rate as the respective weights.[42] Since we are considering wage determination at the level of different age-education cells in an industry, the expected outside option has to be

[40] We assume a representative firm in every industry.

[41] Here and in what follows we use small letters for the natural logarithm of the corresponding variable.

[42] See for instance Layard *et al.* (1991) or Beissinger (1996) for a more detailed description of this type of model.

weighted with the aggregate unemployment rate u_i for the corresponding age-education group.[43] We therefore assume a log-linear wage equation of the form

$$w_{ijt} - p_t^c = \gamma_{0t} - \gamma_1(\ell_{it} - n_{it}) + \gamma_2(w_{it} - p_t^c) + \mu_{ijt} \qquad (0 < \gamma_2 < 1). \tag{4}$$

The second term on the right-hand side uses the approximation $u_{it} \approx \ell_{it} - n_{it}$, the third term stands for the cell-specific aggregate real wage level and the last term denotes sector-specific influences on the wage formation for skill group i.[44] Therefore, eq. (4) captures "inside forces" (μ_{ijt}) as well as "outside forces" (u_{it} and $(w_{it} - p_t^c)$).[45] The parameter γ_0 is thought to represent wage pressure arising from other variables that are not explicitly taken into account, such as the generosity of the unemployment insurance system or union militancy. Since these influences are subject to change, the parameter γ_0 may vary over time.

Being interested in the employment and wage growth of different skill groups, we take log differences of the variables at the end and beginning of the sample period. This yields

$$\Delta n_{ij} = \Delta y_j + \sigma \Delta c_{ij} - \sigma \left(\Delta w_{ij} - \Delta p_j\right) \tag{5}$$

and

$$\Delta w_{ij} = \Delta \tilde{\gamma}_0 - \gamma_1(\Delta \ell_i - \Delta n_i) + \gamma_2 \Delta w_i + \Delta \mu_{ij}, \tag{6}$$

where $\tilde{\gamma}_{0t} := \gamma_{0t} + (1 - \gamma_2) p_t^c$.

More specifically, we assume two alternative kind of inside forces, the first being "employment related" and the second "efficiency" or "productivity related". With λ as a weighting parameter

[43] In a simple version, consumer wages are set as $W_{ijt}^c / P_t^c = \zeta_{jt} Z_{it}$, where the outside option Z_{it} is defined as $Z_{it} = (1 - u_{it}) W_{it} / (\Theta P_t^c) + u_{it} B_{rt} / \Theta$; B_r denotes the (gross) level of real unemployment benefits in consumption units and Θ the tax wedge. Since in this specification unemployment benefits are adjusted with respect to changes in the tax wedge, the bargained wage *in production units* is not influenced by this variable. This corresponds to the view that in the long run the tax burden is borne by the employees.

[44] The parameter γ_2 is less than one because a rise in the aggregate real wage increases the outside option less than proportionally (given a positive unemployment rate).

[45] See Layard *et al.* (1991), chap. 4, for a theoretical model and an overview of some empirical studies with regard to the relevance of inside and outside forces.

$(0 < \lambda < 1)$ and c_i as an aggregate efficiency index of age-education group i, one can formulate

$$\Delta\mu_{ij} = \lambda\gamma_3(\Delta n_{ij} - \Delta n_i) + (1-\lambda)\gamma_4(\Delta c_{ij} - \Delta c_i),$$

or, with a suitable definition of $\tilde{\gamma}_3$ and $\tilde{\gamma}_4$

$$\Delta\mu_{ij} = \tilde{\gamma}_3(\Delta n_{ij} - \Delta n_i) + \tilde{\gamma}_4(\Delta c_{ij} - \Delta c_i). \tag{7}$$

Substituting this expression in (6) yields

$$\Delta w_{ij} = \Delta\tilde{\gamma}_0 - \gamma_1\Delta\ell_i + (\gamma_1 - \tilde{\gamma}_3)\Delta n_i + \tilde{\gamma}_3\Delta n_{ij} + \gamma_2\Delta w_i + \tilde{\gamma}_4(\Delta c_{ij} - \Delta c_i). \tag{8}$$

It can be assumed that a single industry is small compared to the whole economy. Therefore, wage setters at the industry level consider the outside option and hence also u_{it} (or n_{it}) and w_{it} to be exogenous. For example, a rise in w_{it} increases the outside option, so other things being equal, w_{ijt} increases as well, leading to lower employment in the respective industry. Of course, if the whole economy is considered, u_{it} (n_{it}) and w_{it} are also determined by the model. Since we pool cells across all industries in our empirical analysis, the endogeneity of u_{it} (n_{it}) and w_{it} has to be taken into account explicitly. These variables are determined by the aggregate labor demand and wage equation for skill group i. Note that all variables entering the sectoral equations also play a role in the aggregate. It is useful to think of the aggregate equations as being influenced by indices of the respective sectoral variables. Therefore, aggregate labor demand for skill group i, n_{it}, is a function of the aggregate output level y_t, the real wage $w_{it} - p_t$ and the efficiency parameter c_{it}, where the variables represent appropriate indices resulting from aggregation over sectors. The aggregate wage equation describes the real wage for skill group i as a function of u_{it} (or n_{it} and ℓ_{it}), and the same institutional variables that already enter the constant term in the sectoral equations (being identical across industries).

The aggregate equations can in principle be solved for n_{it} and w_{it}. Assuming a log-linear approximation yields

$$\Delta n_i = \delta_0 + \delta_1\Delta\ell_i + \delta_2\Delta c_i \qquad (0 < \delta_1 < 1) \tag{9}$$

and

$$\Delta w_i = \eta_0 - \eta_1 \Delta \ell_i + \eta_2 \Delta c_i. \tag{10}$$

Using these reduced-form relationships, we replace Δn_i and Δw_i by $\Delta \ell_i$ and Δc_i in the sectoral equations.[46]

For the efficiency variables c_{it} and c_{ijt}, that are not observable, we use the aforementioned approximation suggested by Card *et al.* (1996)[47]:

$$\Delta c_i = \nu_0 + \nu_1 w_{i0} \qquad \text{and} \qquad \Delta c_{ij} = \nu_0 + \nu_1 w_{ij0}. \tag{11}$$

These considerations lead to the estimation equations

$$\Delta n_{ij} = \alpha_0 + \alpha_1 \Delta y_j + \alpha_2 \Delta p_j + \alpha_3 \Delta \ell_i + \alpha_4 w_{ij0} + \alpha_5 w_{i0} + \varepsilon_{1ij} \tag{12}$$

$$\Delta w_{ij} = \beta_0 + \beta_1 \Delta y_j + \beta_2 \Delta p_j + \beta_3 \Delta \ell_i + \beta_4 w_{ij0} + \beta_5 w_{i0} + \varepsilon_{2ij}, \tag{13}$$

where α_0 and β_0 are suitable defined constant terms and

$$\begin{aligned}
\alpha_1 &:= 1/(1+\sigma\tilde{\gamma}_3) & \beta_1 &:= \alpha_1\tilde{\gamma}_3 \\
\alpha_2 &:= \sigma\alpha_1 & \beta_2 &:= \alpha_2\tilde{\gamma}_3 \\
\alpha_3 &:= \alpha_1\sigma(\gamma_1 + \delta_1(\tilde{\gamma}_3 - \gamma_1) + \gamma_2\eta_1) & \beta_3 &:= -\alpha_3/\sigma \\
\alpha_4 &:= \alpha_1\nu_1\sigma(1-\tilde{\gamma}_4) & \beta_4 &:= \alpha_1\nu_1(\tilde{\gamma}_3\sigma + \tilde{\gamma}_4) \\
\alpha_5 &:= \alpha_1\nu_1\sigma(\tilde{\gamma}_4 + \delta_2(\tilde{\gamma}_3 - \gamma_1) - \eta_2\gamma_2) & \beta_5 &:= -\alpha_5/\sigma.
\end{aligned}$$

In the empirical application, the cross-equation restrictions on the parameters are explicitly

[46] Note that Δy only affects the constant term. In our model we assume that the labor demand and wage curve are downward and upward sloping, respectively. In this case an increase in ℓ_i leads to a less than proportional increase of n_i, hence $0 < \delta_1 < 1$.

[47] This approach can be criticized if applied to an economy with substantial rigidities. If the initial wage level was not at its equilibrium (market) level because of rigidities, the measure would be biased to some extent. In such a situation it could be better to enlarge the approximation by utilizing also the initial unemployment rate as an inverse proxy of labor demand changes in the subsequent time period. The problem is that workers are not *per se* attached to a specific industry and it is not meaningful to calculate sectoral unemployment rates. Inclusion of u_{i0} as a regressor gives a negative sign in the wage equation that is only weakly significant. Since the other coefficients were affected only marginally, we decided to work with the original hypothesis of Card *et al.* (1996).

taken into account. Since it can be expected that the disturbances of the employment and wage equations are correlated, we use a SUR estimator.

5.2 Estimation results

Table 5 gives the regression results for the two time periods chosen (1980 to 1990 and 1984 to 1990), for male and female workers separately. The regressions are based on a total number of cells ranging from 220 to 315.[48] We first observe that the fit of the regression is better for the wage equations than for the employment equations. For the former we find a standard error of the regression of between 5 and 7 percent, with R^2 ranging from 0.77 to 0.85. The standard error of the regression is higher for the employment equations. R^2 lies in the range between 0.24 and 0.39 in three out of four cases, but appears to be extraordinary low in the regression for male workers over the shorter time period. Since the latter regression represents an outlier also in other respects, the results should be interpreted with caution. In general, a comparison of the results for the two sample periods reveals considerable variation. This has to be expected from the descriptive results presented in section 3, because of the influence of the business cycle. Since the years 1980 and 1990 presented two roughly comparable situations in the business cycle, we clearly prefer the corresponding results to those for the shorter time period.

Output and prices appear with a statistically significant positive sign in all estimates of the employment equation. In the wage equation this is only the case for the 1980 to 1990 estimation period. The coefficient of production in the employment equation lies in the range from 0.7 to 1.0, being significantly smaller than unity in the estimations over the longer time period, but not in those for the shorter period. Disregarding the aforementioned outlier regression, one can observe that the results for the sectoral price variable are roughly comparable in all variants. This is also the case for the labor supply variable ($\Delta \ell_i$) which – in correspondence with theoretical expectations - is significantly positive in the employment equations and significantly negative in the wage equations. For female workers the influence of potential labor on employment and wage formation seems to be somewhat stronger than for male workers. As an interesting by-product of our analysis, the elasticity of substitution can be calculated. If only the estimations for the

[48] The maximum number of cells is 420. Cells were excluded from the estimation when (i) the cell size was less than 30 persons, or (ii) the calculated median was close to the social contribution ceiling. Since the latter occurred in only a few cases, we can neglect the methodological problems arising from truncating the data.

full-sample period are considered, we find a value of 1.8 for men and 3.3 for women. This is in the range what other researchers have found for the U.S.[49], but in contrast to the low value that Steiner, Wagner (1997) have found for Germany (employing the same data source, but a different theoretical approach).

A remarkable distinction between males and females is found for the labor demand indicator at the aggregate level (w_{i0}). For males, the coefficient of this regressor is positive in the employment and negative in the wage equation, whereas the opposite sign pattern occurs for females. Although we cannot exactly identify the structural coefficients γ_1 and γ_2, it is obvious from the theoretical model that a negative coefficient for α_5 implies a relatively high value for γ_1 and/or γ_2. Hence, according to our results, wages of female workers exhibit a relatively high sensitivity with respect to outside forces. Moreover, from the structural coefficient $\tilde{\gamma}_3$, which can be identified, we have evidence that wages of female workers were also more influenced by "employment related " inside factors than those of males (considering only estimates for the time period 1980 to 1990). In contrast to this, the sign pattern we find for males are consistent with a high value of $\tilde{\gamma}_4$ and low values of γ_1, γ_2, and η_2. The remuneration of male workers seems to be not very sensitive with respect to aggregate unemployment and wages, but rather sensitive with respect to sector-specific technological developments that lead to productivity changes. In other words: For males outside forces determining wages are less important than for females, and productivity related as well as employment related inside forces are more relevant. It should be stressed however, that eq. (7) models the behavior of insiders as depending on sectoral employment and productivity *relative* to the aggregate.

The most striking difference with respect to gender is found in the coefficient of the variable being included as indicator of industry-specific labor demand shocks (w_{ij0}). For male workers we get a strong and highly significant positive influence of relative labor demand shifts on changes in wages, while the coefficient of the indicator variable is not significant in the employment equation. This corroborates our findings from the graphical analysis in section 4.3, whereas those for female workers have to be modified. What the estimates of the econometric model show for the latter, is a highly significant influence of shifts in labor demand on employment, but not on wages. For the shorter time period, we even find a significant negative coefficient in the

[49] Bound, Johnson (1992) report a value of 1.7.

wage equation. Hence the general picture obtained here for female workers is what one would expect from the Krugman hypothesis: Sluggish wage adjustments to demand shocks (or changes in wages that are even contrary to market demand forces) shift the burden of adjustment to changes in employment. In contrast to this, our findings for male workers clearly contradict the two-sides-of-the-same-coin approach. If the approximation of Card *et al.* (1996) is correct, then wages of male workers did react to impulses from labor demand and this reaction was strong enough to prevent corresponding changes in the employment structure. Whereas for female workers, quantities (employment) responded to non-neutral technological shocks instead of prices (wages), the contrary is true for male workers.

6 Summary and conclusions

We have analysed the hypothesis that structural unemployment in Germany has risen because rigid relative wages hindered the necessary adjustments in the face of a substantial shift in demand against the unskilled. Some economists see this development merely as the flip side of the rise in wage inequality accompanied by impressive employment growth rates in the United States. To scrutinize the hypothesis we employ a large German micro-data source (IAB-Beschaeftigtenstichprobe) that is especially suitable for disaggregated studies of the wage and employment structure. On the one hand, *prima facie* evidence seems to corroborate the two-sides-of-the-same-coin hypothesis. The same groups of workers that are suffering from heavy declines in relative wages in the United States exhibit relatively high unemployment rates in Germany. According to our descriptive results, for instance, the labor market performance of younger workers and of employees with lower education is, in general, worse compared to other groups. On the other hand, a closer look at the data reveals that the evidence is ambivalent. Employment prospects for the unskilled are not uniformly deteriorating across age groups, industries and time. For example, younger unskilled workers suffered from heavy employment losses during the recession at the beginning of the eighties. They partly regained their previous employment share, however, in the second half of the decade, especially in manufacturing. Comparing the years 1990 and 1980 and considering especially unskilled and skilled male workers it becomes evident that percentage-point increases in unemployment rates are very similar across age groups and sometimes higher for older workers. In proportional terms the increase in

the unemployment rates of older workers is therefore even more pronounced. This result seems to be at odds with findings for the United States where older (i.e. more experienced) workers belong to the winners of the labor market developments in the eighties. Additionally we point to the fact that the unemployment rate not only of the unskilled but also of skilled workers and even graduates increased during the eighties. Therefore, labor demand shifts being neutral with respect to skills have also to be considered. Taking the medium skill group as a reference, our calculations show that only between 20 and 34 percent of the increase in male unemployment can be explained by relative demand shifts. Choosing graduates as reference group and thereby favoring the relative demand shock hypothesis, this proportion rises to values ranging from 47 to 68 percent of the overall rise in male unemployment. Although these calculations heavily rest on the particular choice of the reference group, they indicate that neutral shocks play an important part in explaining Germany's rise in unemployment as well.

As a next step, we analyze the wage and employment dynamics for narrowly defined age-education-industry cells for males and females separately. We relate changes in wages and employment rates for these cells to the initial level of wages for the respective group, whereby the latter serves as a proxy for skill-specific demand shocks as suggested by Card *et al.* (1996). In contrast to the results of Krueger and Pischke (1997), we find a significant positive relationship between wage growth and initial wages for male workers. Therefore, we conclude that wage inequality across the age-education-industry dimension has increased. On the other hand and in accordance with these authors our data show no significant relationship between the change in the log employment rate and the initial wage. This pattern is just the opposite of what should be expected for a country with substantial rigidities if the two-sides-of-the-same-coin hypothesis was true. Contrary to our results for male workers, the evidence for females is more supportive to a rigidity explanation of unemployment.

To investigate the two-sides-of-the-same-coin hypothesis more carefully, a theoretical framework is developed that relies on imperfect competition on the labor market and explicitly takes the sectoral dimension into account. From this model, regression equations are derived that allow to characterize the wage and employment dynamics of the various cells. Based on SUR-estimates we find evidence that wages of females were more influenced by outside factors than those of males, the latter being more sensitive to sector-specific technological developments. Our estimates imply a elasticity of substitution between the different types of workers of 1.7 for

males and 3.3 for females.

The most striking difference with respect to gender is found for the variables representing labor demand shocks. For male workers we get a strong and highly significant positive influence of relative labor demand shifts on changes in wages, while the coefficient of the indicator variable is not significant in the employment equation. This corroborates our findings from the graphical analysis, whereas those for female workers have to be modified. For the latter the estimates of the econometric model show a highly significant influence of shifts in relative labor demand on employment, but not on wages. Hence the general picture obtained for female workers is in line with the two-sides-of-the-same-coin hypothesis. Sluggish wage adjustments to demand shocks (or changes in wages that are even contrary to market demand forces) shift the burden of adjustment to changes in employment. In contrast to this, our econometric estimates for male workers clearly contradict the rigidity explanation. If the approximation of Card *et al.* (1996) is correct, then wages of male workers did react to impulses from labor demand and this reaction was strong enough to prevent corresponding changes in the employment structure. Whereas for females, quantities (employment) responded to non-neutral technological shocks instead of prices (wages), the contrary is true for males.

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Table 1

Total Number of Persons, Unemployment and the Unemployment Rate by Skill and Gender in the Sample (1980, 1985, 1990)

	1980				1985				1990			
	L	$L\%$	U	u	L	$L\%$	U	u	L	$L\%$	U	u
	men											
unskilled	17637	20.4	589	3.3	16072	18.8	2154	13.4	14370	16.4	1382	9.6
skilled	63411	73.5	939	1.5	63324	73.9	2981	4.7	65422	74.6	2010	3.1
graduates	5265	6.1	57	1.1	6274	7.3	138	2.2	7922	9.0	147	1.9
	women											
unskilled	13048	31.1	667	5.1	11483	26.9	1259	11.0	9924	22.0	992	10.0
skilled	28025	66.8	973	3.5	29897	70.1	1787	6.0	33252	73.7	1636	4.9
graduates	880	2.1	23	2.6	1243	2.9	109	8.8	1914	4.2	128	6.7

Notes: Source: Own calculations with IAB-BST data; L: total number of persons; $L\%$: percent of column sum of L (for each gender); U: unemployed persons; u: unemployment rate in percent.

Table 2

Unemployment Rates in the Sample by Skill, Gender and Age (1980, 1985, 1990)

year	age group 18-25 (1)	26-30 (2)	31-35 (3)	36-40 (4)	41-45 (5)	46-50 (6)	51-55 (7)
				male unskilled			
1980	6.5	5.0	2.4	2.9	2.1	2.1	2.2
1985	26.1	15.7	14.3	10.8	10.8	7.5	8.2
1990	12.9	10.0	9.0	9.5	8.3	9.5	7.9
				male skilled			
1980	2.5	2.4	1.4	1.0	0.9	1.0	1.1
1985	6.9	5.6	4.8	4.0	3.8	3.6	4.4
1990	3.3	3.7	2.7	2.8	3.0	2.8	3.2
				male graduates			
1980	0.0	1.0	1.9	1.4	0.3	1.0	0.2
1985	2.6	2.1	2.4	2.3	2.4	2.1	1.2
1990	1.4	1.0	1.9	2.6	2.4	1.8	1.4
				female unskilled			
1980	9.1	8.3	4.2	2.7	3.1	2.8	3.3
1985	21.6	15.9	8.4	7.2	4.7	5.3	7.3
1990	17.7	14.6	10.6	6.8	5.5	5.2	7.5
				female skilled			
1980	3.6	5.1	3.8	2.2	2.2	2.4	3.5
1985	5.5	8.6	6.7	4.8	4.0	4.1	7.1
1990	3.3	6.7	6.7	4.1	4.4	4.2	6.4
				female graduates			
1980	2.3	2.7	6.6	0.8	0.0	0.0	1.8
1985	4.2	9.5	12.2	13.8	5.0	0.0	1.9
1990	1.0	5.5	8.1	9.2	8.9	4.7	3.6

Notes: Source: Own calculations with IAB-BST data; all unemployment rates in percent.

Table 3

Development of the Age Structure of Employment by Sector and Skill, 1980-1990 (Employment Share 1980=100)

	Manufacturing			Services		
	1980	1985	1990	1980	1985	1990
			male unskilled			
18-30	100.0	99.8	105.0	100.0	96.0	99.0
31-45	100.0	86.4	96.7	100.0	86.2	97.0
46-55	100.0	116.0	99.9	100.0	122.7	105.1
			male skilled			
18-30	100.0	101.1	103.8	100.0	94.4	91.3
31-45	100.0	90.6	88.6	100.0	92.7	91.0
46-55	100.0	115.8	116.3	100.0	123.2	131.1
			male graduates			
18-30	100.0	95.7	104.8	100.0	79.1	77.5
31-45	100.0	93.2	87.9	100.0	102.6	96.8
46-55	100.0	123.1	130.8	100.0	119.9	144.7
			female unskilled			
18-30	100.0	102.6	97.9	100.0	86.3	78.2
31-45	100.0	89.2	94.4	100.0	96.8	96.8
46-55	100.0	109.6	108.3	100.0	120.8	130.8
			female skilled			
18-30	100.0	96.3	94.4	100.0	94.7	88.8
31-45	100.0	97.5	93.5	100.0	103.2	102.3
46-55	100.0	118.4	134.6	100.0	113.6	140.3
			female graduates			
18-30	100.0	115.9	106.0	100.0	89.0	74.3
31-45	100.0	101.8	135.3	100.0	111.1	127.6
46-55	100.0	60.8	32.3	100.0	107.1	110.4

Notes: Source: Own calculations with IAB-BST data. The shares for each gender and sector are calculated as N_{ij}/N_j, where i denotes the age group and j the skill category. For example, the third element in the first row indicates that the share of young unskilled male workers with respect to all unskilled male workers in Manufacturing has increased by 5 percent from 1980 to 1990.

Table 4

Percentage Contribution of Relative Factor Demand Shifts to the Overall Rise in Unemployment 1980 to 1990

	reference group:			
	skilled workers		graduates	
gender	#1	#2	#1	#2
male	34.46	19.77	67.89	46.52
female	31.20	24.99	$-^*$	$-^*$

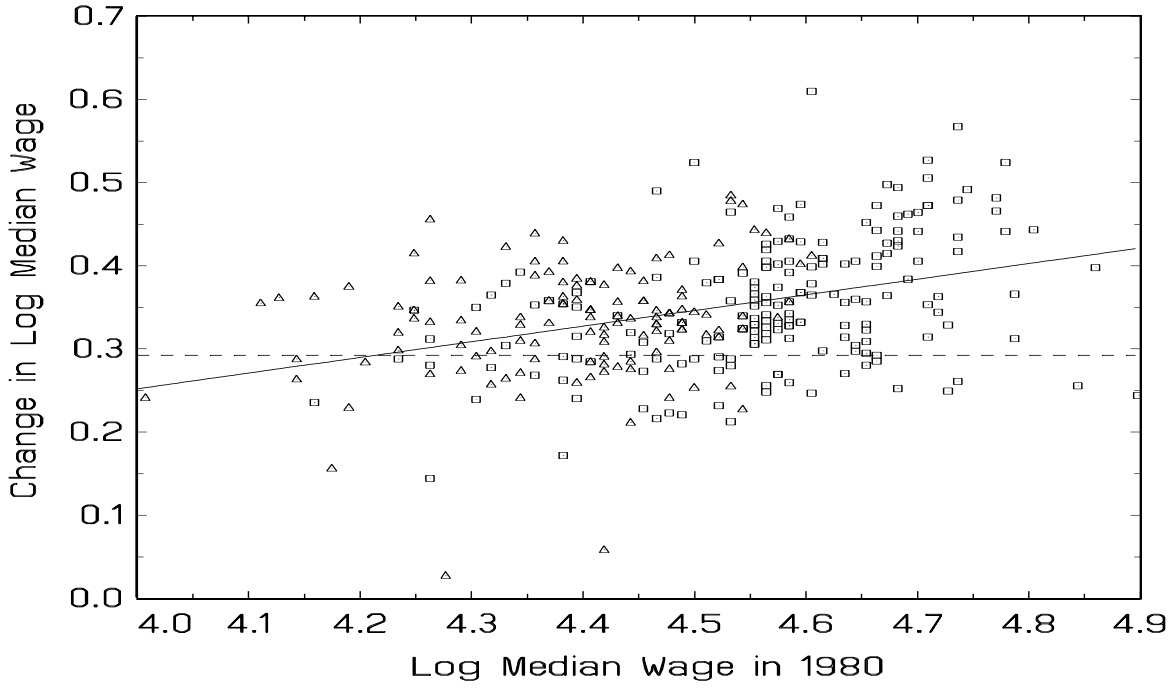
Notes: #1: equal-percentage-point approach; #2: equiproportionate approach; *: value is negative;

Table 5

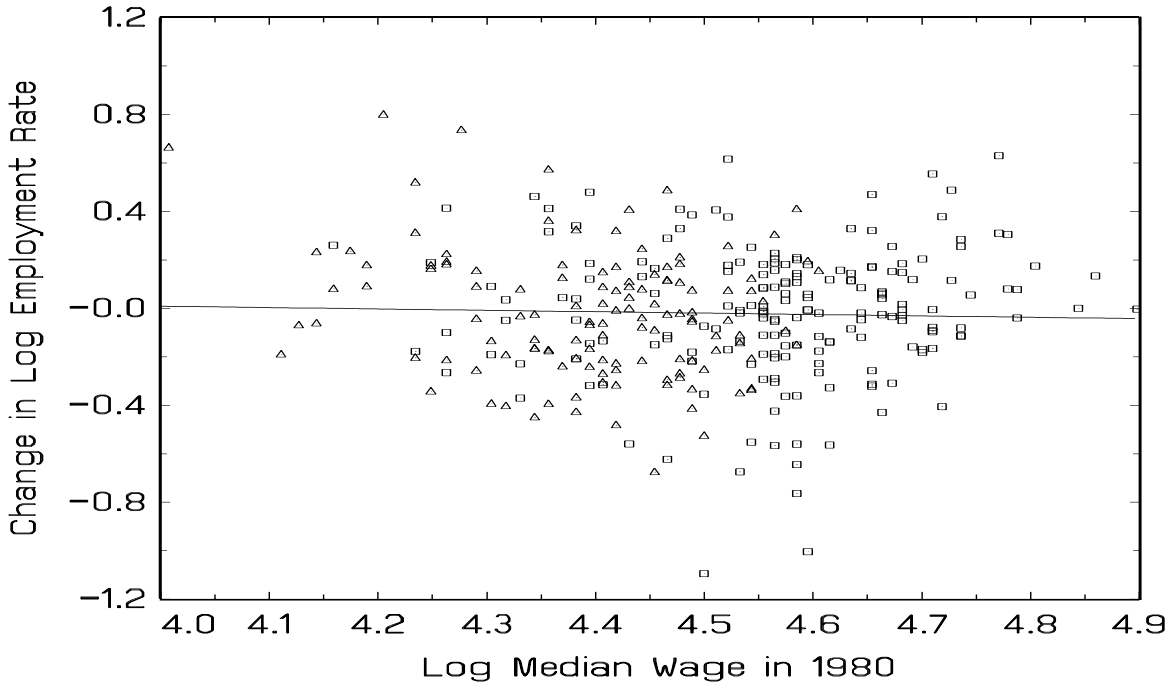
Regression Results for Skill/Age/Industry-Cells (Employment Weights)

	1980-1990		1984-1990	
	male workers	female workers	male workers	female workers
	dependent variable: Δn_{ij}			
constant	−1.260*	−0.851	0.162	−1.548**
	(0.580)	(0.743)	(0.424)	(0.386)
Δy_j	0.883**	0.695**	1.001**	0.934**
	(0.038)	(0.054)	(0.010)	(0.054)
Δp_j	1.571**	2.294**	0.412*	1.928**
	(0.176)	(0.229)	(0.180)	(0.231)
$\Delta \ell_i$	0.175**	0.491**	0.003	0.220**
	(0.028)	(0.065)	(0.005)	(0.038)
$w_{ij,0}$	−0.200	0.443**	−0.136	0.334**
	(0.148)	(0.109)	(0.087)	(0.079)
$w_{i,0}$	0.336**	-0.430**	0.054*	−0.070
	(0.098)	(0.164)	(0.026)	(0.061)
	test statistics			
N	315	222	311	220
s.e.	0.309	0.298	0.254	0.232
R^2	0.238	0.391	0.081	0.244
	dependent variable: Δw_{ij}			
constant	−0.392**	−0.352*	0.176*	0.237*
	(0.136)	(0.207)	(0.082)	(0.120)
Δy_j	0.065**	0.092**	−0.001	0.032
	(0.020)	(0.013)	(0.022)	(0.025)
Δp_j	0.116**	0.302**	−0.001	0.066
	(0.038)	(0.054)	(0.010)	(0.054)
$\Delta \ell_i$	−0.098**	−0.149**	−0.006	−0.106**
	(0.012)	(0.018)	(0.012)	(0.015)
$w_{ij,0}$	0.342**	0.012	0.135**	−0.046*
	(0.049)	(0.026)	(0.026)	(0.018)
$w_{i,0}$	−0.189**	0.131**	−0.130**	0.034
	(0.052)	(0.049)	(0.031)	(0.030)
	test statistics			
N	315	222	311	220
s.e.	0.065	0.070	0.042	0.049
R^2	0.846	0.823	0.823	0.766
	structural parameters			
σ	1.775**	3.284**	0.410*	2.062**
	(0.218)	(0.426)	(0.180)	(0.281)
$\tilde{\gamma}_3$	0.074**	0.131**	−0.001	−0.034
	(0.025)	(0.027)	(0.022)	(0.028)

Notes: **, * indicates significance at the 1% (5%) level; w denotes the log median wage, ℓ the labor force, n employment, y production; index i refers to the skill group and j to the industry; N denotes the number of cells, s.e. is the standard error of regression; standard errors below the coefficients in parenthesis; estimation method: Seemingly Unrelated Regression with restriction imposed in accordance with the theoretical model (see text).



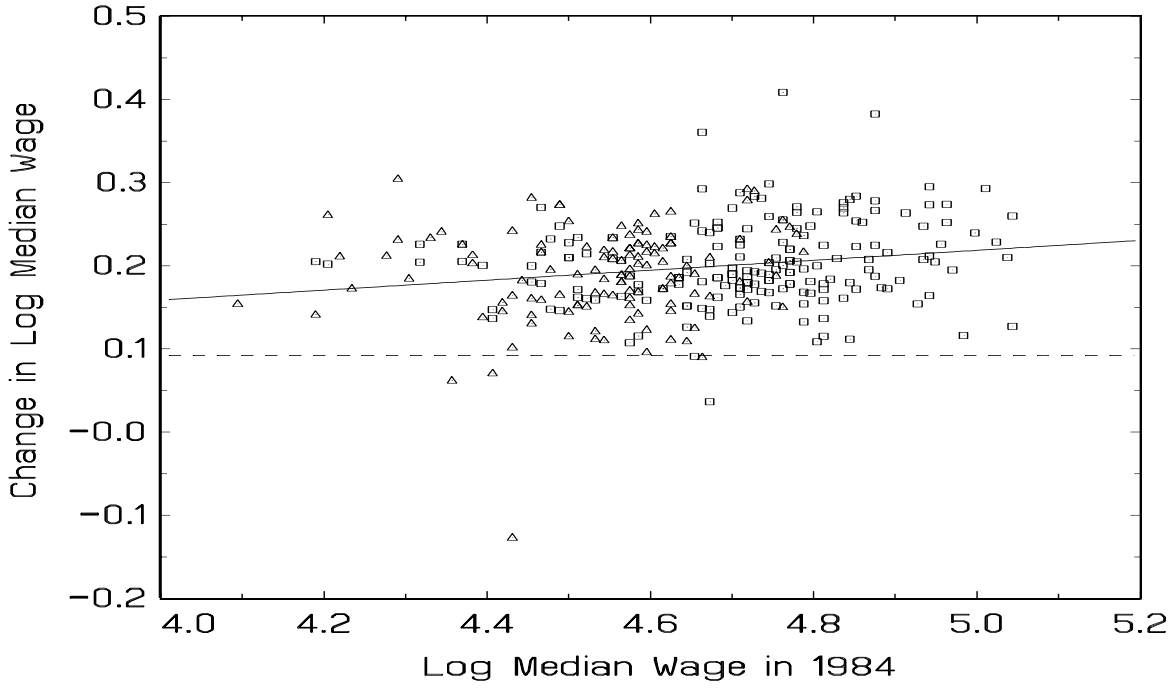
(a)



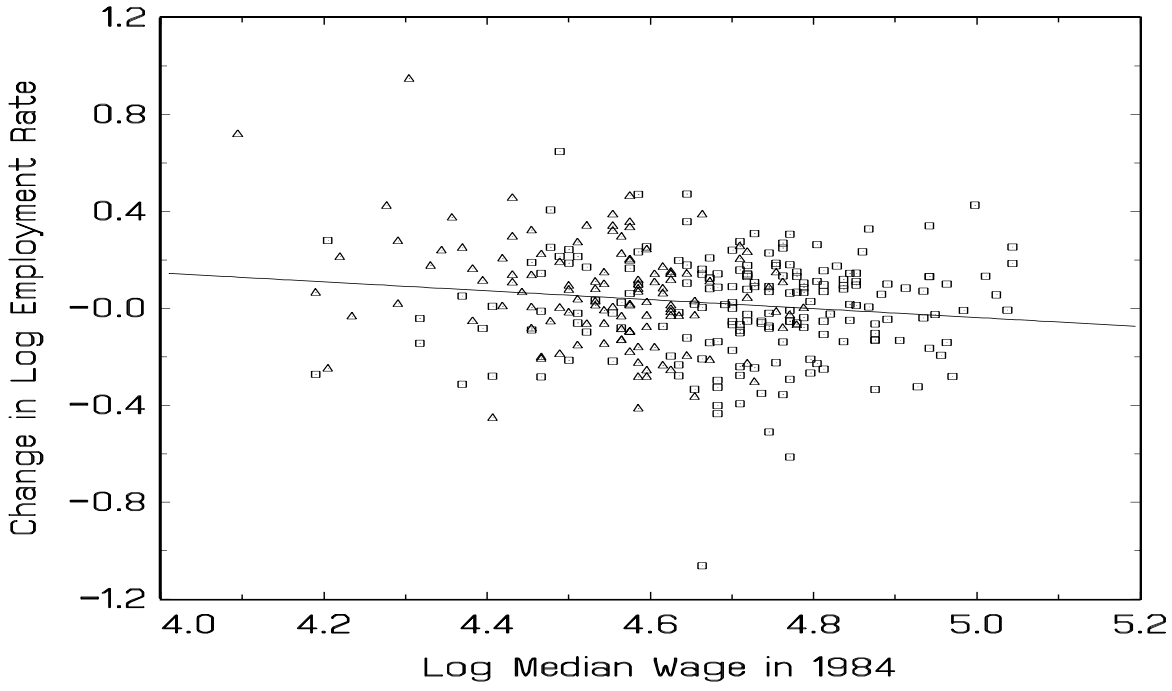
(b)

Figure 1: Change in Log Wages and Log Employment versus the Initial Wage Level for Men by Skill, Age and Industry in Germany 1980-90

Source: IAB-BST, own calculations. The dashed line represents the nominal wage growth required to maintain a constant real wage. Triangles indicate unskilled, squares skilled workers. For detailed descriptions see text.



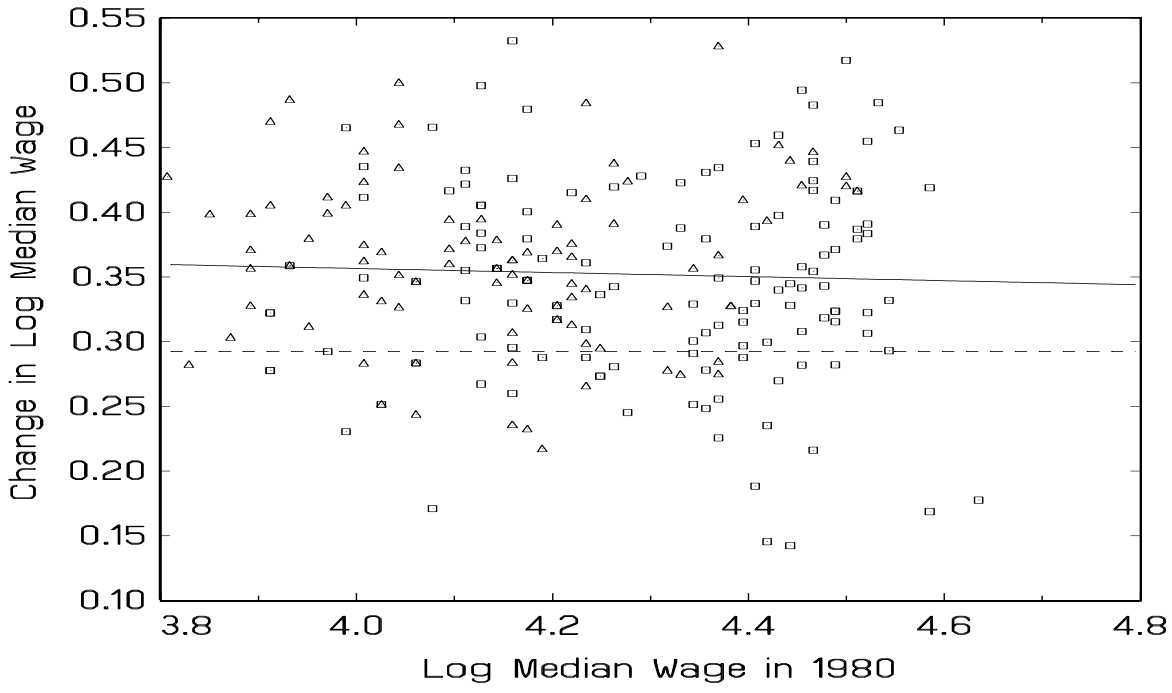
(a)



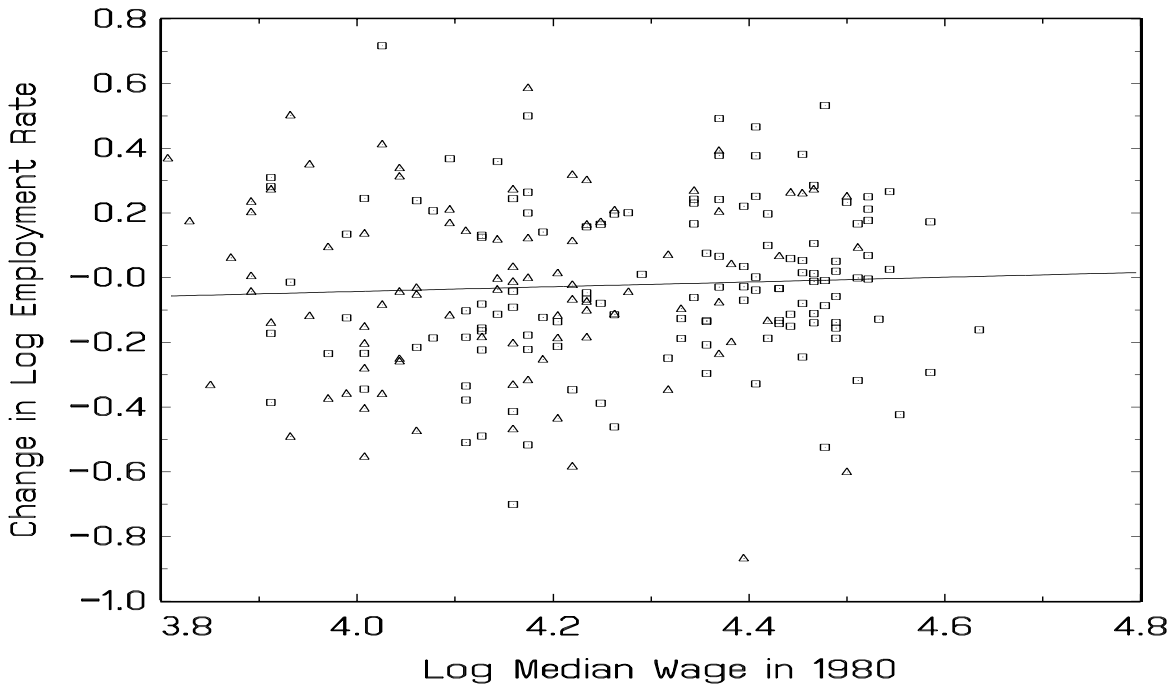
(b)

Figure 2: Change in Log Wages and Log Employment versus the Initial Wage Level for Men by Skill, Age and Industry in Germany 1984-90

Source: IAB-BST, own calculations. The dashed line represents the nominal wage growth required to maintain a constant real wage. Triangles indicate unskilled, squares skilled workers. For detailed description see text.



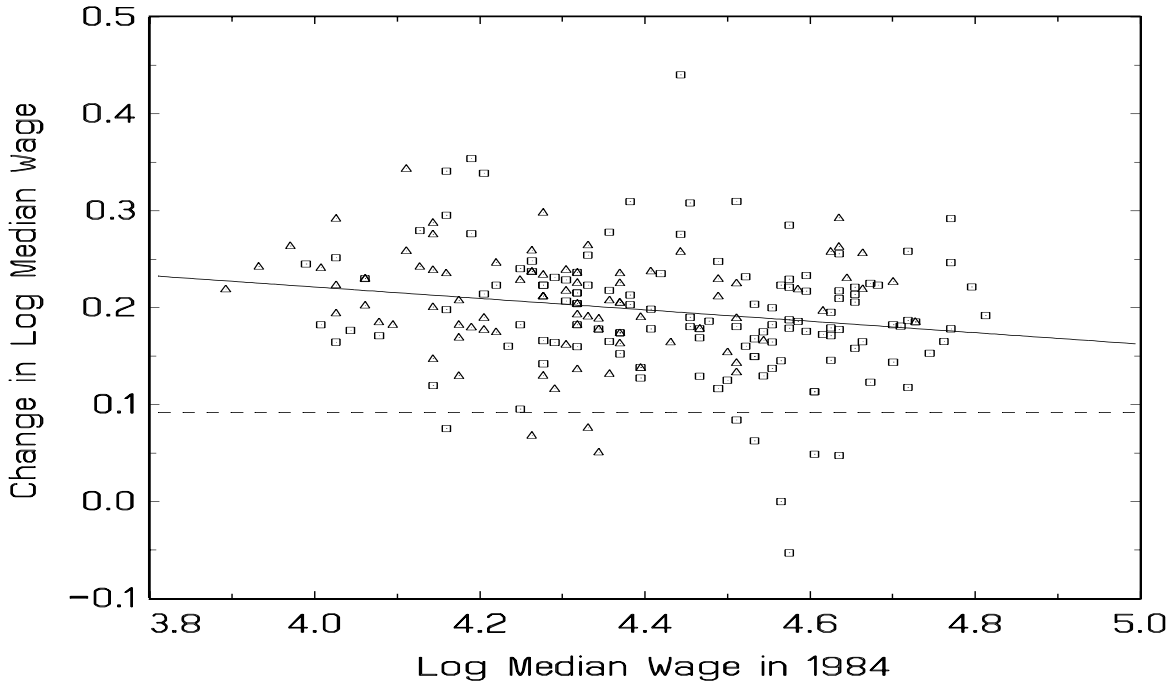
(a)



(b)

Figure 3: Change in Log Wages and Log Employment versus the Initial Wage Level for Women by Skill, Age and Industry in Germany 1980-90

Source: IAB-BST, own calculations. The dashed line represents the nominal wage growth required to maintain a constant real wage. Triangles indicate unskilled, squares skilled workers. For detailed description see text.



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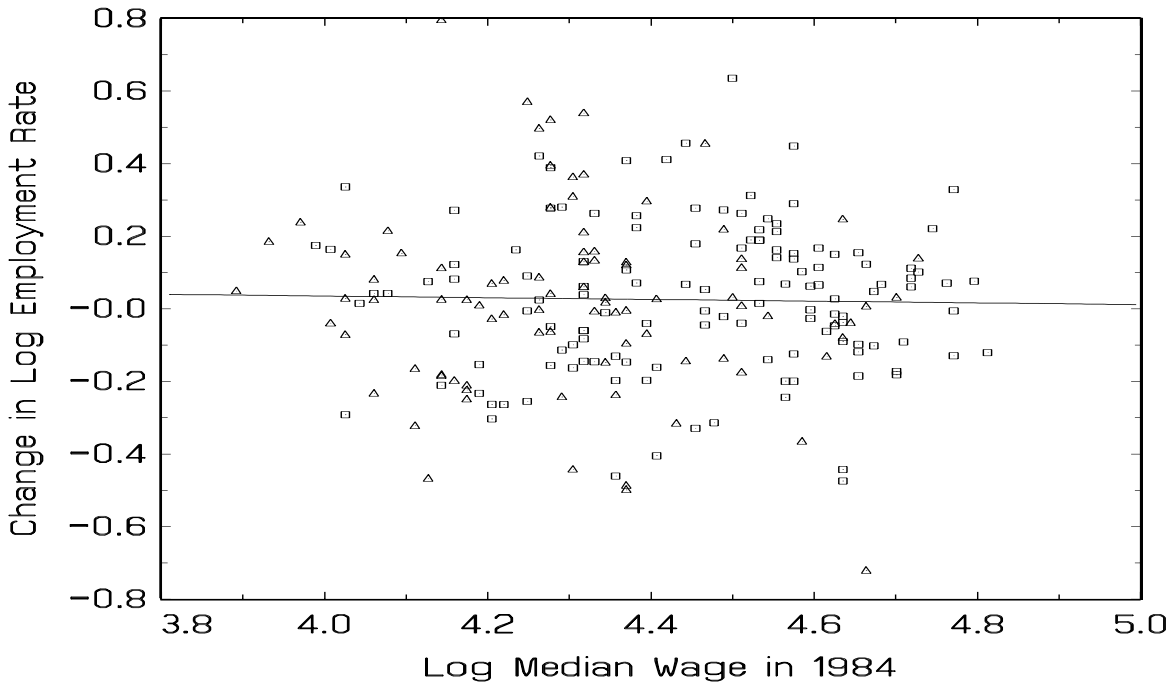

(b)

Figure 4: Change in Log Wages and Log Employment versus the Initial Wage Level for Women by Skill, Age and Industry in Germany 1984-90

Source: IAB-BST, own calculations. The dashed line represents the nominal wage growth required to maintain a constant real wage. Triangles indicate unskilled, squares skilled workers. For detailed description see text.

TABLE A

Aggregation of Sectors

#	description	IAB-BST classification
1	Agriculture, Forestry and Fisheries	00 – 03
2	Electricity, Gas, Heat and Water	04
3	Mining	05 – 08
4	Chemical Products and Petroleum Processing	09 – 11
5	Synthetic Material and Rubber Products	12, 13
6	Stone and Earth Products, Fine Ceramics, Glass	14 – 16
7	Iron, Non-Ferrous Metals, Foundry, Fabricated Metal Products, Shipbuilding, Iron Products	17 –22, 31, 37
8	Machinery, Steel, Light Metal and Tracked Vehicles	23, 24, 26, 27
9	Vehicles and Repairs	28 – 30
10	Air and Space	32
11	Office and Data Processing Machines	33
12	Electric Appliances and Repairs	34
13	Precision and Optical Instruments	35, 36
14	Woodwork and Wood Processing, Furniture	40 – 42
15	Pulp, Paper and Products	43
16	Printing and Publishing	44
17	Leather and Textiles, Apparel, Musical Instruments, Toys	38, 39, 45 – 53
18	Food, Beverages, Tobacco	54 – 58
19	Construction	25, 59 – 61
20	Trade	62
21	Railways, Ship Traffic, Other Transportation, Postal Services	63 – 68
22	Banking, Insurance, Business Services	69, 79, 81
23	Catering, Hotels and Other Services	70 – 73, 86, 90
24	Education Services	74, 75
25	Art, Theater, Photography	76, 83
26	Literature, Publishing	77
27	Health and Veterinary	78, 84
28	Architecture and Engineering	80, 82, 85
29	Private Non Profit Organizations	89
30	Government, Welfare Services	87, 88, 91 – 94