# How Robust Are Nominal Wage Rigidities?

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*COMMENTS VERY WELCOME.*

**Abstract**: Several studies indicate that firms are reluctant to cut nominal wages during periods of relatively high nominal per capita GDP growth. It has been argued, however, that in an environment with a low nominal per capita GDP growth, i.e., when nominal wage cuts become customary, firms would no longer hesitate to cut nominal pay. To examine this argument we use data from Switzerland where nominal GDP growth has been very low between 1991 to 1997. It turns out that, although nominal wage cuts indeed become more customary during this period of time, the rigidity of nominal wages does not vanish but even increases over time. Our estimates indicate that the fraction of nominally rigid wages is between 35 and 40 percent among full-time workers who stay in their jobs. Moreover, nominal rigidity decreases if inflation or regional unemployment rises or if real per capita GDP growth decreases.

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## 1. Introduction

One of the core questions of modern macroeconomics is whether and through which channels nominal demand shocks affect output and employment. In this context, the inertia of nominal wages plays a key role. The extent and the nature of nominal wage rigidity is likely to have strong implications for the real effects of nominal demand disturbances. In recent years there has been a renewed interest in the question of nominal wage rigidity (e.g., Akerlof, Dickens, and Perry, 1996; Card and Hyslop , 1996; Kahn 1996; Lebow, Stockton, and Washer, 1995; McLaughlin, 1994, Smith, 1998), and, in particular, whether there are forces that prevent nominal wage cuts.

Below, we will argue that there are serious reasons – the existence of nominal loss aversion and nominal fairness standards – that may prevent firms from implementing nominal pay cuts. Most of the above cited evidence indicates that nominal pay cuts are indeed relatively infrequent. In this sense, the evidence is consistent with the assertion of nominal wage rigidity. A major counter-argument is, however, that the infrequency of nominal pay cuts is due to the fact that nominal per capita GDP growth and, hence, average nominal wages were rapidly rising during the periods considered by these authors (Gordon, 1996; Mankiw, 1996). If, instead, nominal per capita GDP growth would be low for a number of consecutive years, nominal pay cuts would be much more frequent and would, hence, no longer be viewed as something special. As a consequence, fairness standards and the reference points used to measure nominal losses would adjust so that firms would no longer be reluctant to cut nominal pay[1].

This paper examines whether nominal wage rigidities disappear in an environment of very low nominal per capita GDP growth. We take advantage of the rather low inflation during a period of almost zero real GDP growth in Switzerland between 1991 and 1997 and a newly available labour force survey. During this period Switzerland experienced inflation and growth rates close to zero in several consecutive years. Note that both low inflation and low

[1] This argument is neatly summarised by Gordon (1996, p. 62): "The … attempt to reason from evidence on nominal wage rigidity in an environment of rapid *positive* average nominal wage change to a hypothetical situation of *zero* average nominal wage change is subject to the Lucas critique. If the macroeconomic environment were different, microeconomic behavior would be different. Nominal wage reductions would no longer be seen as unusual if the average nominal wage was not growing. Workers would not see them as unfair, and firms would not shy away from imposing them."

real GDP growth provide an ideal environment for the study of the above counter-argument. Low real GDP growth means that structural changes and the associated reallocation of labor is likely to involve many *real* wage cuts. High real GDP growth would, instead, allow to reallocate labor by different, yet positive, growth rates of real wages for different types of labor. Inflation rates that are close to zero mean that the real wage cuts that are necessitated by structural economic changes and the required reallocation of labor also imply *nominal* wage cuts. Thus, if fairness standards and reference points indeed adjust to this environment, we should find no or at least declining evidence of nominal wage rigidity.

Our examination is based on a model that allows us to disentangle nominal wage rigidities from other determinants of real wage changes. *The results indicate that the reluctance to cut nominal wages is a robust phenomenon*: Up to 40 percent of all wage cuts that would be realized in the absence of nominal wage rigidity turn into wage freezes instead.

We also find that full-time workers' wages are more likely to be rigid than part-time workers' wages and that among job stayers the fraction of nominally rigid wages is much higher than among job movers. In addition, our results show that a rise in regional unemployment rates causes a small, yet significant, reduction in the fraction of real wage cuts that are prevented by nominal inertia. However, we also find that a one percentage point increase in inflation reduces the fraction of nominally rigid wages by more than a one percentage point increase in the regional unemployment rate.

Our results also indicate that in the absence of nominal rigidities, real wages would indeed be quite flexible in their response to unemployment. The estimates suggest that even incumbent employees' wage growth would be substantially reduced by an increase in unemployment if nominal inertia were absent. The effect is even stronger for those who switch jobs.

Our findings have potentially important implications for monetary policy. The estimates are consistent with the view that low inflation imposes permanently higher unit labor costs, as less real wage cuts occur, and that full-time workers are disproportionately affected. This may lead to permanently lower overall employment and distortions between full-time and part-time jobs.

The remainder of the paper is structured as follows: Section 2 discusses potential reasons for the downwards rigidity of nominal wages. Section 3 reviews the previous studies that used data similar to ours and highlights the advantages of our data set. Section 4 provides a description of the empirical pattern of wage changes in Switzerland between 1991 and 1997

and Section 5 presents our empirical model of wage changes. Section 6 presents the results and Section 7 concludes the paper.

## 2. Reasons for Nominal Wage Rigidity

From the viewpoint of the standard economic model with optimizing agents a nominal wage cut is nothing special. From a behavioral or psychological viewpoint, however, nominal pay cuts are special for at least two reasons:

(i) Nominal pay cuts are likely to be experienced as particularly painful for reasons of nominal loss aversion.

(ii) Nominal pay cuts are likely to violate standards of fairness and are thus interpreted as an insult by the employees.

The notion of loss aversion as developed by Kahneman and Tversky (1979) is based on the idea that losses and gains relative to a neutral reference point are the "carrier of subjective value" that motivates behavior. Loss aversion means that losses are psychologically more salient than gains of the same absolute size, i.e. they are experienced as particularly painful and are thus likely to trigger different behaviors than, e.g. a reduction in gains. There is ample evidence from questionnaire studies and many experimental examinations indicating the behavioral relevance of loss aversion (e.g., Tversky and Kahneman, 1991). Many people are willing to take more risks in the domain of losses (Kahneman and Tversky, 1979) and their financial decisions seem to be affected by loss aversion (Thaler and Tversky, 1996; Benartzi and Thaler 1995). Moreover, they make systematically sub-optimal decisions to avoid losses in intertemporal choice situations (Fehr and Zych, 1997), their ability to coordinate on Pareto-superior equilibria is systematically affected by the desire to avoid losses[2] (Cachon and Camerer, 1996) and price formation in competitive experimental markets also seems to be significantly influenced by loss aversion (Myagkoff and Plott, 1997).

[2] Cachon and Camerer show that in coordination games with multiple Pareto-ranked equilibria, the subtraction of a constant number from all payoffs, so that Pareto-inferior equilibria involve losses, enables agents to avoid the play of inferior equilibria. Note that the subtraction of a constant from all payoffs leaves the game strategically unchanged. The authors show, however, that the play of inferior equilibria *cannot* be avoided when these equilibria do not involve losses.

In a recent paper Genesove and Mayer (1998) provide strong evidence for nominal loss aversion in housing markets. They show that in a given market situation, i. e., for a given expected selling price, those sellers who bought their house at a higher nominal purchase price than the prevailing expected selling price ask for substantially higher selling prices than those sellers who bought their house below the prevailing expected selling price. Moreover, it turns out that sellers who face nominal losses relative to the original purchase price do in fact sell their houses at higher prices. Interestingly, Genesove and Mayer also find that nominal loss aversion is not only exhibited by owner-occupants but also by professional investors in the housing market.

In our view there is no reason why workers should exhibit less nominal loss aversion than owner-occupants or investors in the housing market. From a psychological viewpoint, it seems rather likely that nominal pay cuts are interpreted as losses. The pain inflicted by these losses may well trigger resentments that induce workers to take actions (e.g. shirking or quitting) that are costly to the firm. This, in turn, may prevent firms from implementing nominal pay reductions.

Survey and experimental studies indicate that fairness standards are relevant for the behavior of employees and employers (e.g. Bewley, 1995, 1999; Blinder and Choi, 1990, Campbell and Kamlani, 1997; Fehr and Falk, 1999; Fehr, Kirchsteiger, and Riedl, 1993). Virtually all of these studies suggest that violations of fairness standards have negative effects on work morale and that firms shy away from violating these standards. There is also evidence that judgements of fairness and job satisfaction are affected by nominal pay (Kahneman, Knetsch and Thaler, 1986; Shafir, Diamond, and Tversky, 1997). This is neatly expressed by the president of a large division (32,000 employees) of an insurance company, interviewed by Bewley (1999):

> *"Real pay cuts (through inflation) are easier than nominal ones. Inflation is gradual. Real pay cuts give people more time to adjust than a sudden 10% cut in pay. … Nominal pay cuts are an insult, even if everybody is cut."*

Bewley collected data from 236 managers and human resource officers regarding the consequences of pay cuts. He draws a consistent picture of compensation officers unwilling to cut nominal wages: 69% agreed that nominal pay cuts hurt morale, 42% feared a direct effect on productivity, 41% asserted that it increased turnover, and some 10% feared more drastic retaliation from employees such as theft or even sabotage.

In our view the employees' resentment in response to the experience of a nominal loss and the violation of fairness standards caused by the nominal pay reductions represent plausible forces inhibiting such cuts. However, in this context one has to take into account that both the definition and, hence, the experience of a loss and the definition of what is fair may shift in response to changes in the economic environment. Put differently: In a situation of very low average growth of nominal wages, pay cuts may become customary so that they are no longer perceived as losses or as a violation of a fairness standard. Therefore, loss aversion and fairness considerations may no longer inhibit nominal pay cuts. This claim can only be examined with data from periods of low average nominal wage growth and that is exactly the reason why the Swiss experience since 1991 is of general interest.

## 3. Previous Studies

In this section, we review four recent studies of wage rigidities that use data of individual wage changes from panel surveys or directly ask individuals to state the wage changes. We restrict attention to them, because of the similarity between our data and the ones used in these studies[3].

McLaughlin (1994) presents an early study of wage rigidities. He finds substantial variability in real wage changes, and concludes that wage changes are not skewed away from wage cuts. In his analysis, the frequency of wage cuts is unaffected by inflation.

Later studies could not replicate these results: Lebow et al. (1995) and Kahn (1997) have very similar findings. Kahn (1997) mentions that the skewness statistics are dominated by observations far away from the median and therefore susceptible to outlier influences. She shows that in a virtually identical data set as McLaughlin's a given real wage change is less likely if it entails a nominal pay cut. She finds strong evidence of nominal wage rigidities at the micro level, but does not address the issue how nominal rigidities affect real wage flexibility.

Card and Hyslop (1996) use a different technique to uncover nominal rigidities. They construct a counterfactual distribution of wage changes, i. e., a distribution of wage changes in

[3] There are other studies that look at wage rigidities, using different types of data sets. Groshen and Schweitzer (1997), e.g. use an employer matched data set over a long period of time. There are various studies using

the absence of nominal inertia. They find that, in the range of negative nominal wage changes, the difference between the counterfactual and the actual density of wage changes becomes larger as inflation declines. Hence, more individuals are affected by nominal rigidities at lower levels of inflation. Card and Hyslop also test whether low inflation leads to slower adjustment of real wages, but find no evidence for this.

Akerlof, Dickens, and Perry (1996) conduct a telephone survey and directly ask individuals to state their wage changes. They find that very few individuals had nominal wage cuts. The authors assess the macro-implications of such nominal rigidities. They estimate a macro model that explicitly incorporates nominal rigidities into the wage dynamics. Their model predicts that long-run unemployment is permanently higher as inflation approaches zero[4].

All of the above studies have in common that nominal per capita GDP growth was substantial over the period considered. The median growth rate of nominal GDP per capita is, for example, never below 6.4 percent in these studies (see Table 1). As pointed out in the introduction, it is therefore difficult to draw inferences from these studies about the behavior of individuals in an environment of low nominal growth. To examine whether nominal inertia vanishes or is reduced in an environment of low nominal GDP growth one needs a data set that is based on a prolonged period of low nominal growth. This is so because one cannot expect that nominal reference points and fairness standards adjust instantaneously to a new environment.

In this study we take advantage of the long recession with low inflation in Switzerland over the years 1991 to 1997. Table 1 shows that during this time period the median nominal per capita GDP growth is much lower (2.13 percent) than the median growth in the US during the time periods covered by the above cited studies. In addition, Table 1 reports the maximum number of *consecutive* years during which nominal per capita GDP growth is below 4 percent and below 2 percent. For the time periods covered by the above studies it occasionally happened that in a single year nominal per capita GDP growth was below 4 percent. However, nominal growth rates below 4 percent never occurred in two or more consecutive years. In

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evidence from wage settlements (Carruth and Oswald (1989), Crawford and Harrison (1997), Holzer (1996), Ingram (1996), Bates (1998)).

[4] In this model, firms are virtually unable to cut wages. Thus, with stochastic shocks to productivity, unit labour costs are higher at lower levels of inflation. Together with a downward sloping labour demand, unemployment is permanently higher at low levels of inflation.

contrast, in Switzerland nominal growth per capita was below 4 percent in all years during the period considered. Moreover, in three consecutive years nominal growth was even below 2 percent.

Before we proceed further a further characteristic of the Swiss labor market deserves to be mentioned. In contrast to many other European countries unions are comparatively weak in Switzerland. The union movement is split, its political influence is relatively small and only 25 percent of the work force is organized in unions. In addition, legal protection of workers from dismissals is virtually absent. This suggests that the institutional conditions for wage flexibility are quite favorable. Or put differently: If we find nominal wage rigidity in the Swiss labor market it seems difficult to attribute this to union power or to legal barriers to wage flexibility.

## 4. The Pattern of Nominal Wage Changes

We use the Swiss Labor Force Survey (SLFS) between 1991 – 1998 to calculate wage changes for 1991 to 1997. The SLFS is a rotating panel of approximately 16,000 individuals. We consider all non-self employed individuals who stated their incomes in two consecutive years for our sample.

To reduce coding errors, we only consider individuals with consistent answers to the wage question in the survey. By consistent we mean that the individual made the same type of earnings statement in two consecutive years[5] (e.g. net earnings per month or gross hourly wage in both years). However, none of the qualitative results are changed, if we include inconsistent answers[6]. This leaves us with a sample of 15,624 individual observations of wage

[5] We believe that this is a very effective way to eliminate measurement errors. A major difference between consistent and inconsistent answers is that if we include inconsistent answers the distribution of wage changes has a spike at –11 and at +11 percent. Both spikes vanish if only consistent answers are used to calculate the distribution of wage changes. Since in Switzerland the difference between gross and net earnings is, on average, 11 percent the two spikes are probably due to the fact that some individuals mixed up gross and net earnings when asked. We also examined whether the two groups differ in other characteristics, such as tenure, experience, the fraction of full time employed, the fraction of job movers, etc., but we found no significant differences in means.

[6] The difference is the classical one with measurement errors: The estimated coefficients are biased towards zero and the standard errors blurred. But the problem is not serious enough for our results to become insignificant.

changes over the seven years. Since most of the individuals in our sample are salaried, wages are defined as earnings per working hour, as specified in the labor contract[7]. The measure of wage changes are log differences of wages.

Figure 2 presents histograms for the distribution of wage changes for the years 1991 to 1997 and Figure 3 shows the histogram for the data of all 7 years. The pattern of wage changes exhibits the following characteristics: Except for 1991 the distribution is characterized by a mass point (spike) for wage changes between zero and two percent. In addition, the distribution is asymmetric because there are far fewer negative nominal wage changes than positive wages changes. A considerable fraction of the spike at the interval [0,2] is due to wage earners with no nominal wage change at all. In Table 2 (column 4) we present the fraction of workers with a zero nominal wage change. The table shows that this fraction rises from 8 percent in 1991 to roughly 22 percent in 1997. However, Table 2 also shows that the fraction of workers receiving a wage cut increases from 17 percent in 1991 to 32 percent in 1996 and 28 percent in 1997.

The raw data thus reveal no unambiguous picture. On the one hand we observe that wage cuts become indeed more customary the longer the economy experiences low nominal GDP growth. This seems to suggest less nominal inertia. On the other hand we also observe an increase in the fraction of workers that receive no wage changes. This could be taken as evidence of increased nominal inertia.

## 5. An Empirical Model of Wage Changes

To resolve the ambiguities arising from the description of the aggregate data we estimate a simple model that provides explicit estimates of the extent and the determinants of nominal wage rigidity. Our model is based on the idea that the usual determinants of individuals' wages, e. g., aggregate factors like the regional unemployment rate and individual factors like schooling, tenure, instances of job switching between firms and sectors, etc., sometimes imply ('require') a real wage reduction for given individuals. Whether the real wage reduction actually occurs depends – among other things – on the strength of the forces that contribute to

[7] Again, to prevent measurement errors, we do not calculate wages as earnings divided by hours *worked*. Bound and Krueger (1991) found that hours worked is heavily polluted with measurement errors. In our sample, hours contracted exhibits significantly less variability than hours worked.

nominal inertia. If these forces are strong one would expect that a large fraction of those ('required') real wage reductions that imply a decrease in the nominal wage do not in fact occur, i. e. downwards rigidity of nominal wages prevents a large fraction of real wages from falling. If, in contrast, the forces causing nominal inertia are weak the fraction of prevented real wage reductions will be small. Moreover, if inflation rises the number of 'required' real wage reductions that also imply nominal wage reductions falls and, therefore, the overall fraction of prevented real wage reductions should fall.

To be more specific, assume that, in the absence of nominal rigidities, individual *i* would receive an 'unconstrained' real wage change in year *t* of

$$\Delta\hat{w}_{ijt} = x_{jt}'\,\beta + e_{it}'\,\gamma + e_{it}^{*} \qquad (1)$$

where *x* is a vector of labor market characteristics in region *j*, *e* a vector of observable individual characteristics, $\beta$ and $\gamma$ are the coefficients corresponding to the explanatory variables and *e** is unobservable. Equation (1) describes what the real wage change would be in the absence of forces causing nominal rigidities. However, if these forces are present, $\Delta\hat{w}_{ijt}$ can fall into three regimes, depending on whether it entails a wage cut or not.

If $\Delta\hat{w}_{ijt} + p_t > 0$, the wage change is positive in nominal terms, hence i's employer is not constrained by nominal rigidities and

$$\Delta w_{ijt} = \Delta\hat{w}_{ijt},$$

i.e. the actual wage change equals the 'unconstrained' one. If $\Delta\hat{w}_{ijt} + p_t < 0$, *i*'s employer would like to cut *i*'s nominal wage. However, with probability $p_i$ the forces causing nominal inertia will prevent a nominal wage cut, i. e., *i* gets a zero nominal change, or, in real terms:

$$\Delta w_{ijt} = -p_t.$$

Of course, the stronger the forces that contribute to nominal inertia the bigger will be $p_i$. With probability $1 - p_i$ nominal inertia will not be sufficiently strong so that *i* experiences

$$\Delta w_{ijt} = \Delta\hat{w}_{ijt}.$$

Note that if $p_i$ is positive for many individuals a fraction p of real wage cuts does not occur which contributes to the existence of a mass point at zero nominal changes. Summarizing the three cases above , the likelihood $L_{ijt}$ for *i*'s actual real wage change is given by

$$L_{ijt} = \begin{cases} f(\Delta w_{ijt} \mid \Delta w_{ijt} > -p_t) & \text{if } \Delta w_{ijt} > -p_t \\ p_i \cdot F(-p_t) & \text{if } \Delta w_{ijt} = -p_t \\ (1-p_i) \cdot f(\Delta w_{ijt} \mid \Delta w_{ijt} < -p_t) & \text{if } \Delta w_{ijt} < -p_t \end{cases} \quad (2)$$

where $f$ and $F$ are the density and c.d.f of $\Delta w_{ijt}$ respectively. In principle, one can estimate equations (1) and (2) by maximum likelihood. In order to get an estimate of $p$ that lies between zero and one, we choose the following functional form:

$$p_{ijt} = \frac{\exp(z_{ijt}' r)}{1+\exp(z_{ijt}' r)} \quad (3)$$

where $z$ is a set of explanatory variables discussed below and $r$ the corresponding vector of coefficients.

One feature of our approach is that we can estimate an explicit measure of nominal wage rigidity, i.e. the fraction $p$ of prevented real wage cuts. If $p$ is significantly positive there is evidence for nominal wage rigidity. A second feature is that we can explicitly estimate the determinants of $p$. This allows us for instance, to assess the impact of regional unemployment, inflation, and real per capita GDP growth on $p$. In addition, we can study the evolution of $p$ over time, i.e. whether p declines as wage cuts become more customary. Finally, we also can examine whether $p$ is different for full-time and part-time workers or for job stayers and job movers. If it is indeed the case that nominal wage cuts hurt work morale it may be better for firms to fire a worker than to cut her nominal wage. It seems very likely that the new employer of the fired worker is not constrained by the impact of historically evolving fairness standards simply because there is no employment history. Therefore, it seems much easier to impose pay cuts on job movers than on job stayers. A similar argument can be made with regard to full-time and part-time workers. For a firm the loyalty and work morale of full-time workers is, of course more important than the loyalty and work morale or part-time workers. Moreover, the relevance of fairness standards is likely to be more important for workers with a greater attachment to the firm. Therefore, firms are likely to be more reluctant to cut the nominal wages of full-time workers.

## 6. Results

In this section, we present the results from the maximum likelihood estimation of (1), (2) and (3). We make the assumption that the $e^*$ are i.i.d. and follow a normal distribution. We will first address the evidence for nominal rigidities and assess the impact of the various factors discussed above on the fraction of prevented real wage cuts $p$. We then analyze how wage changes react to changes in unemployment, once one allows a fraction of wages to be rigid.

### 6.1. The Extent and the Determinants of Nominal Wage Rigidity

According to our model the extent of nominal wage rigidity is captured by the size of $p$. Table 3 presents the estimates for various specifications of equation (3). Since the implications of these estimates for the fraction of rigid wages $p$ requires some calculations Table 4 presents the values of p that are implied by the estimates in Table 3.

In column (A) of Table 4 we impose the same $p$ on all job movers and job stayers: The only determinants of $p$ are a constant and a dummy variable equal to one, if the worker stayed with the same employer during the respective year. Both the job stayer dummy and the constant are significant at the 1 percent level. Column (A) in Table 4 shows that, on the basis of specification (A), the point estimate for $p$ is 36.4 percent for job stayers and 15.8 percent for job movers. This gives a first indication that nominal wage rigidity is substantial for job stayers and that there are large differences between job stayers and job movers.

In column (B), we introduce an additional dummy variable for full-time workers. As hypothesized in the previous section we find that being a full-time worker has a big and highly significant impact on the probability of receiving a zero wage change instead of a pay cut. According to column (B) in Table 4 $p$ is much larger for full-time workers compared to part-time employees and the difference is highly significant. The point estimates are 39.4 percent for full-time employees and 22.2 for part-time employees. Moreover, on the basis of specification (B) the point estimate of $p$ for job movers is only 8.3 percent.

In column (C) of Table 3 we include real per capita GDP growth, the rate of inflation and the unemployment rate in individual $i$'s canton of residence in the regression. The idea here is that improving job prospects, i.e., less unemployment, render individuals less willing to accept a wage cut. Whether a decrease in inflation gives rise to a lower fraction of rigid wages because wage cuts become more customary or whether it induces an increase in $p$ is an open question. Likewise, a reduction in real per capita GDP growth is associated with a rise in the frequency

of real and nominal wage cuts which might well reduce the fraction of rigid wages because wage cuts are more customary. Our estimates in column (C) indicate that a rise in unemployment and inflation reduces the fraction of rigid wages at the one percent significance level. This suggests that inflation and unemployment "grease the wheels of the labor market". The estimates imply that a rise in the unemployment rate by one percentage point decreases *p* by 1.6 percentage points while a rise in inflation by one percentage point decreases *p* even by 2.3 percentage points. Thus, the grease effect of inflation is higher than the grease effect of the unemployment rate. Real per capita GDP growth has a positive impact on the fraction of rigid wages at the five percent level. A one percentage point increase in real per capita growth increases the *p* by 1.5 percentage points.

A further important result of column (C) is that neither the size nor the significance levels of the job stayer dummy and the full-time dummy are affected by the inclusion of the three other variables. This indicates that the quantitative results reported in column (B) are quite robust. What do the estimates in column (C) imply for the point estimate of *p*? The implied value of *p* for job movers is 8.6 percent, the implied value for full-time stayers is 40.6 percent and the implied value for part-time stayers is 23 percent (see Table 4). Thus, these estimates are very similar to those of column (B) which indicates again the robustness of the results.

In column (D) of Table 3 we interact the real per capita growth rate, the inflation rate and the cantonal unemployment rate with a job mover (job stayer) dummy. The results indicate that these three variables have no significant impact on the fraction of rigid wages among job movers. In view of the rather low size of *p* for job movers in column (B) and (C) of Table 4 this result is not so surprising. For job stayers, however, the inflation and the unemployment variables remain highly significant and the real per capita growth is still significant at the 5 percent level. Moreover, the size of the coefficients for the job movers in column (D) are very similar to the size of the coefficients in column (C). In column (E) we do not interact job mover dummies with real growth, inflation and unemployment. This leaves the impact of these variables on job stayers completely unchanged and causes only minor changes in the job stayer dummy and the full-time dummy.

The above results indicate that nominal inertia prevents between 35 and 40 percent of real wage cuts for full-time job stayers. For part-time stayers roughly 20 percent of real wage cuts are prevented by nominal inertia while for job movers less than 10 percent of the real wage cuts are prevented. Regional unemployment and inflation has a significant grease-effect on the

labor market, i.e. reduces the fraction of prevented real wage cuts. Interestingly inflation seems to have a bigger grease-effect than the rate of unemployment.

To provide a picture of the evolution of nominal rigidity over time Figure 3 depicts the values of $p$ that are predicted by the specification in column (C) together with the evolution of inflation and real per capita GDP growth. The scale on the right hand side measures the value of $p$ while the scale on the left hand side of Figure 3 measures inflation and real per capita GDP growth. The figure indicates that, although wage cuts become more customary over time (see Table 2), the fraction of rigid wages increases over time. In the same time period the rate of inflation decreases from roughly 5 percent in 1991 to zero in 1997. It is also interesting to note that $p$ reaches its highest value when inflation is at its minimum. This suggests that, contrary to the hypothesis that nominal wage rigidity will tend to vanish in an environment where wage cuts become more customary, nominal wage rigidity is rather robust phenomenon.

### 6.2 Wage Changes in the Absence of Nominal Rigidities

We now turn to the estimation of equation (1). Recall that (1) can be interpreted as the real wage changes as they would be if nominal rigidities were absent. This is so because when we estimate (1) the peculiar features of the distribution of wage changes (i. e., the asymmetry and the spike at zero) as modeled in (2) is explicitly taken into account. Intuitively, this means that our ML-estimates of equation (1) are similar to Tobit-estimates. If the fraction of rigid wages would be $p = 1$ then our estimate would be identical to a Tobit-estimate with a binding lower bound on wage changes at nominal zero. Formally, our estimation method means that observations of real wage changes of $-p$ have the likelihood $pF(-p)$ instead of $f(-p)$ and observations of real wage changes below $-p$ have the likelihood $(1-p)f(.)$ instead of $f(.)$, where $f(.)$ and $F(.)$ are the density and the c.d.f. of the real wage changes. Since our ML-estimates of (1) explicitly take into account the existence of nominal inertia they provide information about the responsiveness of real wage changes to other economic factors that is not confounded by the existence of nominal inertia.

We experimented with a number of labor market related variables, but in the following, $x$ will contain changes in the cantonal unemployment rate, as well as regional and time fixed effects

as indicated below. In all models, we include a set of individual characteristics[8] in order to remove individual specific differences in wage growth.

The estimates of (1) are displayed in Table 5. As before, the most restrictive version of the model is reproduced in column (A). We impose the same coefficient on the change of unemployment on all individuals. The point estimate is negative and highly significant. It suggests that a one percent increase in unemployment reduces average wage growth by 0.45 percent. The level of the unemployment rate has no significant impact on average wage growth.

In column (B), we distinguish between job stayers and job movers and allow a different coefficient on $\Delta u$, depending on whether the individual changed jobs or not. Job movers' wage changes are far more sensitive to changes in unemployment. The point estimate of – 0.94 is more than two times larger (in absolute value) than the one for job stayers. Still, a one percent increase in unemployment decreases the wage growth of job stayers by 0.41 percent if nominal rigidities were absent. The average first year premium from switching jobs can be read off from the coefficient on the job mover dummy variable and is estimated to be 2.7 percent, indicating strong self-selection of job changes. As for the specification in column (A) the unemployment level has not significant impact on the wage growth.

In column (C) we, therefore, remove the unemployment level from the regression. This changes the other coefficients relative to specification (B) only slightly indicating the robustness of the results. In columns (D) and (E) we show that the differences in the impact of $\Delta u$ on the wage growth of job stayers and job movers are robust with respect to the inclusion of regional and time fixed effects. In column (D) we control for regional fixed effects. The result indicates that $\Delta u$ has still a much stronger impact on job movers' than on job stayers' wage growth. Hence, regional differences in job mobility does not explain this difference. In fact, the point estimates of both coefficients on the change in umemployment get slightly larger. Column (E) shows that real wages changes in Switzerland are not entirely driven by common business cycle components because local variations in $\Delta u$ have a strong impact on wage growth.

[8] These characteristics were: tenure, tenure squared, experience, experience squared, as well as dummy variables for job categories and education levels.

The results of Table 5 indicate that real wage growth would be fairly responsive to changes in unemployment, if nominal rigidities were absent. This is true even for job stayers, although the impact on job movers is much stronger.

## 7. Concluding Remarks

The argument that nominal inertia vanishes during a relatively long period of low nominal per capita GDP growth is not supported by our data. Our results do not lend support to the conjecture that the forces that contribute to nominal inertia are easily malleable by the macroeconomic environment. Although it is indeed the case that nominal wage cuts become more customary in a low nominal growth environment the fraction of rigid wages does not decline. Instead, it turns out that the fall in inflation gives rise to an increase in the fraction of rigid wages. For full-time workers who stay in the same firm between 35 to 40 percent of real wage cuts are prevented by nominal inertia. For part time job stayers the fraction of rigid wages is considerably lower (i.e., 22 percent) although it is still substantial. Only for job movers nominal wage rigidity is rather low. Increases in regional unemployment reduce the fraction of rigid wages and increases in real per capita GDP growth increase nominal rigidity. Interestingly, the impact of a rise in inflation on the fraction of rigid wages is higher than the impact of a rise in regional unemployment.

We also provide estimates of the impact of unemployment and unemployment changes on individuals' real wage growth that are not confounded by the existence of nominal inertia. We find a negative and significant impact of changes in regional unemployment rates on real wages growth.. A one percent increase in unemployment decreases incumbents' wage growth by approximately 0.4 percent, and this effect is even stronger for workers who switched jobs. This implies that real wages would exhibit substantial flexibility if only nominal rigidities were absent.

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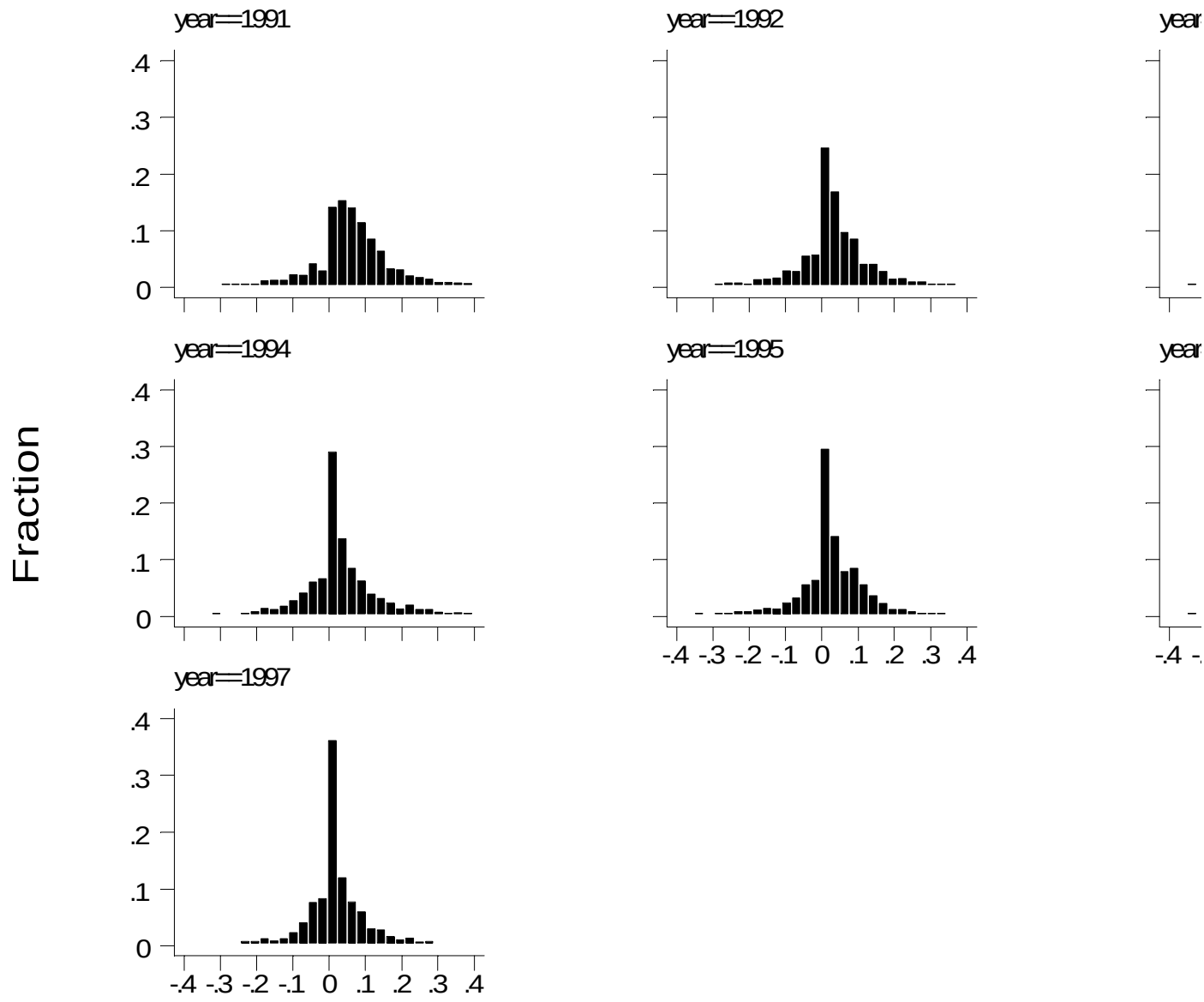


Frequency of Log Wage Changes, by Year

Figure 1

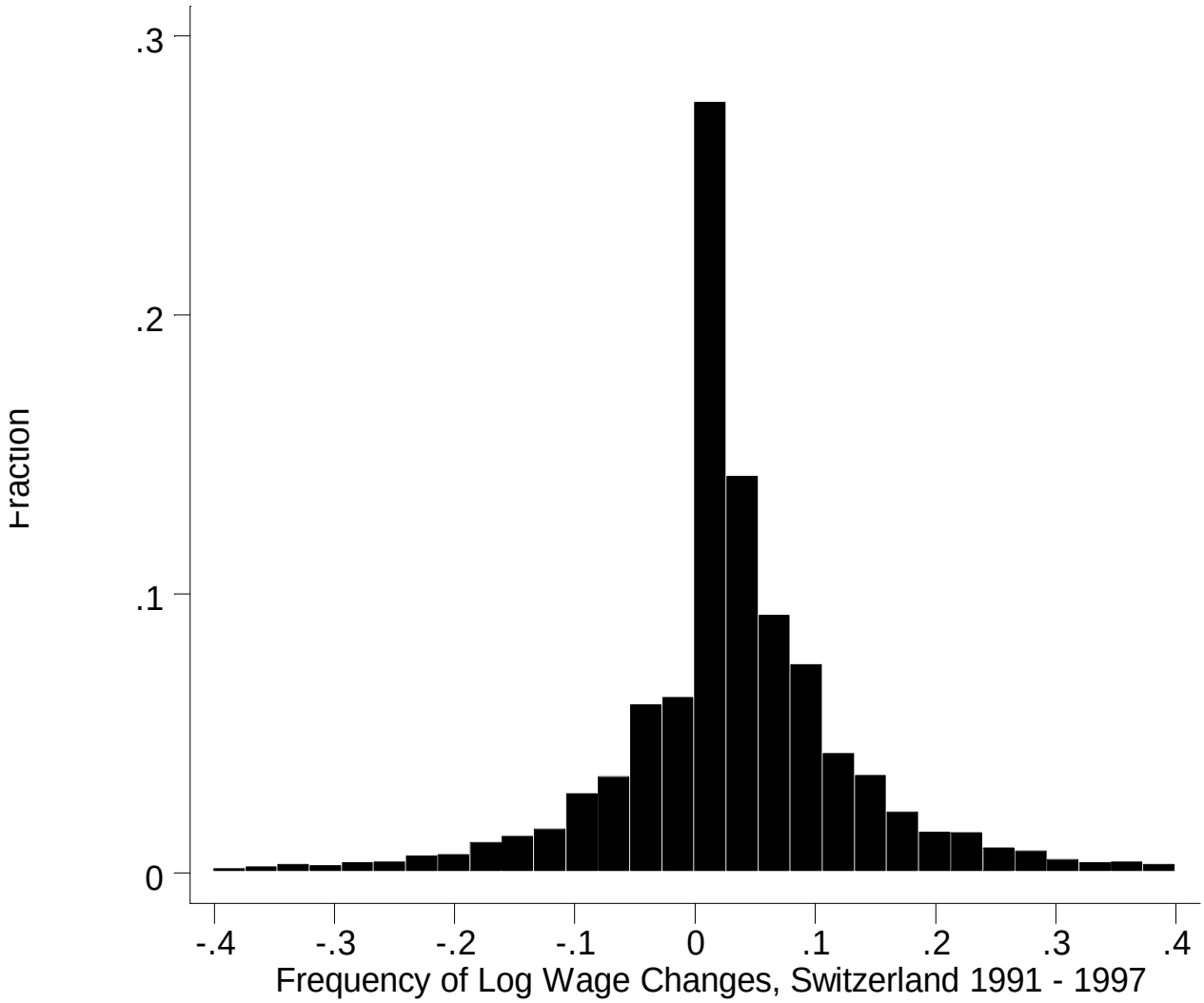
Fraction
.3
.2
.1
0
-.4
-.3
-.2
-.1
0
.1
.2
.3
.4
Frequency of Log Wage Changes, Switzerland 1991 - 1997

Figure 2

## Figure 3: The Predicted Fraction of Rigid Nominal Wages over Time

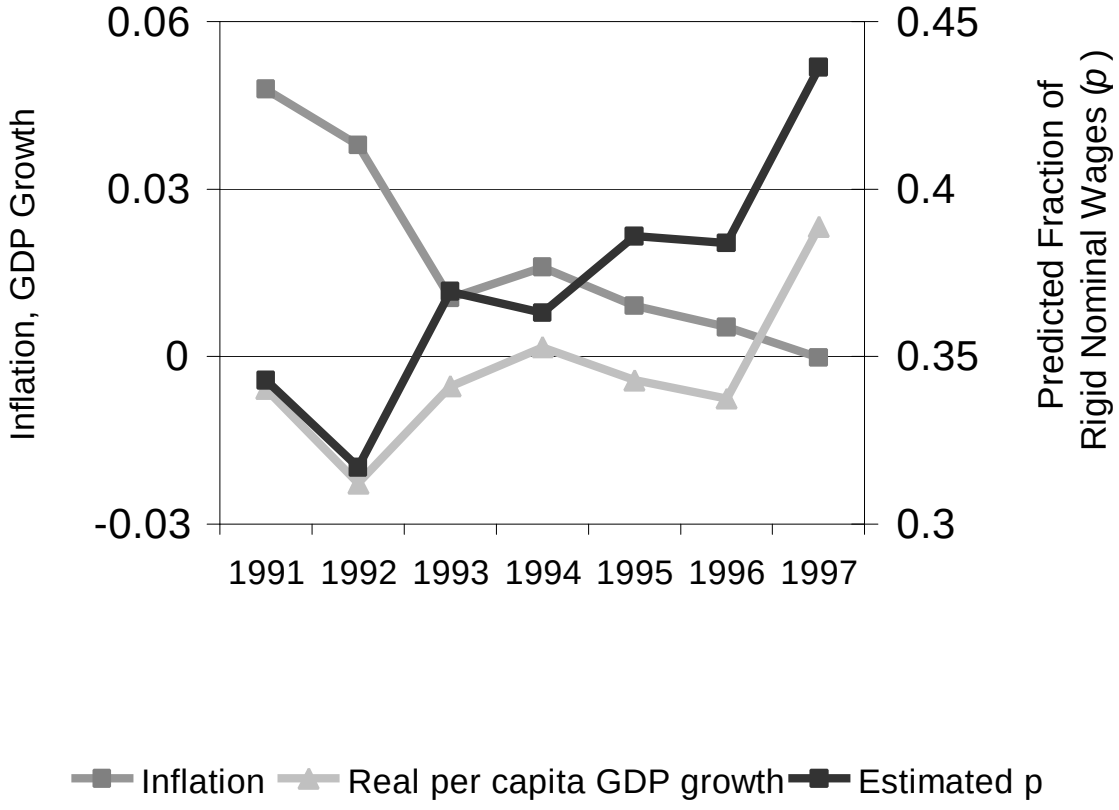

TABLE 1: NOMINAL GDP PER CAPITA GROWTH DURING THE SAMPLE YEARS

| | YEARS CONSIDERED | MEDIAN | NUMBER OF CONSECUTIVE YEARS BELOW | |
|---|---|---|---|---|
| | | | 4 PERCENT | 2 PERCENT |
| A. PREVIOUS STUDIES (UNITED STATES) | | | | |
| Card and Hyslop (1996) | 1976 – 1991 | 7.19% | 0 | 0 |
| McLaughlin (1994) | 1976 – 1986 | 9.59% | 0 | 0 |
| Kahn (1997) | 1971 – 1988 | 7.28% | 0 | 0 |
| Akerlof, Dickens, and Perry (1996) | 1945 – 1995 | 6.47% | 0 | 0 |
| B. THIS STUDY (SWITZERLAND) | 1991 – 1997 | 2.13% | All Years | 2 |

Sources: Population Distribution Branch, Bureau of the Census; Compiled by Jordan Rappaport, Department of Economics, Harvard University, January 1996, Federal Office of Statistics, Swiss Labour Force Survey 1991 - 1998; own calculations

TABLE 2: DESCRIPTIVE STATISTICS OF WAGE FREEZES AND WAGE CUTS IN THE SWISS LABOR FORCE SURVEY, 1991 – 1997

| YEAR | RATE OF INFLATION | PER CAPITA REAL GDP GRWOTH | FRACTION WITH ZERO NOMINAL WAGE CHANGE | FRACTION WITH NOMINAL WAGE CUT | NUMBER OF OBSERVATIONS |
|---|---|---|---|---|---|
| 1991 | 4.7% | -0.8% | 0.080 | 0.172 | 2060 |
| 1992 | 3.7% | -1.9% | 0.123 | 0.245 | 2324 |
| 1993 | 1.1% | -0.8% | 0.135 | 0.278 | 2512 |
| 1994 | 1.6% | 0.1% | 0.075 | 0.262 | 2575 |
| 1995 | 0.9% | -0.4% | 0.092 | 0.247 | 1829 |
| 1996 | 0.6% | 0.5% | 0.205 | 0.321 | 2088 |
| 1997 | -0.02% | 2.3% | 0.217 | 0.279 | 2236 |

Sources: Federal Office of Statistics, Swiss Labour Force Survey 1991 - 1998; own calculations

TABLE 3: THE FRACTION OF RIGID WAGES

DEPENDENT VARIABLE: $p_{ijt} = \frac{\exp(z_{ijt}'r)}{1+\exp(z_{ijt}'r)}$

ML ESTIMATES

| | (A) | (B) | (C) | (D) | (E) |
|---|---|---|---|---|---|
| Job Stayer (Dummy Variable) | 1.106** (8.10) | 1.151** (8.38) | 1.156** (8.40) | 1.641** (2.94) | 1.622** (9.27) |
| Full-time Employed (Dummy Variable) | | 0.822** (11.56) | 0.825** (11.56) | 0.825** (11.56) | 0.824** (11.55) |
| Cantonal Unemployment Rate ($u_{jt}$) | | | -6.680** (3.64) | | |
| Real per capita GDP growth ($\Delta GDP_t$) | | | 6.373* (2.45) | | |
| Rate of Inflation ($p_t$) | | | -9.676** (3.53) | | |
| $u_{jt} \cdot Stayer_{it}$ | | | | -6.980** (3.73) | -6.980** (3.73) |
| $\Delta GDP_t \cdot Stayer_{it}$ | | | | 6.278* (2.36) | 6.278* (2.36) |
| $p_t \cdot Stayer_{it}$ | | | | -10.103** (3.60) | -10.103** (3.60) |
| $u_{jt} \cdot Mover_{it}$ | | | | 0.713 (0.08) | |
| $\Delta GDP_t \cdot Mover_{it}$ | | | | 8.452 (0.68) | |
| $p_t \cdot Mover_{it}$ | | | | 0.204 (0.02) | |
| Constant Term | -1.713** | -2.403** | -1.959** | -2.425** | -2.405** |

| | | | | | |
|---|---|---|---|---|---|
| | (12.81) | (16.21) | (10.81) | (4.40) | (16.22) |

Source: Swiss Labor Force Survey 1991 - 1998, own calculations

Notes: a. stadard errors in parenthesis. *, ** denotes significance at the 5 percent and 1 percent level respectively

b. Number of observation: 15,624. See text for a description of the data.

TABLE 4: IMPLIED FRACTIONS OF RIGID WAGES

BASED ON ESTIMATES FROM TABLE 3

| | RESPECTIVE COLUMN IN TABLE 3 | | |
|---|---|---|---|
| | (A) | (B) | (C) |
| IMPLIED $p_i$ | | | |
| For Stayers | 36.4% | | |
| For Movers | 15.8% | 8.3% | 8.6% |
| For Full-Time Stayers | | 39.4% | 40.6% |
| For Part-Time Stayers | | 22.2% | 23.0% |

Source: Swiss Labor Force Survey 1991 - 1998, own calculations

Notes: a. All calculations are based on estimates from table 3.

b. Estimates in column (C) are calculated using the average unemployment rate.

TABLE 5: THE UNCONSTRAINED WAGE EQUATION

DEPENDENT VARIABLE: $\Delta\hat{w}_{ijt}$

ML ESTIMATES

| | (A) | (B) | (C) | (D) | (E) |
|---|---|---|---|---|---|
| $\Delta u_{jt}$ | -0.449**<br>(-4.37) | | | | |
| $u_{jt}$ | -0.023<br>(-0.499) | | | | |
| $\Delta u_{jt} \cdot Stayer_{it}$ | | -0.411**<br>(-3.85) | -0.332**<br>(-2.96) | -0.427**<br>(-3.82) | -0.566*<br>(-2.38) |
| $u_{jt} \cdot Stayer_{it}$ | | -0.000<br>(-0.00) | | | |
| $\Delta u_{jt} \cdot Mover_{it}$ | | -0.940*<br>(-2.43) | -0.852*<br>(2.16) | -1.013**<br>(-2.62) | -1.163**<br>(-2.64) |
| $u_{jt} \cdot Mover_{it}$ | | -0.318<br>(-1.79) | | | |
| Job Mover (Dummy Variable) | 0.010**<br>(2.91) | 0.027**<br>(3.19) | 0.015**<br>(3.22) | | |
| Time Fixed Effects | No | No | No | No | Yes |
| Regional Fixed Effects | No | No | No | Yes | No |

Source: Swiss Labour Force Survey 1991 – 1998; own calculations.

Notes: same as table 3. All estimates include a constant term, labor market experience, job categories (dummy variables), educational dummies.