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Where Have All the Workers Gone? Employment Termination in East Germany after Unification

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Abstract

Employment termination in East Germany in the first nine months after unification is analyzed within a discrete hazard rate model with three absorbing states, namely short-time work, unemployment and non-participation. Estimation is based on a cohort of employed individuals in June 1990 and the calendar data in the second wave of the German Socio-Economic Panel (East). The time-dependency (duration dependence) of these rates is described by a flexible specification of the baseline hazard function. The effects of personal characteristics, education and occupation, wages, firm characteristics as well as industry and region on both the transition rates into the three states and the survival rate in employment are analyzed.

1   Introduction

In the wake of currency, economic and social union (CESU) and the implied pro-found economic and institutional changes production and employment in the east German economy decreased dramatically. Overall employment in the economy fell from roughly 9 million in the second quarter of 1990 to a yearly average of just over 6 million in 1992. By the end of this period, the official unemployment rate was some 17 percent, starting from virtually zero in 1990. Although these numbers are impressive, they give only an incomplete picture of the dramatic employment losses. In the first few months after CESU employment was reduced by about half a million by early retirement schemes which are still in use, if on a more moderate scale, to cushion the restructuring process. Of even greater importance has been the use of short-time work to avoid mass layoffs by firms with very little chance to survive this process, where of short-time workers peaked in the second quarter of 1991 at nearly 2 million with an average working-time of only 50 percent of standard hours. Since then, labor market programs and vocational training schemes financed by the federal labor office have become increasingly important; during 1991 about half a million persons have been in one of these programs (see, e.g., Sachverständigenrat, 1992).

So far, most empirical accounts of labor market developments in East Gemany are based on aggregate data and focus on the stocks of employment or unemployment at a given point in time rather than on the flows between these labor market states. For at least two reasons, such analyses do not give an adequate description of the labor market impacts of the restructuring process in East Germany. First, it affects individuals quite differently depending on, inter alia, their personal characteristics, qualification and occupation as well as firm and industry where they have been employed. In view of the sharp overall wage increases in East Germany after unification a very important question is to what extent individual employment opportunities are, given these factors, affected by the wage structure and changes in individual wages. Second, transitions between labor market states should be particularly important during the restructuring process to a market economy (see Bellmann et al., 1992), where in East Germany short-time work also seems to play an important role (see Büchel/Pannenberg, 1992). This is also confirmed by offical statistics on aggregate labor market flows (see, e.g., Bundesanstalt für Arbeit, 1992, p. 785).

There are only a few studies which attempt to analyze labor market transitions in East Germany at the individual level (Bellman et al., 1992; Büchel/Pannenberg, 1992). These studies focus on individual transitions between different labor market states and quantify some of the factors affecting these transitions. The present paper is an empirical analysis of the determinants of the transitions from employment into short-time work, unemployment and non-participation in the first nine months after the introduction of CESU using data from the first two waves of the German Socio-Economic Panel for East Germany. It differs from the mentioned studies in both the sample design and the specification of the econometric model, and also takes into account the effects of some additional important explanatory variables on individual employment behavior, in particular wage effects.

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The remainder of the paper proceeds as follows. The data base and the sample design are briefly described in the next section. The econometric model used to analyze the determinants of these transitions is presented in some detail in chapter 3. The main results of the study are summarized and discussed in chapter 4, and chapter 5 concludes.

2   Data and sample design

The empirical analysis of the present paper is based on the first two waves of the Socio-Economic Panel for East Germany (GSOEP-East) which is a representative sample of the resident population on a household basis. In the first wave, which was carried out in June 1990 immediately before the introduction of the CESU, some 4,000 individuals older than sixteen years of age living in about 2,000 households were interviewed. The answers to the questionaire give information on an individual´s employment status, personal characteristics, educational and occupational indicators, industry and region of residence, wages etc.[1]. The second wave of the GSOEP-East was conducted in Spring 1991 with a somewhat more detailed questionaire.

Besides the employment status at the date of interview the GSOEP-East also contains "calendar" information on an individual´s employment status in, respectively, nine (first wave) and ten (second wave) categories[2] for each month within the period July 1989 to March 1991. Given that we are interested in employment dynamics after the introduction of the CESU here, and that we want to take into account the transitions from employment into short-time work, the following analysis is restricted to the period June 1990 to March 1991. Hence, we only use the "calender" information on an individual´s monthly labor market status from the second wave which is aggregated into the four categories

(i)   *employment,*

(ii)   *short-time work,*

(iii) *unemployment, and*

(iv)   *non-participation.*

This aggregation is motivated by both the consideration that these four categories are by far the most important ones from an economic viewpoint and by the sample size, especially with respect to the aggregation of (early) retirement with other forms of non-participation. The category *employment* also includes employees in firm training schemes and commuters to the western part of Berlin and West Germany (for an analysis of the latter see Scheremet/Schupp, 1991). In the period under consideration, short-time employment has been a quantitatively very important way of employment adjustment and seems to be sufficiently different in structural aspects from normal employment to warrant an own category (see Büchel/Pannenberg,

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[1] For a general description of the GSOEP-East see Schupp/Wagner (1990).

[2] The category *short-time work* was only introduced in the second wave.

1992). In this period, special employment programs and training schemes administered by the federal labor office, which are not explicitly recorded in our data base and can therefore not be distinguished from normal employment, were quantitatively unimportant. Finally note that job-to-job transitions without intervening spells of non-employment are not taken into account by this aggregation of states.

Our sample design refers to a subsample of all persons in the GSOEP-East

- who have been employed in June 1990, and

- for whom there is complete information on both the calender date in the period July 1990 to March 1991 and all explanatory variables in the model.

This sample selection has the advantage that the analysis refers to a well defined cohort of persons, namely those employed immediately before the introduction of the CESU. Given these restrictions the remaining subsample consists of 3,010 individuals for whom there is complete information available.

For this subsample, the transitions from (full-time) employment into short-time work, unemployment and non-participation in each month within the observation period are given in Figure 1. The peak for all three transition was already reached in July 1990. Transitions into short-time work and non-participation have remained considerable throughout the period, while those into unemployment have stabilized at a relatively low level. Note the local peaks for the transitions into short-time work and non-participation in, respectively, December 1990 and October 1990 as well as February 1991.

Figure 1.   Transitions from Employment into Short-time Work,
Unemployment and Non-participation

July 1990 - March 1991
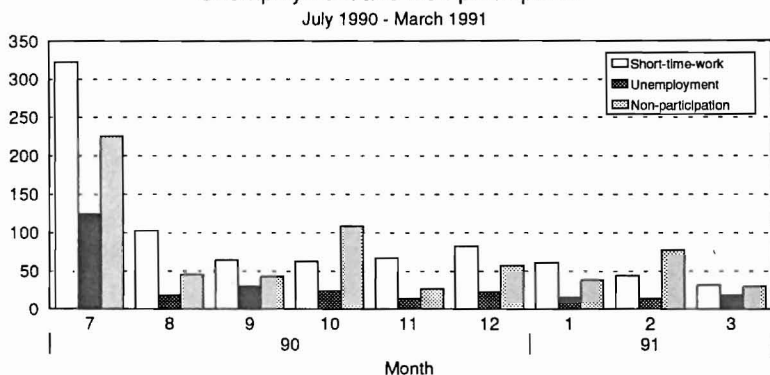
Source: GSOEP-East, waves 1-2; own calculations

The process of employment termination can concisely be described by the *empirical survivor function* which, in the present context, shows the number of those with continuous employment up to a particular month within the period June 1990 to

March 1991 relative to the number of those employed at the beginning of this period. As Figure 2 shows, the survivor function declines sharply throughout. In March 1991, 60 percent of those employed in June 1990 had changed their labor force status at least once or, to put it differently, only 40 percent have remained in their former employment status.

Figure 2. Empirical Survivor Function and Employment Ratio
June 1990 - March 1991
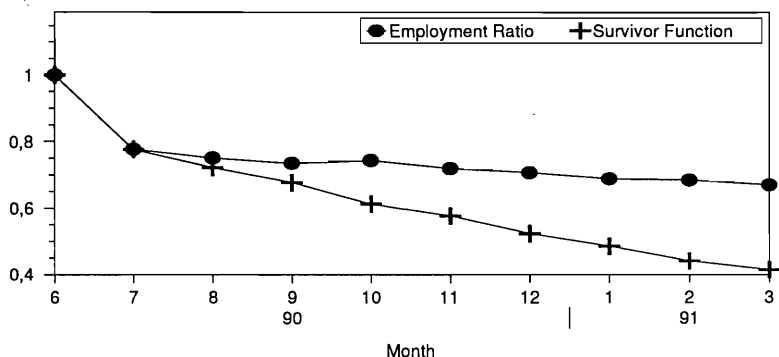
Source: GSOEP-East, waves 1-2; own calculations

This dramatic picture has, however, to be qualified somewhat with respect to the employment consequences of the restructuring process, since the survivor function does not take into account re-entrants into employment. Since a considerable number of workers whose unemployment spell terminated within the observation period find a new job or return to full-time work within a relatively short period of time, the *employment ratio*, ie. the employment stock in a given month normalized by the number of persons employed in June 1990, and the survivor function diverge over time. As the plot of the employment ratio in Figure 2 shows, in June 1991 more than two thirds of the cohort are still in the old job or have found a new one in the meantime. Half of all new transitions into employment within the observation period have been from short-time work, the other half splitting up roughly equally into transitions from unemployment and non-participation. Taking into account repeated unemployment spells would make the econometric analysis considerably more complicated if we allowed for state dependence effects, which will not be attempted here.

3   A discrete hazard rate model of employment termination

In this section we present the econometric model which is used to analyse and quantify important determinants of the transitions from employment into short-time work, unemployment and non-participation. These transitions will be analyzed within a discrete hazard-rate model, where the dependent variable is the conditional probability of a transition from employment in any one of these three states.

The structure of the statistical model is the following. The observation period June 1990 to March 1991 is divided into the intervals $\{[0,1),[1,2),...,[8,9),[9,\infty)\}$. An individual's employment spell is described by a non-negative random variable, T, which takes on integer values only. If an employment spell ends in the period $[I_{t-1}, I_t)$ we define $T = t$. An employment spell can end in any one of j states,

with $j = \begin{cases} 1, & \text{if short-time work} \\ 2, & \text{if unemployement} \\ 3, & \text{if non-participation} \end{cases}$

We make the simplifying assumption that the set of states, $S = \{1,2,3\}$, is absorbing and equal for each person, and thus implicitly assume that the termination of an individual's first employment spell within the observation period is not affected by future transitions. Dropping this assumption, which may seem somewhat problematic, especially with respect to the transition into short-time work, would render estimation considerably more involved, and remains a topic for future research.

The central variable for modelling the transition process from employment into any one of these absorbing states is the discrete transition rate. For the i-th person ($i = 1$, ..., n) the transition rate into state j (j=1,2,3) in interval t, $\lambda_{ij}(t_i)$, is the conditional propability of a transition into state j in this interval, given individual i has been employed until t. Somewhat more formally,

(1) $\lambda_{ij}(t_i | x_i(t_i)) = \Pr[T_i = t_i, M = j | T_i \geq t_i, x_i(t_i)]$

where we condition on a vector of covariates for individual i in interval t , $x_i(t_i)$.

Assuming that the competing risks are independent, the hazard rate from employment is given by (the index i is dropped for convenience)

(2) $h(t|\cdot) = \sum_{j=1}^{3} \lambda_j(t|\cdot).$

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In terms of the hazard rate the conditional probability of remaining employed in period t is given by

(3) $\Pr[T > t | T \geq t, \cdot] = 1 - h(t | \cdot)$.

Not conditioning on the individual's previous employment history, the survivor function up to period t is given by

(4) $\Pr[T > t | \cdot] \equiv S(t | \cdot)$

which, in terms of the hazard rate, can be written as

(5) $S(t | \cdot) = \prod_{\tau=1}^{t-1} (1 - h(\tau | \cdot))$.

The probability of a transition into state j in period t can be written in terms of the respective transition rate and the survivor function as

(6) $\Pr[T = t, M = j | \cdot] = \lambda_j(t | \cdot) \prod_{\tau=1}^{t-1} (1 - h(\tau | \cdot))$

The specification for the transition rates chosen is a multinomial logit model which is relatively easy to handle and guarantees a positive hazard rate for any value of the covariate vector (for a description of the multinomial logit model see, e.g., Maddala 1983, pp. 34). The model allows for four possible labor market states, namely employment, short-time work, unemployment and non-employment, with the first one as the base category. While the set of covariates is the same for all alternatives, the coefficient vectors are allowed to vary between alternatives with the one for the employment state set to the null vector. This model specification implies independence of states to which transitions can take place.

Using the index i again, for this model the transition rate into state j in period t is given by

(7) $\lambda_{ij}(t_i | \alpha_j(t_i), z_i(t_i)) = \dfrac{\exp(\alpha_j(t_i) + \beta_j' z_i(t_i))}{1 + \sum\limits_{j=1}^{3} \exp(\alpha_m(\tau_i) + \beta_m' z_i(t_i))}$

and the survivor function is

(8) $S(t_i | \cdot) = \prod\limits_{\tau=1}^{t-1} \dfrac{1}{1 + \sum\limits_{j=1}^{3} \exp(\alpha_j(\tau_j) + \beta_j' z_i(\tau_j))}$

where the term $\alpha_j(t_i)$ is a vector of dummy variables for each of the months in the period July 1990 to March 1991, with June 1990 the base category, $z_i(t_i)$ is a vector

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of possibly time-varying covariates, β_j is a corresponding vector of parameters to be estimated, and $\left[x_i(t_i)\right]=\left[\alpha_j(t_i) \; z_i(t_i)\right]$, by definition.

The term $\alpha_j(t_i)$ describes the time dependency of the transition process and is also known as *baseline hazard* function. Its specification by monthly dummy variables is rather flexible and takes into account that (i) transitions into short-time work and non-participation are particularly likely to occur in certain months within the observation period, and (ii) the baseline hazard may differ between the three states by allowing the coefficients associated with these dummies to be different for each of the three absorbing states.

The vector of covariates includes the following groups of variables:

(i)   *individual characteristics* and *household structure:* age, sex, marital status, number of children;

(ii) *education* and *qualification:* years of schooling, skill level, tenure in current employment;

(iii) *labor income:* monthly gross wage as of June 1990, its growth rate between May 1989 and May 1990 and the bonus paid for the year 1989;

(iv) *labor market expectations:* individual evaluations of chances to find a new job;

(v)   *firm characteristics:* firm layoffs occurred in the past, expected firm layoffs, legal form of firm has changed, firm size;

(vi) *industry* and *region.*

In addition to linear and quadratic terms of age a dummy variable which takes on the value of one for age greater than 55 years, and zero otherwise, will also be included as explanatory variable in the model to account for early retirement which has been used extensively as a policy instrument to avoid "open" unemployment in the wake of the CESU (see, e.g., Franz, 1992). The set of explanatory variables also comprises interaction terms between sex, marital status and the number of children to allow for gender differences in the effects of household characteristics on individual employment behaviour. Variables descriptions and summary statistics of the variables in the model are given in Table 1. If not stated otherwise, all variables refer to the date of interview of the first wave in 1990.

The explanatory variables in the model account for both demand and supply side influences on individual employment behaviour. Since the estimated model is a reduced form relationship with relatively little structure imposed on it, demand and supply side factors are not formally identifiable. This seems unavoidable in the present context as we know of no appropriate theory to account for employment transitions in a situation studied here. We must therefore rely on a more informal reasoning to interpret the effects of the various explanatory variables in the model on employment behavior.

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Table 1. Definition of Variables and Summary Statistics

Variable Name	Description	Mean	Std. dev.	Mini-mum	Maxi-mum
Individual Characteristics and household structure					
AGE	Age in years	38.64	11.81	17.00	72.00
AGE55	Older than 55 years	0.09	-	0.00	1.00
FEMALE	=1	0.48	-	0.00	1.00
MARRIED	=1	0.75	-	0.00	1.00
CHILD	Number of children	0.85	0.95	0.00	4.00
FEMALE_MARRIED	Interaction variable	0.36	-	0.00	1.00
FEMALE_CHILD	"	0.41	-	0.00	4.00
MARRIED_CHILD	"	0.73	-	0.00	4.00
Education and qualification					
SCHOOL	Years of schooling	12.57	2.71	8.00	18.00
UNSKILL	Un-/ semi-skilled (Skilled worker)[1]	0.52	-	0.00	1.00
HISKILL	Highly skilled	0.23	-	0.00	1.00
TRAIN	Apprenticeship training etc.	0.04	-	0.00	1.00
TEN	Firm tenure in years	12.47	10.39	0.00	54.25
Occupation	(Manual)[1]				
OCC1	Transport, communication	0.09	-	0.00	1.00
OCC2	Services	0.08	-	0.00	1.00
OCC3	Trade, insurance	0.04	-	0.00	1.00
OCC4	Education etc.	0.07	-	0.00	1.00
OCC5	Scientists, engineers	0.11	-	0.00	1.00
OCC6	Administrators	0.10	-	0.00	1.00
OCC7	Management	0.04	-	0.00	1.00
OCC8	Other and 'missing'	0.15	-	0.00	1.00
WAGE90	Gross monthly wage in '90 (in 1000 M.)	1.11	0.44	0.11	4.10
GRWAGE	Gross rate in wages between 5/ 89 and 5/ 90	0.13	0.27	-0.95	2.36
BONUS90	Yearly bonus received in 5/90 for '89 (in 1000 M.)	0.68	0.57	0.00	4.60
ELAYOFF	Firm layoffs expected	0.74	-	0.00	1.00
JOBDIFF	Difficult/ virtually imposssible to find a job	0.82	-	0.00	1.00
LAYOFF	Firm layoffs occured	0.47	-	0.00	1.00
LEGFORM	Change in firm's legal form	0.36	-	0.00	1.00
Firm size	(less than 20 employees)[1]				
FS1	20 - 200 employees	0.39	-	0.00	1.00
FS2	200 - 2000 employees	0.36	-	0.00	1.00
FS3	more than 2000 employees	0.24	-	0.00	1.00

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Table 1 continued

| Variable | | Statistics | | | |
Name	Description	Mean	Std. dev.	Mini- mum	Maxi- mum
Industry	(Electrical and mechanical engineering)[1]				
IND1	Agriculture, forestry	0.13	-	0.00	1.00
IND2	Mining, energy	0.05	-	0.00	1.00
IND3	Chemicals, synthetics, paper, wood	0.05	-	0.00	1.00
IND4	Construction, quarring etc.	0.07	-	0.00	1.00
IND5	Iron, steel, heavy industry	0.05	-	0.00	1.00
IND6	Textile, clothing, food	0.05	-	0.00	1.00
IND7	Wholesale and retail trade	0.08	-	0.00	1.00
IND8	Public transport	0.08	-	0.00	1.00
IND9	Public services	0.22	-	0.00	1.00
IND10	Private services	0.03	-	0.00	1.00
IND11	Other and 'missing'	0.04	-	0.00	1.00
Region	(Sachsen)[1]				
REG1	Mecklenburg-Vorpommern	0.12	-	0.00	1.00
REG2	Brandenburg	0.16	-	0.00	1.00
REG3	Sachsen-Anhalt	0.19	-	0.00	1.00
REG4	Thüringen	0.17	-	0.00	1.00
REG5	Berlin (East)	0.06	-	0.00	1.00
# Individuals[2]		3,010			

[1] For dummy variables the base category is given in parantheses.
[2] The number of individuals refers to those employed at the date of interview in 1990 for whom information on all variables included in the estimation is available.
Source: GSOEP-East, waves 1 - 2; own calculations.

To derive the sample likelihood function for this model, define the indicator function

$$\delta_{ij} = \begin{cases} 1 \text{ , if individual } i \text{ makes a transition into state } j \\ 0 \text{ , otherwise.} \end{cases}$$

Then, assuming independence of all observations, the sample likelihood function is given by

$$(9) \quad L = \prod_{i=1}^{n} \prod_{j=1}^{3} \left[\lambda_{ij}(t_i | x_i(t_i)) \right]^{\delta_{ij}} \left[\prod_{\tau=1}^{t_i-1} \left(1 - h_i(\tau | x_i(\tau)) \right) \right] .$$

Plugging the transition rates in eqn. (7) and the survivor function in terms of the hazard rate into eqn. (9), the likelihood function is known up to a vector of coefficients to be estimated. It can be shown that the likelihood function for a discrete hazard rate model, as given by eqn. (9) is equivalent to a multinomial logit

model where, assuming independence, all individual observations are pooled (see, e.g., Allison, 1982). Given the validity of the model specification, the estimates for α_j and p_j have the standard properties of ML estimates. An estimate of the asymptotic variance-covariance matrix of the estimated coefficients is obtained from the negative inverse of the information matrix, which is then used to calculate asymptotic t-values.

4   Estimation results

Estimation is based on a pooled sample of 15,672 observations referring to 3,010 individuals, the estimation period is July 1990 to March 1991. We first present and discuss the estimated effects of the explanatory variables in the model on the transition rates into short-time work, unemployment and non-participation as well as their effect on the survival rate in employment. Then, the time dependency of the transition process is characterized by the estimated transition rates and the hazard rate.

The estimated β_j coefficients together with their respective absolute t-values for the transition rates into short-time work, unemployment and non-participation are given in Table 2. As described in the previous section, all coefficients are implicitly normalized by those referring to the employment state and the estimated effects are therefore to be interpreted relative to the effect of the respective variable on the conditional probability of remaining in employment. Besides calculating (absolute) t-values for the effect of a variable on the transition into a particular state, we have also tested whether a variable has a statistically significant effect on the transition rate into any of the three states, where variables with no significant effects are marked by an asterisk in the last column of Table 2.

As an individual´s probability of remaining employed in any given month, i.e. the survivor function, depends on all three transition rates which may either reinforce or counteract each other, in Table 3 we compare the value of the survivor function in the first, third, sixth, and ninth month for a reference person and other persons defined by alternative variations of certain significant explanatory variables in the model. The reference person is defined by characteristics which are favorable for remaining employed (see footnote to Table 3). Hence, the values of the survivor function at the chosen months are relatively high for persons with such characteristics. Interpretation of results is predominantly in terms of the survivor function, although reference is also made to the estimated effects of certain variables on the transition rates if this allows for additional insights into the transition process.

Table 2   Transition from Employment into Short-time Work, Unemployment and Non-participation - Multinomial Logit Model, Maximum Likelihood Estimates

| Variable [1] | Transition into | | | | | | |
| | Short-time-work | | Unemployment | | Non-participation | | |
Name	Coef.	|t|	Coef.	|t|	Coef.	|t|	χ^2 [1]
CONSTANT	-2.8515	3.80	-3.0838	2.50	1.8810	2.36	27.00
Dummy for month...							
08/ 90	-1.0518	8.45	-1.8157	6.69	-1.4701	7.69	165.00
09/ 90	-1.4407	9.68	-1.1254	5.26	-1.2665	6.84	158.36
10/ 90	-1.3096	8.78	-1.4838	5.73	-0.1907	1.40	107.43
11/ 90	-1.1502	7.94	-1.8978	5.93	-1.4488	6.71	135.96
12/ 90	-0.8559	6.28	-1.1831	4.76	-0.6814	4.02	72.74
01/ 91	-1.0728	6.99	-1.5299	5.13⁻	-0.9284	4.82	92.82
02/ 91	-1.2777	7.32	-1.8010	5.13	-0.2015	1.29	78.81
03/ 91	-1.4983	7.59	-1.1673	4.27	-1.0922	4.94	95.49
AGE	0.0610	1.51	0.0702	1.03	-0.2875	6.87	52.38
AGESQ	-0.0009	1.67	-0.0010	1.06	0.0038	7.04	55.58
AGE55	-0.2159	0.80	1.1306	2.57	1.0379	4.84	30.36
FEMALE	0.1469	0.83	0.0143	0.05	0.0704	0.36	0.79 *
MARRIED	0.0694	0.42	0.0186	0.06	-0.6955	3.58	13.24
CHILD	-0.3455	2.50	0.2507	1.80	0.3424	2.78	17.61
FEMALE_MARRIED	-0.0777	0.39	-0.0348	0.11	0.5329	2.45	6.33 *
FEMALE_CHILD	0.1173	1.33	0.1111	0.80	-0.3710	3.56	15.76
MARRIED_CHILD	0.2347	1.70	-0.3537	2.25	0.0443	0.34	8.49
SCHOOL	0.0251	1.15	-0.0196	0.50	0.0321	1.29	3.18 *
UNSKILL	-0.078	0.73	-0.0831	0.45	-0.1635	1.26	2.16 *
HISKILL	-0.1390	0.90	0.3194	1.19	-0.2631	1.39	4.24 *
TRAIN	-1.0263	2.99	-0.3413	0.76	-1.1192	3.22	18.54
TEN	0.0101	0.71	-0.0330	1.32	0.0425	2.66	9.43
TENSQ	0.0001	0.23	-0.0003	0.36	-0.0008	1.94	3.98 *
OCC1	-0.0245	0.16	-0.1397	0.51	0.2091	1.10	1.55 *
OCC2	0.2958	1.61	-0.5263	1.62	0.3004	1.43	7.46 *
OCC3	0.4075	1.49	-1.0347	2.20	0.3753	1.28	8.86
OCC4	-0.3390	1.28	-0.5917	1.49	0.1190	0.49	4.09 *
OCC5	-0.1458	0.93	-0.2554	0.82	0.3323	1.73	4.74 *
OCC6	-0.3670	2.37	-0.3601	1.28	0.0372	0.2	7.14 *
OCC7	-0.6208	2.56	-0.4432	1.14	-0.0734	0.26	7.71 *
OCC8	-0.1139	0.84	0.1163	0.51	0.2677	1.65	3.85 *
WAGE90	-0.7034	4.34	-0.7127	2.58	-0.2874	1.68	26.63
GRWAGE	0.5377	3.34	-0.5432	1.77	-0.0766	0.38	15.26
BONUS90	0.0631	0.80	-0.5559	3.65	-0.1996	1.93	17.74
ELAYOFF	0.2772	2.34	0.7211	3.58	0.0736	0.64	18.04
JOBDIFF	0.3597	3.10	0.1240	0.66	0.0775	0.59	10.09

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Table 2 continued

Variable [1]	Short-time-work		Transition into Unemployment		Non-participation		
Name	Coef.	|t|	Coef.	|t|	Coef.	|t|	χ^2 [1]
LAYFORM	0.2627	3.07	0.3122	2.09	0.0564	0.54	13.36
LEGFORM	0.0615	0.72	-0.1684	1.07	-0.1358	1.22	3.21 *
FS1	0.2758	1.49	-0.4857	2.07	0.2299	1.24	8.34
FS2	0.2233	1.21	-0.4119	1.77	0.2854	1.54	7.23 *
FS3	0.4220	2.18	-0.5567	2.06	0.0153	0.08	9.35
IND1	-0.0212	0.15	0.8305	2.79	-0.0498	0.24	7.98
IND2	-0.8507	4.21	-0.4215	0.82	-0.0376	0.16	18.2
IND3	-0.1433	0.86	0.4640	1.25	-0.2155	0.86	3.17 *
IND4	-0.3731	2.27	1.0556	3.45	-0.1861	0.81	18.63
IND5	-0.2313	1.40	-1.1820	1.89	-0.3525	1.28	6.70 *
IND6	-0.4094	2.35	0.2301	0.64	0.0111	0.05	6.11 *
IND7	-0.7572	3.81	0.5652	1.64	-0.2570	1.06	18.69
IND8	-1.3706	6.40	-0.1543	0.38	-0.2780	1.29	42.04
IND9	-1.4899	8.47	0.0633	0.21	-0.2881	1.52	73.29
IND10	-1.4665	4.23	0.7649	1.86	-0.0306	0.11	21.90
IND11	-0.5162	2.42	0.1231	0.29	-0.4026	1.45	7.79 *
REG1	-0.3386	2.46	0.3089	1.44	-0.1311	0.82	9.03
REG2	-0.0187	0.15	0.2619	1.21	0.4007	2.90	9.73
REG3	-0.1837	1.64	0.0928	0.44	0.0933	0.68	3.51 *
REG4	-0.0818	0.70	0.4477	2.27	0.0800	0.55	6.07
REG5	0.3750	2.05	-0.0539	0.16	0.5586	2.89	12.06

Log. Likelihood full model	-5898
Log. Likelihood restrict. model	-6723
LR statistics: χ^2 (171) [3]	1652
Pseudo R^2 (McFadden) [3]	0.12
# Observations	15,672
# Individuals	3,010

[1] For definition of the variables and summary statistics see Table 2.

[2] The χ^2 statistic tests the null hypothesis that the combined effect of the category-specific coefficients of a variable is not signifikantly different from zero. The critical value of this test statistic with 3 d.o.f. at the 5 percent level is 7.81.

"*" indicates that the respective variable is not signifikant at the 5 percent level.

[3] The LR statistic is twice the difference of the log likelihood of the restricted and full model, respectively.

McFaddens Pseudo R^2 is a simple transformation of this statistics with a range between 0 and 1.

Table 3. Values of the Survivor Function at 1, 3, 6, and 9 Months (Percentages)

Variable	1th Month	3rd Month	6th Month	9th Month
Reference Group	89.3	83.5	73.3	65.4
Female	86.8	79.7	68.0	59.3
Age = 25 years, Tenure = 5 years	90.2	84.9	75.1	67.2
Age = 55 years, Tenure = 35 years	79.9	70.2	50.4	36.6
Occupation = Services	86.2	78.8	66.3	57.0
Occupation = Trade	91.2	86.4	77.1	69.6
Occupation = Management	93.2	89.4	82.2	76.2
Wage May 90 = 1000 Marks	81.5	71.8	56.8	46.2
Wage May 90 = 3000 Marks	93.9	90.5	84.1	78.7
Wage growth = 0 %	89.8	84.3	74.5	66.8
Wage growth = 30 %	88.7	82.5	71.9	63.8
Bonus = 0 Marks	89.0	83.1	72.4	63.9
Bonus = 4000 Marks	89.0	82.9	72.7	65.0
Layoffs = yes	86.9	79.9	68.0	59.1
Layoffs expected = yes	86.6	79.5	67.5	58.5
Job prospects = bad	85.9	78.4	66.0	56.7
Firm size less than 20 employees	91.9	87.5	79.3	72.6
Industry= Agriculture	89.3	83.6	73.5	65.6
Industry= Mining, Electricity	94.0	90.8	84.2	78.7
Industry= Construction	91.7	87.2	79.1	72.5
Industry= Wholesale/ Retail trade	93.8	90.5	84.0	78.6
Industry= Transport/ Communication	95.9	93.7	88.9	84.8
Industry= Public services	96.1	94.0	89.5	85.6
Industry= Privat services	95.4	93.0	87.7	83.0
State = Mecklenburg/ Vorpommern	91.7	87.2	78.9	72.2
State = Brandenburg	88.5	82.4	71.2	62.6
State = Berlin (East)	84.7	76.7	63.0	52.9

Definition of the Reference Group: Male, married, 2 children, age=40 years, qualified worker, wage May 90 = 2000 M, wage growth=15%, wage bonus=2000 M., tenure=20 years, no layoffs occured , no layoffs expected, good job prospects, unchanged legal form, firm size>2000 employees, industry=mechanical and electrical engineering, state= Sachsen.

Note: Calculations are based on estimation results in Table 2.

To begin with the estimated effects of personal characteristics, we observe important differences in transition rates with respect to gender, age and indicators for household structure in Table 2. Gender has no significant direct effect on any of the transition rates, but does influence employment behaviour indirectly through household structure, i.e. the interaction terms. Due to the presence of the interaction terms of gender with marital status and children, the quantitative effects of these variables are somewhat difficult to disentangle in Table 2, and are more readily apparent from the results for the survivor function in Table 3. The comparison of the selected points of the survivor function for a female employee with otherwise identical characteristics as the (male) reference person shows that women have, other things equal, a somewhat lower probability of remaining in employment. As the results for the transition rates for the interaction terms of gender with marital status and children suggest, this result is mainly due to the higher transition rate into non-participation for females. Given that the private costs of nursing children have increased sharply due to the wide-spead closing of nurseries run by former state-owned large firms ("Kombinate"), this result comes as no surprise. A further decline of the female participation rate, which has been the higher in the former GDR than in any other country is to be expected.

Age effects the transition rates into the three states quite differently. The transition rate into unemployment (non-participation) first increases (decreases) at a decreasing rate. At the age of 55 years there is a sharp upward jump in both these rates. To some extent, this reflects the strategy often used by firms to get rid of older workers by the extensive use of early retirement arrangements, in particular the so-called "Altersübergangsgeld" introduced in October 1990 and restricted to the eastern part of Germany, for which male (female) retiring employees aged 57 (55) years were eligible. That the effect of the age dummy on these two rates is comparable in size can be explained in the sense that for older workers near the legal early retirment age unemployment is just another name for the same thing. The overall effect of the age dummy is quantitatively very important. As the calculations in Table 3 show, the survival rate in employment after nine months is only 36.6 percent for someone aged 55 years and with otherwise equal characteristics to the reference person, compared to 65.4 percent for the latter with 40 years of age and 67.2 percent for someone aged 25 years[3].

Turning to the educational variables, we find that years of schooling as well as an individual´s skill level have no significant effects. The latter result is not too surprising given the inclusion of both the tenure and the occupational dummy variables in the model. Tenure with a firm seems not particularly important for the transitions into short-time work and unemployment. With respect to the positive coefficient for the transition rate into non-participation it should be mentioned that, given job mobility was supposedly a rather rare event in the former GDR, tenure and age are probably highly correlated and their separate effects therefore not easy to disentangle.

As the values of the test statistic in Table 2 show, only one of the occupational dummies is statistically significant at the five percent level, although two others

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[3] To make the comparisons with respect to age somewhat more realistic, in Table 3 we have adjusted an employee´s tenure with his or her firm accordingly. Although both the age and the tenure effect contribute therefore to the shift of the survivor function, the age effect is quantitatively much more important.

(occupation in services or in management) are marginally significant and are there-fore also included in Table 3. The relatively small values of the survivor function for occupations in services can perhaps be explained in the sense that restructuring in this sector will have to take place on a massive scale at the intra-sectoral level, as a considerable employment surplus relative to West Germany in education, science and culture corresponds to a shortage in other areas (see, e.g., Franz, 1992, p. 253). Since most employees with managerial tasks in June 1990 were more or less politically appointed members of the Communist party, the relatively high values for the survivor function for this group confirm the wide-spread belief that the restructuring process at the firm level has been somewhat late to get started.

This impression is also supported by the results for the effect of an individual´s wage in the past on his or her chance to remain employed in the current job. Given that qualification and other variables determining employment at the individual level are statistically controlled for in the model, we would expect a higher wage to decrease an individual´s chance of remaining employed. What we actually observe, however, is a relatively strong positive effect of the wage level in May 1990 in a given job on an individual´s probability to remain in this job after the CESU. Although considerably weaker, the effect of the bonus received for the year 1989 is qualitatively the same.

The stong increase in wages is widely considered as one of the main reasons for the huge employment losses in East Germany subsequent to the introduction of the CESU. However, the calculations in Table 3 suggest that the increase in wages between May 1989 and May 1990 had only a rather small effect on the probability of employment termination in the period under consideration. For example, an in-crease in the growth rate of wages in the year prior to the CESU from 20 to 30 percent would have resulted in a decrease of the survival rate after 9 months from 65.4 to 63.8 percent, hardly a dramatic change. Alternatively, the respective value of the survivor function would only have increased to 66.8 percent had the real wage remained unchanged. Although this result may appeal to some readers it should be borne in mind that its relevance for more recent developments in East Germany depends on the structural stability of the estimated relationships, which, of course, cannot taken for granted.

Given this caveat, the above result seems important and interesting enough to dis-cuss it in some more detail here. Possible explanations for the sluggish adjustment of employment in the observation period mentioned in the literature (see, e.g., Franz, 1992) are:

- certain agreements introduced under the last East German government to protect workers with a tenure of at least 15 year against job loss, or to make them eligible for severance pay in the amount of up to three yearly salaries;

- the absence of a efficiency-oriented management which was still made up of the former managers and directors of the firms (Kombinate);

- a low substitution elasticity between labor and capital as there was little in-centive to invest in the capital stock of old firms due to an "end-game situation" (Franz, 1992, pp. 264);

It should also be noted that the major part of the wage increase did not occur before the end of 1990, and most agreements of the adjustment of eastern wages to the level in the west in union contracts were also only introduced since then. To what extent employment has been reduced by wage developments in later periods can therefore only be answered on the basis of more recent data.

Looking at the estimation results for the transition rates in Table 2 reveals that the small wage effect on the suvivor function comes about by two counteracting effects. While an increase in wages has a rather strong positive effect on the transition rate into short-time work, it reduces the transition rate in unemployment by roughly the same amount, although the latter effect is statistically not significant. Taking into account that due to special legal provisions for East Germany together with agreements set out in union contracts the renumeration while in short-time work at considerably reduced hours, and often even for zero hours of work, can reach up to 92 percent of the net wage in the last job (see, e.g., Franz, 1992, p 246), the tremendeous flow into short-time work seems hardly surprising. Taking into account that due to the special regulations for East German firms are exempted from paying social security contributions these results also suggest that short-time work is considered an attractive alternative to unemployment (for related results see also Büchel/Pannenberg, 1992).

The transition rate into short-time work is significantly higher if an individual has pessimistic expectations on the probability of receiving a job offer elsewhere. If, at the date of interview, the worker expected firm layoffs to occur in the future the transition rate into both short-time work and unemployment is raised significantly. Similar effects are observed when firm layoffs had already occurred at the date of interview. Taken together these results can be interpreted in the sense that in firms where the restructuring process had already been under way when the CESU came into effect expectations of further job losses were fulfilled, while in firms which were relatively slow to adjust employment in the first place there was also no subsequent employment adjustment.

This interpretation raises the interesting question how changes in legal form of the firm have affected subsequent individual employment behavior. The estimation results in Table 2 for the respective variable indicate that there is no statistically significant effect of this variable. It should be noted, though, that this variable refers to a period before privatization in East Germany started in earnest and thus can only be considered a weak indicator for the state of this process.

Since in the period under consideration privatization was more or less restricted to small firms, the effect of firm size may give some indirect evidence on the consequences of privatization on individual employment behavior. As expected, employees in small firms have significantly higher survival rates than in larger ones. The results in Table 2 show, however, that this is due to the considerably higher transition rates into short-time work of employees working in larger firms, whose transition rate into unemployment is actually considerably lower. This result is compatible with the hypothesis of short-time work being a mechanism to avoid layoffs as described above. It also indicates that transitions into unemployment are particularly likely from employment relationships in newly privatized firms.

Relative to the engineering sector which was particularly hard hit by the breakdown of foreign trade following currency union, individuals in most other industries have significantly higher survival rates for employment. As the results for the transition rates make clear this is primarily due to reliance on short-time work in the engineering sector. Workers in construction, trade, transport and communication, and private services have experienced relatively stable employment during the first phase of the restructuring process. Although huge employment losses in public services seem unavoidable given the mentioned predominance of some services, so far survival rates of employment remained relatively high in this sector, which may also be due to a certain provision for former civil servants which allowed them to remain formally employed for a limited short period at virtually zero hours and at reduced pay ("Wartestandsregelung").

Some significant differences in employment hazards remain between regions, where employees in the mainly agricultural state of Mecklenburg-Vorpommern have the highest and those in East-Berlin the lowest survival rates in employment. Since industry effects and other structural factors have been controlled for in the model, these differences must be explained by other regional factors not included in the model. Although these factors cannot be disentangled without undertaking a detailed regional analysis it seems noteworthy that there are remarkable regional differences in transition rates, especially with respect to short-time work and non-participation which are relatively high in East Berlin. This may be due to the fact that here the adminstrative infrastructure of the labour offices was set up much earlier than in the other East German states.

So far, we have neglected time-varying macroeconomic factors which may affect firms, industries or regions quite differently and thus contribute to an understanding of differences in employment behavior at the individual level, the most important of these factors probably being the real exchange rate and its effect on trade in individual industries, and changes in labor market policy measures. In the econometric model these factors will be accounted for in a rather simple and flexible way by the baseline hazard function, to which we now turn.

While the quantitative effects of the explanatory variables in the model determine the level of the transition rates and, hence, the hazard rate, the time-dependency of these rates (duration dependence) is given by the baseline hazard function, i.e. the values of the monthly dummy variables. Given that estimation is based on a cohort of employed persons in June 1990, the time-dependency of these rates can directly be interpreted in terms of historical time, ie. the development in the months July 1990 to March 1991[4]. In Figure 3, the transition rates into short-time work, unemployment and non-participation implied by our specification of the baseline hazard function are plotted, where all covariates in the model have been evaluated at variable means.

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[4] This would not be the case if new entrants or re-entrants in employment were included in the sample.

Figure 3. Estimated Transition Rates into Short-time Work, Unemployment and Non-participation

July 1990 - March 1991
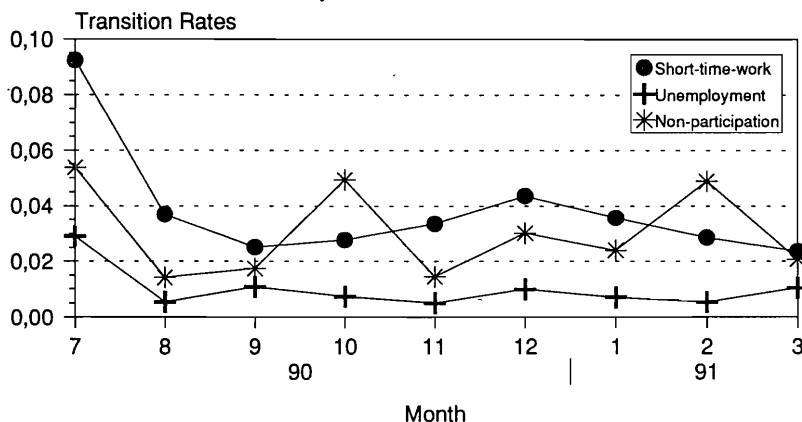
Source: GSOEP-East, waves 1-2; own calculations

While all three rates reach their peaks in July 1990 immediately after the introduction of CESU, their subsequent development is quite varied. While the transition rate into unemployment remains at a relatively low level throughout, the transition rates into short-time work and, even more so, into non-participation show pronounced fluctuations which are mainly due to chances in labor market policy mentioned above.

In Figure 4, a summary picture of employment termination in East Germany within the observation period is provided by the empirical and estimated hazard functions, evaluated at variable means. While the former is calculated from the raw data as ratio of the number of persons leaving employment in any given month to to stock of employed at the beginning of the respective month, the latter is simply obtained as sum of the three transition rates. This aggregation results in a sharp drop of the hazard rate in August 1990 to roughly one third of its value in July and three local peaks in October and December of this year and in February 1991. The comparison of the two rates show that the estimated hazard tracks its empirical counterpart quite well, although the levels of the two rates differ somewhat.

Figure 4. Empirical and Estimated Hazard Rates from Employment
July 1990 - March 1991
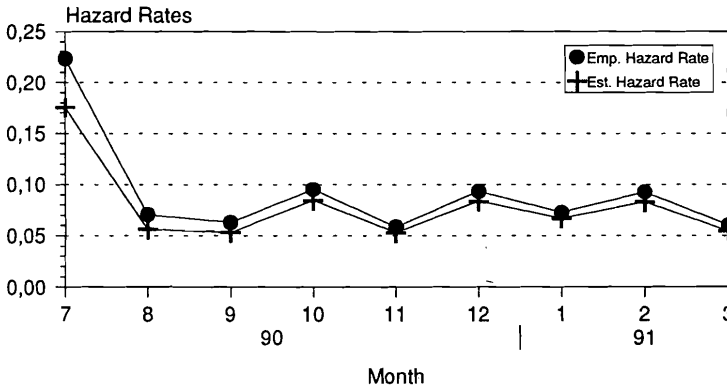
Source: GSOEP-East, waves 1-2; own calculations

5 Summary and Conclusion

The analysis of the present paper has focussed on the determinants of the transitions from employment into short-time work, unemployment and non-participation in East Germany in the first nine months after unification. The estimation results have shown that these transitions and, hence, the survival rate in employment is affected by personal characteristics, education and occupation, firm characteristics, industry and region as well as the level and growth rate of individual wages. With respect to the wage variables it has been shown that (i) the higher an individual´s wage before unification the higher his or her survival rate in employment, and (ii) that an individidual´s wage increase in the previous year has only a small impact on this rate. The detailed results for the transition rates have also shown that in order to disentangle the effects of certain variables it is very important to distinguish between transitions into short-time work and unemployment as well as non-participation.

The present paper is only a first step in the analysis of labor market dynamics in East Germany, and is even somewhat incomplete as a description of employment termination as the econometric model does not take into account the fact that a considerable number of workers who have terminated their former job return to regular work within a couple of months. To give a more complete picture of the process of employment termination and labor market dynamics in general a model incorporating all relevant transitions between short-time work unemployment and non-participation would be needed. It is hoped that the results of the present paper will help to start work along these lines.

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