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**Article — Published Version**

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Economics of Transition and Institutional Change

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*Suggested Citation:* Gürtzgen, Nicole; Diegmann (né Nolte), André (2020) : Does low-pay persist across different regimes? Evidence from German Unification, Economics of Transition and Institutional Change, ISSN 2577-6983, Wiley, Hoboken, NJ, Vol. 28, Iss. 3, pp. 413-440, <https://doi.org/10.1111/ecot.12244>

This Version is available at:

<https://hdl.handle.net/10419/230007>

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# Does low-pay persist across different regimes? Evidence from German Unification

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## Funding information

This study was funded by the German  
Research Foundation (grant number GU  
1081).

## Abstract

Using German administrative data, we study across-regime low-pay persistence in the context of an economic transformation process. We first show that individuals' initial allocation to the post-unification low-wage sector was close to random in terms of market-regime unobservables. Consistent with a weak connection between individuals' true productivity and their pre-unification low-wage status, the extent of across-regime state dependence is found to be small and appears to vanish over time. For males, across-regime state dependence is most pronounced among the medium- and high-skilled, suggesting the depreciation of human capital as an explanation.

## KEYWORDS

economic transition, human capital, low-pay dynamics, state dependence

## JEL CLASSIFICATIONS

J31; J64; P21; C33; C35

## 1 | INTRODUCTION

Does the transition from a centrally planned to a market economy offer new perspectives for those who, in economic terms, were relatively deprived under the old regime? Or does the economic

An earlier version of this paper circulated under the title 'Changing fortunes during economic transition – low-wage persistence before and after German Unification'.

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transformation bring along an equally unfavourable position under the new system, thereby reflecting a certain degree of economic state dependence even across completely different political and economic regimes? This question is of considerable relevance against the background of Central and Eastern Europe's recent history of transitions from centrally planned to market economies and is crucial to understanding the welfare implications of economic transitions. The issue is also important from a quantitative point of view, as during a large part of the 20th century about one third of the world's population lived under communist regimes.

In this study, we address these issues in the context of Eastern Germany. The former German Democratic Republic (GDR) is a particularly interesting case because it has experienced a unique pathway of political and economic transformation after 1989 through its Unification with the Federal Republic of Germany (FRG). Compared to other transition countries, the transformation process took place much more quickly, as the political and economic system of Western Germany was immediately adopted by Eastern Germany. Although a large body of research has documented the evolution of the Eastern German labour market after Unification, there is barely any evidence on how an individual's fortunes post-unification were determined by his or her relative economic position pre-unification. Previous empirical research on this question has been limited by the availability of suitable representative longitudinal micro-data to track individuals' labour market careers across different political and economic regimes. Our study seeks to fill this research gap by exploiting a unique large-scale administrative dataset (*BASiD*) from the German Pension Register and the German Federal Employment Agency. The *BASiD* data provide an ideal basis for our empirical analysis as it allows us, first, to identify individuals living in Eastern Germany before Unification and, second, it enables us to track individual employment histories both before and after the fall of the Iron Curtain.

To measure individuals' relative economic positions, we will exploit information on the incidence and duration of individuals' position in the bottom part of the pre-unification wage distribution. Even though earnings inequality in the GDR was considerably lower than in the FRG, one may still identify workers who fared considerably worse than the average. For instance, in 1989, the poorest 10% of the working-age population earned less than 50% of the overall average monthly wage.<sup>1</sup> Having identified individuals' low-wage status prior to Unification, we then proceed to investigate how workers' low or high-wage status determines their economic fortunes after the transition. In particular, we are interested in the extent of low-wage state dependence across economic regimes by distinguishing persistence in low pay due to observed and unobserved heterogeneity from true state dependence, also referred to as genuine state dependence. In analyzing state dependence, the relevant state we are interested in therefore refers to a position at the bottom part of the wage distribution.<sup>2</sup>

The literature on state dependence acknowledges three main explanations – which are difficult to distinguish in standard empirical applications – for genuine or true state dependence of low pay (see e.g. Arulampalam, et al. 2000; Stewart, 2007). These are productivity signalling, stigmatization and human capital depreciation. The first one – signalling low productivity levels – relates to the fact that employers do not observe the true productivity and use the relative wage position as an additional signal for the purpose of evaluation. As to the signalling argument, the heavily regulated pre-unification labour market should have rendered the selection into low-wage jobs based on workers' true (unobserved) productivity very unlikely in the GDR. Given that workers had their wages set according to a

<sup>1</sup>Own calculations from the 1990 German Socioeconomic Panel retrospective GDR survey (GSOEP, Version 33, <https://doi.org/10.5684/soep.v33>).

<sup>2</sup>As will be spelled out later, we have to employ different thresholds defining low-pay before and after German Unification, such that the notion of state dependence – in its strict sense – does not refer to a position in the same quantile of the wage distribution.

centrally determined wage grid, Bird et al. (1994) suspect that 'because the human capital model was obviously not relevant under socialism, the observed correlation between wage income and schooling and experience in the GDR must simply exist because the socialist wage regime took factors like these into account in assigning wages'. This leads us to hypothesize that conditional on observables – which are taken into account by the wage setting mechanism – signalling of unobservable productivity is unlikely to serve as an explanation for *across regime* low-pay persistence.

A further explanation for low-pay persistence, also capturing a kind of a signalling argument, may be stigmatization. Stigmatization might be present as long as low-wage jobs are systematically associated with characteristics, such as social class affiliation, against which employers might discriminate. In the GDR, it is reasonable to think of low-wage jobs as having – at least to some extent – resulted from political discrimination. This in turn might have favoured true persistence due to signalling political opposition. Even though the nature of the stigma is likely to differ considerably across the different regimes, such an effect could be present and lead to persistence *within* each regime. However, stigmatization is unlikely to contribute to *across regime* genuine state dependence.

A final explanation for low-pay state dependence that might be relevant even across the regimes relates to human capital depreciation. Even though a selection into a pre-unification low-wage job should have been unrelated to workers' true productivity, the latter might still have been depreciated due to unfavourable working or job conditions inherent to low-wage jobs (Kneipp, 2009). While there is evidence that job-specific human capital acquired under socialism became largely obsolete in the FRG labour market (Gathmann, 2004; Ragnitz, 2007), general skills, such as mathematical, language, problem-solving as well as physical skills, were transferable to the post-unification labour market (Fuchs-Schündeln & Izem, 2012; Smolny & Kirbach, 2011).<sup>3</sup> As a result, as long as unfavourable job or working conditions of GDR low-wage jobs have led to a depreciation of general skills,<sup>4</sup> this might serve as a potential explanation for low-wage state dependence even *across* the regimes.

In exploring the importance of workers' pre-unification wage positions for their post-unification wage outcomes, our analysis contributes to the literature on labour markets of transition economies. A large body of research has examined how returns to human capital have changed during economic transition. The general picture that emerges is that returns to education generally increased, whereas returns to work experience did not change or even decreased during the transition process (see e.g. Brainerd, 1998; Münich et al. 2005; Rutkowski, 1996). For Germany, Bird et al. (1994) and Krueger and Pischke (1995) show that there was little change in returns to education after Unification. Moreover, these studies document very small returns to age and seniority prior to Unification, which – similar to what has been found for other transition economies – declined during the transition process (see also Gathmann, 2004). Orlowski and Riphahn (2009) show that returns to experience and seniority in Eastern Germany were small compared with Western Germany, even 20 years after Unification.

While these results indicate that specific human capital gained during socialist work experience became obsolete in the post-unification labour market, very little is known about the consequences of experience accumulated in low-wage jobs. In addressing the relevance of individuals' pre-unification wage positions for their post-unification outcomes, our analysis thus provides new insights into whether low-wage jobs in a centrally planned economy have been associated with

<sup>3</sup>The argument in Fuchs-Schündeln and Izem (2012) is based on the assumption that regional unemployment rates close to the inner German border should have jumped discontinuously if only Eastern German workers' characteristics caused the lower labour productivity in Eastern Germany.

<sup>4</sup>As a quite extreme example, one may think of intellectuals and artists who – as a means of state repression – were forced to work within the production sector, typically in intellectually less demanding occupations.

the depreciation of *general* human capital, thereby leading to adverse long-term consequences for post-unification labour market outcomes. In doing so, we also contribute to the literature on low-wage state dependence by exploiting the German Unification as a natural experiment that enables us to shed light on the underlying mechanisms leading to low-wage persistence. This is especially important as disentangling the potential channels of state dependence has typically been hard in empirical applications. The transformation of the Eastern Germany economy provides an ideal case to study the relative importance of the potential mechanisms as it allows us to derive testable hypotheses based on the time pattern of across-regime state dependence. The reason is that with human capital depreciation being the relevant mechanism, catching up processes should have resulted in a decline in state dependence over time. With signalling low productivity levels being the relevant channel, high initial uncertainty after Unification might have hampered the selection into low-wage jobs based on individuals' productivity. To the extent that uncertainty has been declining over time, productivity signalling should have resulted in an increase in state dependence after Unification.

Overall, our results indicate that the impact of the accumulation of GDR low-wage employment years on post-unification low-wage experience is heterogeneous across time periods and skill groups. Relatively short low-wage experience under socialism (1–3 years) does not affect the probability of being low paid after Unification. However, a larger accumulation of GDR low-wage employment years (more than 3 years of low-wage employment) increases the probability of low-wage employment after Unification during the first 3 years between 1991 and 1993 by about 2.5% points. Compared to the overall mean probability of low-wage employment during this time period of about 13%, this effect is sizeable also in economic terms. Moreover, the effect almost reverses its sign for male workers for the time period between 1994 and 1996. This indicates a strong catching-up process and provides support for the human capital depreciation explanation. For female workers, the effect remains positive but becomes insignificant. Breaking down the estimates by skill groups provides further support for the human capital argument as the most plausible explanation for low-wage state dependence. Consistent with the notion that a depreciation of human capital should be more relevant for those possessing a certain level of skills, our results point to a more pronounced extent of across-regime state dependence for medium- and high-skilled workers.

The remainder of the study is structured as follows. Section 2 provides institutional background information on the East German labour market prior to and after Unification. Section 3 provides a description of the dataset and the sample selection. Section 4 presents descriptives on the association between GDR low-wage employment years and post-unification low-wage outcomes. Section 5 lays out the econometric strategy and Section 6 presents the estimation results on across-regime state dependence. Section 7 presents basic robustness checks. Section 8 concludes.

## 2 | INSTITUTIONAL BACKGROUND

### 2.1 | The East German labour market prior to unification

Following the Soviet example, the GDR introduced tight central economic planning along with subordination of firms to the state administration. Moreover, all citizens of the GDR had the constitutional right and duty to work (where the 'right' included an unlimited guarantee of employment and the 'duty' brought along the threat of being sentenced for antisocial behaviour if one was suspected of remaining voluntarily jobless). The East German labour market before Unification was thus heavily regulated: controlling the supply of and demand for labour was seen

as an instrument for the efficient use of resources and economic growth (see Grünert, 1997a for a detailed overview).

Although enterprises were effectively controlled through the centralized redistribution of investment capital, salary funds and other financial means, they were fairly free in planning and using the labour forces they had at their disposal. Under given general institutional constraints, enterprises could influence, for example, employment policies, regulations pertaining to job transfers, salary ranges and promotion regimes. At the same time, individuals were – in principle – free to choose their workplace. Once employed, they agreed upon an individual labour contract with their firm, which included far-reaching employment rights (such as the right to employment appropriate to their acquired skills or the right to be paid according to the quantity and quality of the work done).

There were clear limits to employer and occupational mobility, though. By the late 1970s, careers had become heavily affected by an increasing influence of the ‘state-governed labour force allocation’, a system that restricted younger cohorts in the choice of occupational training and their subsequent job (Huinink & Solga, 1994). Since the 1960s, quotas were set for occupations into which individuals were allocated after leaving secondary education. Since the late 1960s, the opportunity to study at a university was greatly restricted through quotas for high school and university admissions. This meant that many young people could not enter the occupation they actually wanted. Very often changing one's work was then only possible within one's occupational career via adult education (also see Zühlke & Goedicke, 2000). A restriction on employer mobility was a general tendency among GDR enterprises to keep the fluctuation of their labour force low and to maintain a high level of permanent staff (*Stammbelegschaft*; see Grünert, 1997b, Section 1). While firm-specific fringe benefits like free childcare, holiday arrangements and ‘loyalty premiums’ (*Trueheprämie*) for long-term employees may have rather reflected regime-conforming than market oriented behaviour, they still served as an important means to keep turnover low. Enterprises had more discretion over bonuses than over base wages, where bonuses have been estimated to account for, on average, 6% of compensation in the GDR (Krueger & Pischke, 1995). Base wages were determined by state-regulated wage grids based on observables (see Stephan & Wiedemann, 1990, for a more detailed account of the wage structure in the GDR). As a consequence, wage dispersion was much lower than in the FRG. While the empirical evidence on the GDR wage structure has established positive returns to education of 4.5–7.7 log points for 1 year of schooling, age-earnings and seniority-earnings profiles – despite the existence of loyalty premiums – appear to be much flatter than in the FRG. Using retrospective information for 1989 from the German Socio-Economic-Panel, Bird et al. (1994) and Krueger and Pischke (1995) estimate returns to experience of about one to two log points for the first year of experience (compared with about 3.4–4.1 log points in the FRG).

## 2.2 | The Eastern German labour market after unification

After Unification the Eastern German labour market underwent a period of dramatic structural change. The monetary union between Eastern and Western Germany took place on 30 June 1990. With the monetary union, Eastern Germany adopted the legal and economic system of Western Germany, including its labour market institutions. As a result, Western German trade unions quite rapidly succeeded in transferring the Western German system of collective bargaining to the East. While the first round of wage negotiations, which took place during summer 1990, mainly resulted in lump-sum wage increases, the second round in winter 1990/91 stipulated wage schedules being tied to a fixed proportion of the western level (Krueger & Pischke, 1995). This gave rise to



tremendous wage increases, which were particularly large within the first year following the monetary union. According to Hunt (2001), monthly real wages rose on average by 20 log points between 1990 and 1991, with the less educated benefitting to a significantly larger extent (compare also the similar figures reported by Krueger & Pischke, 1995). For the time period between 1991 and 1996, Hunt (2001) reports an annual growth of monthly wages of about nine log points, yielding a cumulative average real annual growth of monthly wages of 78% over the period between 1990 and 1996. Later studies report that real wage growth in Eastern Germany has come to a halt in the mid-1990s (Franz & Steiner, 2000) and even started to decline in the first years of the 21st century (Aretz, 2013). This presumably reflects the fact that since the mid-1990s unions increasingly lost their importance, as most employers could not afford the initial wage increases. While union membership rates dropped from about 40% in 1992 to about 18% in 2004 (Addison, Schnabel, & Wagner, 2007), the proportion of employees subject to an industry-level contract declined from 56% in 1996 to 41% in 2004.<sup>5</sup>

At the same time, many Eastern German technologies became obsolete during the transition process. After Unification, Eastern Germany experienced massive inflows of capital and technology from Western Germany. On 1 July 1990, the 'Treuhand' as a holding company for the state-owned sector was set up with the primary purpose to sell all of its holdings. When the Treuhand closed down at the end of 1994, about 860 enterprises had been sold to foreign investors and 3,000 had been acquired through management buy-outs (Kettenacker, 2013). The privatization process not only resulted in massive worker flows across industries, but was also visible within industries. Moreover, Eastern German firms made intensive use of short-time work ('*Kurzarbeit*') as an instrument provided by the government to adjust to the economic downturn right after Unification. In 1991, more than two million workers in Eastern Germany were subjected to short-time work and this instrument was especially used in manufacturing (60%), agriculture (15%) and in the water, energy and mining industry (5%), whereas construction, trade, transport and communication were characterized by relatively stable employment during the first phase of the restructuring process.

The massive structural change brought about by the privatization process has led some researchers to inquire into whether human capital accumulated during the old regime became obsolete in the post-unification labour market. Using data from the 1990 German Socio-Economic Panel retrospective GDR survey, Gathmann (2004) finds that returns to pre-unification accumulated work experience drop to zero after Unification. The author interprets her results as evidence of a full obsolescence of socialist work experience, suggesting a full depreciation of job-specific human capital. Fuchs-Schündeln and Izem (2012) demonstrate that the low labour productivity in Eastern Germany can mainly be attributed to less favourable job characteristics rather than to individual skills. The authors conclude from their findings that a large part of Eastern Germans' human capital accumulated during the socialist regime was transferable to the post-unification labour market and, therefore, should have been general human capital.

### 3 | DATA AND SAMPLE

The data used in the empirical analysis are taken from German register data (*BASiD*). The data combine information from the *German Pension Register* with various data sources from the German

<sup>5</sup>Own calculations from the IAB-Establishment Panel. Representative data on collective bargaining coverage in Eastern Germany are only available from 1996 onwards.

Federal Employment Agency. The scientific use file of the data (*BASiD*-SUF) is a stratified random 0.25% sample of all birth cohorts from 1940 to 1977, who have at least one entry in their social security records, leading to an overall sample of about 60,000 individuals. The sample has been drawn in a disproportionate manner and can be made representative using a weighting factor that is part of the dataset (for a detailed description see Bönke, 2009 and Hochfellner, Müller, & Wurdack, 2012).<sup>6</sup>

The data provide longitudinal information on individuals' entire pension-relevant biographies up to the year 2007. Individual work histories cover the period from the year individuals were aged 14 until the age of 67 years. In Germany, statutory pension insurance is mandatory for all employees in the private and public sector, with the exception of civil servants and self-employed individuals. In addition, contributions to pension insurance are paid by unemployment or health insurance during periods of unemployment and prolonged illness.

The *BASiD* data provide an ideal basis for analyzing the impact of former GDR citizens' low-pay status on their later career outcomes for several reasons. First, it is the only German administrative data source that encompasses full employment biographies. In particular, the *Pension Register* contains information on all periods for which contributions were paid (employment, long-term illness, unemployment) as well as periods without contributions, which were still creditable for the pension insurance. The latter refers to activities for which an individual receives pension credits, such as periods of school or university attendance after the age of 16, periods of training and apprenticeship and periods of caring.

Second, the *BASiD* data are the only individual level data that contain employment biographies of former GDR citizens before German Unification. After Unification, former GDR citizens were entitled to transfer their pension-relevant activities to the FRG pension insurance system. For this purpose, the FRG Pension Insurance recorded all periods prior to Unification which were creditable for the pension insurance (see above) as well as earnings up to the GDR social security cap. The pension data therefore allow us to track former GDR workers' entire pre- and post-unification employment histories up to the year 2007. Apart from the individual information on pension relevant activities, the *Pension Register* provides information on age and gender.

Starting from 1975 in Western and from 1992 in Eastern Germany, employment spells subject to social security contributions from the *Pension Register* can be merged with data from the German Federal Employment Agency, the *Integrated Labour Market Biographies* and the *Establishment History Panel*. The *Integrated Labour Market Biographies* provide further time-varying individual information on blue or white-collar status, occupational status, educational status (six categories) and an establishment identifier. Finally, the *Establishment History Panel* contains information on the establishment's workforce composition, establishment size as well as sector affiliation. Tables A1 and A2 in the online Appendix A provide more detailed descriptions on the variables gained from the *Pension Register* and *Employment Statistics Register*. For former GDR citizens, the data lack explicit information on education prior to 1992. We therefore impute the educational status by using information from the *Pension Register* on individuals' creditable schooling and apprenticeship periods (for detailed information see Görtzgen & Nolte, 2017).<sup>7</sup>

<sup>6</sup>Note that the representativeness of the data based on the sample weights that are provided in the data refer only to the calendar year 2007. Later on, in our analysis, we will use administrative population data to construct weights for each gender-year cell.

<sup>7</sup>More specifically, we adopt Imputation Procedure 2 (*IMP2*), which aims to match three education categories (low, medium and high-skilled), into which the six categories in the *IEB* have been typically summarized in many empirical applications.



In our analysis, the main outcome variable of interest is labour earnings, which can be calculated by exploiting information on monthly pension credit points gained from social security employment.<sup>8</sup> Earnings are top-coded at the social security contribution limit. Compared with the FRG, where the earnings cap increases over time, the GDR threshold remained constant at 600 Marks throughout the entire GDR period. Due to this unchanged earnings cap, the fraction of GDR workers with top-coded earnings increased substantially over time and was much larger than the corresponding fraction in the FRG. Despite the restricted information on earnings, the data are still suited to analyze low-pay transitions as the earnings information allows us to dichotomize the GDR earnings distribution into low- and high-wage sectors.

For our empirical analysis, we focus on the employment biographies of former GDR citizens. Given that our data cover the cohorts 1940–1977, we confine our sample to the cohorts between 1940 and 1960 and follow their employment histories starting from the year 1980 until 1999. Focussing on these cohorts enables us to track the pre- and post-unification labour market histories of individuals aged between 30 years and 50 years in 1990. As the employment histories of later cohorts (i.e. those born after 1960) can be observed only after 1980, restricting our observation to the birth cohorts 1940–1960 permits us to observe a reasonable amount of pre-unification labour market years for all cohorts.<sup>9</sup> This is crucial for our empirical strategy, which will use information on pre-unification labour market histories as a key ingredient in explaining post-unification labour market outcomes. The *BASiD-SUF* file provides monthly information on individuals' pension credit points as well as their main labour market state in a given month. Regarding wage information, we first aggregate individual monthly (nominal) labour earnings to the annual level by adding up and averaging monthly earnings for a given year. In accordance with the literature on low-wage dynamics, we are interested in annual transition rates (low-wage and employment transitions) and therefore construct a yearly panel based on information on the labour market state observed in July of any given year.<sup>10</sup> The reason for choosing July is twofold. First, July is the first month after the monetary union and, thus, the first month after Unification where wages are fully observed. Second, choosing July also accounts for seasonality and follows other wage dynamic studies not only related to low-wage dynamics (see e.g. Dustmann, Ludsteck, & Schönberg, 2009).<sup>11</sup> Given that our data lack explicit information on working hours, we are not able to convert monthly into hourly wages. To avoid measuring persistence in working time decisions instead of earnings, we therefore exclude those individuals who, based on the information from the *Employment Statistics Register*, worked

<sup>8</sup>One credit point corresponds to the average of annual earnings of all gainfully employed workers in Germany. Following the German Social Act (SGB VI) Appendices 1 and 10, earnings in Eastern Germany before and after Unification are derived by multiplying individual pension credit points with the average yearly earnings using *Anlage 1 SGB VI* (see Table A.2) and dividing that by a so-called East factor using *Anlage 10 SGB VI*.

<sup>9</sup>The cohort structure of our data implies that the earliest period in which we observe insured individuals is the year 1954, when those born in 1940 were 14 years old. During the subsequent years, younger cohorts successively enter the dataset, which gives rise to an increasingly mixed age structure. An overview on the age-year structure of the pension subpart is given by Bönke et al. (2010). To ensure representativeness within the selected cohorts in terms of the working-age population's age structure, we have constructed weights based upon administrative population data from the German Federal Statistical Office.

<sup>10</sup>In case of parallel labour market states, the Pension Insurance assigns the labour market state that exhibits the maximum number of days in a given month.

<sup>11</sup>We also performed robustness checks using wage information from July only, pointing to no major significant differences. We exclude individuals from the wage distribution if their monthly wages fall short of 150 Marks, as this is considered to be unreasonably low. This leads to the exclusion of 35 men and 90 women in total.

**TABLE 1** Number of individuals in the sample in each year 1980–1999

| Year<br>(1) | Number of individuals<br>(2) | Western migration (%)<br>(3) | Retired (%)<br>(4) |
|-------------|------------------------------|------------------------------|--------------------|
| 1980        | 4,818                        |                              |                    |
| 1981        | 4,790                        | 0.6                          | 0.0                |
| 1982        | 4,770                        | 0.4                          | 0.0                |
| 1983        | 4,761                        | 0.2                          | 0.0                |
| 1984        | 4,749                        | 0.2                          | 0.1                |
| 1985        | 4,733                        | 0.3                          | 0.0                |
| 1986        | 4,723                        | 0.2                          | 0.0                |
| 1987        | 4,711                        | 0.2                          | 0.0                |
| 1988        | 4,697                        | 0.2                          | 0.0                |
| 1989        | 4,683                        | 0.2                          | 0.0                |
| 1990        | 4,609                        | 1.5                          | 0.1                |
| 1991        | 4,442                        | 3.7                          | 0.1                |
| 1992        | 4,284                        | 3.4                          | 0.3                |
| 1993        | 4,178                        | 2.5                          | 0.0                |
| 1994        | 4,048                        | 3.2                          | 0.0                |
| 1995        | 3,949                        | 2.5                          | 0.0                |
| 1996        | 3,850                        | 2.4                          | 0.1                |
| 1997        | 3,775                        | 1.9                          | 0.1                |
| 1998        | 3,694                        | 2.1                          | 0.1                |
| 1999        | 3,495                        | 5.4                          | 0.2                |

*Note:* The table reports the number of observed individuals over time. Column (3) reports the fraction of individuals migrating to West Germany. Column (4) reports the fraction of individuals entering retirement.

*Source:* BASiD 2007.

part-time at least once after Unification.<sup>12</sup> We perform robustness checks with respect to this exclusion in Section 6.

Table 1 shows the number of individuals over the whole sample period. Overall, our sample selection yields an unbalanced panel with 4,818 individuals. The main reason for panel attrition is migration from Eastern to Western Germany. While the share of migrants was rather negligible prior to Unification, the fraction of migrants increased to above 3% in the first two years after Unification. The observed decline afterwards and the increase in the second half of the 1990s – also referred to

<sup>12</sup>The *Employment Statistics Register* is available from 1992 onwards. We do not observe full-time and part-time decisions before 1992. By excluding individuals with at least one part-time spell after 1991, we rely on the assumption that individuals who had a preference for part-time employment after 1991 were also likely to have worked part-time prior to Unification. Using retrospective information from the GSOEP for July 1989, we find that part-time rates among females (males) were 22.5% (1.7%). Moreover, between July 1989 and July 1990 persistence in part-time employment was relatively high at 91%. Only 2% of those in full-time employment in 1990 had been part-time employed in 1989. Among those working part-time in 1990, we find that 11% had worked full-time in 1989. See also online Appendix E for further descriptions of part-time employment by gender and age. Moreover, there exists a positive correlation between the number of low-wage years before Unification and part-time employment after Unification for females and a rather weak correlation for males. To some extent, this is likely to represent part-time employment decisions before Unification.

as the second wave of migration – is consistent with what has been documented in the literature (e.g. Fuchs-Schündeln & Schündeln, 2009). The last column refers to early retirement as a reason for panel attrition, with a strong increase in 1991/92 relative to prior levels hinting towards a potentially selective process. Based on the sample presented in Table 1, Table 2 summarizes the main variables and provides summary statistics for both time periods prior to the transition (Pre: 1980–1989) and during and after the transition (Post: 1990–1999).

With regard to qualification, about 14% in the sample did not receive any formal degree, while about two thirds were medium skilled and had obtained some sort of vocational training. As mentioned above, entry into higher levels of qualification was extremely restricted prior to Unification, resulting in a small fraction of 10% holding a university degree. The educational information for the remaining 8% is missing. Using information on occupational status from the first available year from the *Employment Statistics Register*, about 50% are blue-collar workers and 40%–44% are white-collar

**TABLE 2** Variable definition and description of basic variables

|                                     |  | Mean  |      | Low-wage |      | High-wage |         |
|-------------------------------------|--|-------|------|----------|------|-----------|---------|
| Variables                           | Description                              | Pre   | Post | Pre      | Post | Pre       | Post    |
| Variables over the period 1980–1999 |  |       |      |          |      |           |         |
| Un or non-employed                  | Indicator (1 = Out-of-employment)        | 0.03  | 0.16 | –        | –    | –         | –       |
| Migrate                             | Indicator (1 = Migrate)                  | 0.001 | 0.02 | –        | –    | –         | –       |
| Age                                 | Age in years                             | 34.7  | 44.5 | 34.4     | 43.7 | 34.9      | 44.0    |
| Female                              | Indicator (1 = Female)                   | 0.53  | 0.52 | 0.52     | 0.49 | 0.53      | 0.49    |
| Education                           |  |       |      |          |      |           |         |
| Low-skilled                         | No formal degree                         | 0.14  | 0.13 | 0.17     | 0.15 | 0.14**    | 0.11    |
| Medium-skilled                      | Apprenticeship                           | 0.69  | 0.69 | 0.72     | 0.75 | 0.69      | 0.70**  |
| High-skilled                        | University                               | 0.09  | 0.10 | 0.04     | 0.03 | 0.09***   | 0.11*** |
| Occupational status <sup>a</sup>    |  |       |      |          |      |           |         |
| White-collar                        | White-collar worker                      | 0.39  | 0.44 | 0.29     | 0.22 | 0.40***   | 0.48*** |
| Blue-collar                         | Blue-collar worker                       | 0.48  | 0.50 | 0.49     | 0.71 | 0.48***   | 0.50*** |
| Skilled occupation                  | Engineer, professional, manager          | 0.14  | 0.17 | 0.07     | 0.04 | 0.15***   | 0.20*** |
| Medium-skilled occupation           | Qualified manual, service, commercial    | 0.55  | 0.48 | 0.61     | 0.47 | 0.54***   | 0.47*** |
| Simple occupation                   | Simple manual, service, commercial       | 0.31  | 0.35 | 0.32     | 0.49 | 0.30      | 0.32*** |
| Labour market characteristics       |  |       |      |          |      |           |         |
| Experience                          | Years worked                             | 14.5  | 23.4 | 13.7     | 22.7 | 14.8      | 23.3    |
| # Interruptions                     | Number of interruptions                  | 3.10  | 5.01 | 3.49     | 4.99 | 3.05***   | 4.57*** |
| Interruption length                 | Cum. length of interruptions (in months) | 14.7  | 23.3 | 22.5     | 25.6 | 13.8***   | 17.7*** |

*Note:* Asterisks in the last two columns correspond to significance levels of *t* tests of the means by low-wage status within each period. To perform the *t* tests, we use the year 1989 for the pre-unification period and 1999 for the post-unification period.

<sup>a</sup>Information for occupational status (white- and blue-collar) and the occupational groups is imputed for the pre-unification period based on information from the first available year from the *Employment Statistics Register*.

*Source:* BASiD 2007.

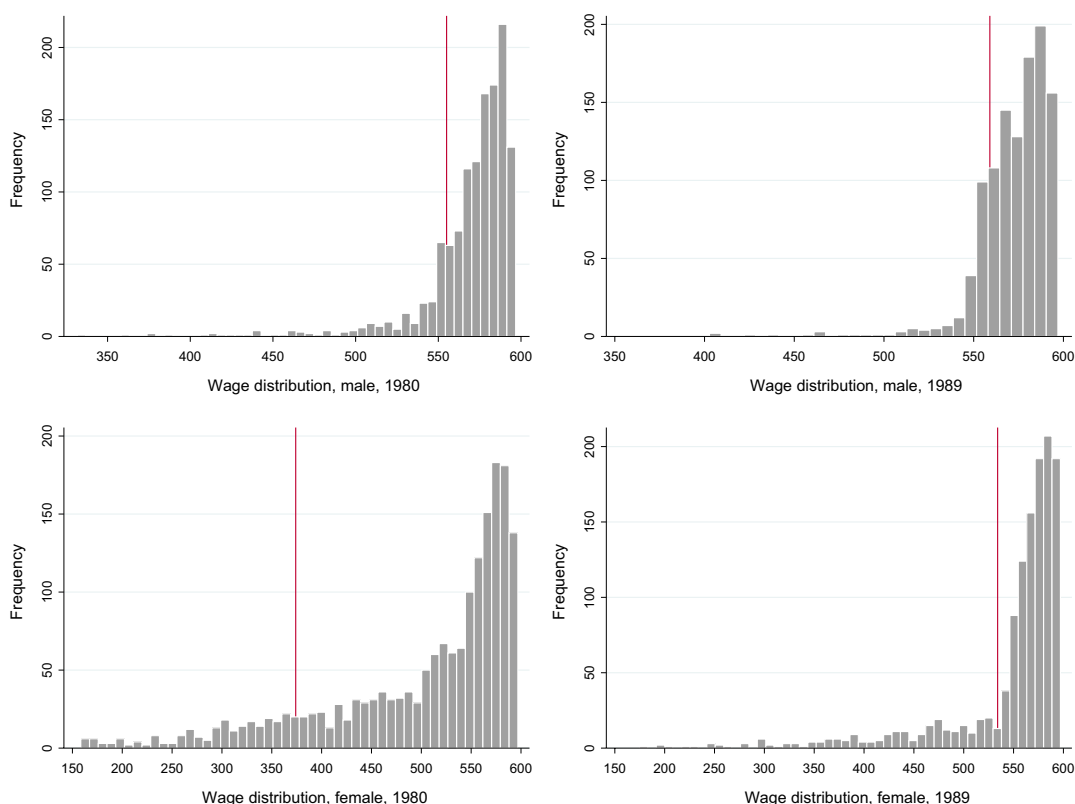
workers. Differentiating the occupational status into skilled, medium-skilled and simple occupations, about 14%–17% of individuals belonged to the first, 48%–55% to the second and about one third to the final category. Given the increasing fraction of un- and non-employed individuals after Unification, the evolution of experience and age can be observed to diverge after Unification. Finally, the last two rows show the number of employment interruptions and the accumulated length of employment interruptions measured in months, which both increased by construction after Unification.

The last columns in Table 2 provide the descriptives broken down by individuals' low- and high-wage status. As expected, low-paid workers are less likely to be high-skilled and work less frequently in skilled or white-collar occupations. They also experienced more and longer (cumulated) labour market interruptions. Moreover, comparing the differences between both groups pre- and post-unification suggests that the differences regarding skills and occupations become more pronounced after Unification.

## 4 | DESCRIPTIVE STATISTICS

### 4.1 | Wage information before Unification and the definition of the low-wage threshold

Regarding wage information prior to Unification, wages until the first half of 1990 were censored above 600 Marks. Figure 1 illustrates the pre-unification wage distribution (separately for male



**FIGURE 1** Distribution of wages between 1980 and 1989, by gender

Source: BASiD 2007, weighted sample.

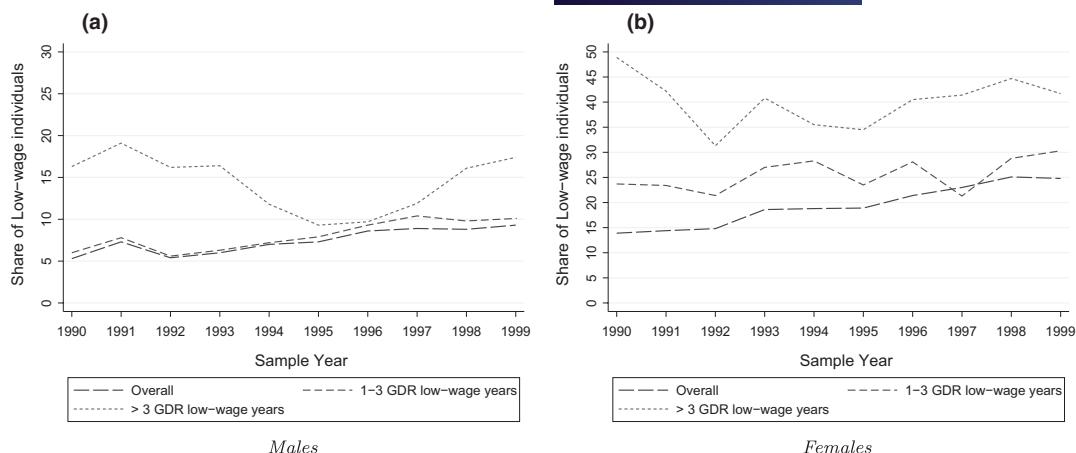
and female workers) for 1980 and 1989, respectively.<sup>13</sup> The figure also marks the first deciles in relation to the censoring limit. It shows that the fraction of individuals earning monthly wages below 600 Marks decreased over time. The upper panel illustrates that the first decile for males increased only slightly between 1980 and 1989, whereas for females it grew from about 370 Mark in 1980 to 530 Marks in 1989. The figures show that due to the large extent of censoring in our data we are only capable of fully observing the lower part of the wage distribution. To measure individuals' relative economic position, we will exploit this information to measure the incidence and duration of individuals' position at the bottom part of the pre-unification wage distribution. Note that because our analysis focuses on birth cohorts from 1940 to 1960, the relative position needs to be interpreted in relation to this specific subpopulation. In accordance with the literature on low pay, individuals are defined as being 'low paid' if their wage does not exceed a specified threshold. Previous studies have used different definitions of the low-pay threshold, such as lower quantiles of the wage distribution (Cappellari, 2002, 2007) or alternatively some fixed proportion of a quantile, such as two thirds of the median wage (Cappellari & Jenkins, 2008; Uhlenhorff, 2006). Given that in 1989, especially among male workers, only a small fraction earned less than the social security contribution limit of 600 Marks, we therefore have to adopt a somewhat more restrictive definition of low pay by fixing the low-pay threshold at the first decile of the wage distribution.<sup>14</sup>

Figure 1 shows that shortly before Unification the first deciles approach the censoring limit of 600 Marks. A particular concern is therefore that measurement error due to underreporting might misclassify a certain fraction of individuals as falling below the censoring limit. Even though we cannot fully rule out such kinds of measurement error, we argue that there are at least two reasons that this is unlikely. First, if measurement error due to under-reporting played a significant role, this should lead to a downward biased estimate of the first decile of the monthly wage distribution. To check whether this is the case, we compare the decile obtained from our dataset with figures from external data sources. An ideal candidate dataset is the German Socioeconomic Panel (GSOEP), whose retrospective survey in 1990 provides representative and uncensored information on former GDR workers' monthly labour earnings for the year 1989. According to the GSOEP, the first decile of monthly wages was about 560 Marks in 1989, whose order of magnitude is broadly in line with our pooled figure of 550 Marks.<sup>15</sup> A second reason speaking against underreporting stems from the administrative nature of the pension data. Central to this argument is the view that earnings-dependent pension entitlements should create large incentives to correctly report (or at least not to underreport) earnings. In online Appendix B, we demonstrate that even though GDR pension entitlements were only to a limited extent earnings dependent, monthly earnings which fell within a small earnings interval (between 500 and 600 Marks – depending on the number of creditable pension years) effectively raised pension entitlements. This provides a

<sup>13</sup>One important reason for why we employ two separate low-wage thresholds is that we observe only monthly wages. As we do not observe the part-time status before 1992, this suggests a gender-specific threshold to be more appropriate (see also Footnote 12 and online Appendix E).

<sup>14</sup>In online Appendix G, we also perform an analysis based on the pooled wage distribution. This has the advantage that the first decile threshold moves farther away from the 600 Mark censoring limit.

<sup>15</sup>Source: German Socioeconomic Panel (GSOEP, Version 33, <https://doi.org/10.5684/soep.v33>), own calculations. The figure is obtained by pooling male and female individuals of working age with positive earnings, after excluding apprentices, civil servants and the self-employed. The censoring limit of 600 Marks corresponds to the 12% percentile.



**FIGURE 2** Percentage of low-wage employment conditional on the number of GDR years below the first decile before Unification. (a) Males, (b) Females

Source: BASiD 2007, weighted sample.

strong argument against a systematic measurement error due to underreporting, especially within this interval.<sup>16</sup>

## 4.2 | Relationship between low-wage employment before and after Unification

In what follows, we provide some descriptives on the relationship between the incidence of low-wage employment before and after Unification. As a first measure of pre-unification low-wage experiences, we count the number of years in which an individual's earnings fell below the first decile between 1980 and 1989. In our sample, there are 1,074 (49%) male and 637 (27%) female workers who spent at least 1 year below the first decile of the wage distribution during 1980 and 1989. To obtain sufficient observations per cell, we construct three GDR low-wage experience categories. The first one corresponds to individuals whose (average monthly) earnings within a given year never fell short of the GDR low-wage threshold.

The second (third) group experienced 1–3 (more than 3) years of GDR low-wage employment. Among those with at least 1 year below the first decile, 90% of males and 66% of females experienced between 1 and 3 years of low wages. Figure 2 reports the descriptive statistics of the probability of being in low-wage employment over the time period between 1990 and 1999 for males and females. Moreover, we plot the same probability conditional on the variable *number of GDR years below the first decile*. From the figure, we first observe that the low-wage sector has been increasing over time for both males and females. Moreover, experiencing a low-wage period between 1 and 3 years during 1980 and 1989 raises the probability of belonging to the low-wage sector after Unification only slightly for male workers, whereas the difference becomes more pronounced for females. The probability of being low paid after Unification increases further if the number of pre-unification low-wage

<sup>16</sup>In online Appendix D, we further validate the data by estimating conditional low-wage probabilities given observable characteristics. The results show reasonable correlations for both males and females with respect to, for example education, age and occupation.



years exceeded 3 years. Interestingly, from both figures, we observe that, conditional on more than 3 years pre-unification low-wage employment, the probability of being low paid does not exhibit an increasing trend as in the pooled sample.

## 5 | MULTIVARIATE ECONOMETRIC ANALYSIS OF ACROSS-REGIME DEPENDENCE OF LOW PAY

The descriptive figures from the previous sections may hide potential compositional effects and do not allow us to infer any conclusions about a causal effect of the GDR low-pay experience on post-unification low-pay status. In what follows, we will therefore attempt to isolate persistence in low pay due to observed and unobserved heterogeneity from genuine state dependence. To do so, we estimate a dynamic multinomial random effects model accounting for three labour market states: low- and high-wage employment as well as out-of-employment. Modelling out-of-employment is of considerable importance for the post-unification period, as ignoring this state might lead to an upward bias of the estimated extent of state dependence, if low-wage individuals are more likely to experience a transition out of employment.<sup>17</sup> Given that the institutional setting changes at the time of Unification, we will start the analysis in 1990, the first year after the fall of the Berlin Wall, and model the stochastic process of low pay until 1999.

A major reason for adopting a dynamic model framework that starts after Unification is that it enables us to exploit the information about the initial allocation of individuals to the post-unification low-wage sector. Observing individuals' labour market careers right at the outset of the new market-economy distinguishes our specific application from other studies on low-wage employment, which are typically not able to identify the initial condition in the data. Overall, this enables us to explicitly test whether the initial condition is significant. From a substantive point of view, this boils down to answering the question of whether there was any initial selection into low-pay based upon (market-economy relevant) unobservables. As we will argue below, this may help us to validate one of our main identifying assumptions concerning the correlation between pre-unification low-wage histories and market-economy relevant unobservables.

A further important advantage of this strategy is that it allows us to analyze across-regime state dependence and to use detailed variables of establishment characteristics in the market economy which is otherwise not possible due to data availability. A further advantage is that we are able to observe the full wage distribution after Unification, which enables us to measure the low-pay outcome by adopting the more conventional measure of two thirds of the median. Our econometric model takes the following form:

$$y_{ikt}^* = \gamma_k y_{it-1} + x_{it} \beta_k + \Gamma_i \varphi_k + \vartheta_{ikt} \quad (1)$$

$$y_{ik1}^* = x_{i1}' \beta_k + \vartheta_{ik1} \quad (2)$$

where  $y_{ikt}^*$  is a latent unobservable variable measuring the propensity of earning a high wage ( $k = 0$ ), a low wage ( $k = 1$ ) or being out-of-employment ( $k = 2$ ) for individual  $i$  in year  $t$  for  $t > 1990$ . The propensity is a function of an individual's previous state,  $y_{it-1}$ , individual characteristics,  $x_{it}$  (see Table C1 in online

<sup>17</sup>The out-of-employment state should be interpreted as an absorbing state and represents a state for individuals who are out of the (Eastern German) wage distribution. We therefore also subsume other states, such as education and a migration decision (see Table 2), into this state to account for the selection into these states.

Appendix C for an overview of included covariates). We further model the unobserved part  $\vartheta_{ikt}$  to consist of an individual and state-specific random component,  $\epsilon_{ik}$ , which is assumed to be time-invariant and uncorrelated with all  $x$ -variables at every point in time, and a time-variant idiosyncratic component,  $u_{ikt}$ , that is  $\vartheta_{ikt} = \epsilon_{ik} + u_{ikt}$ . By making distributional assumptions about  $u_{ikt}$ , we assume a type I extreme value distribution. For identification, the high-wage status is treated as the reference state.  $y_{ik1}^*$  refers to the initial condition measured in 1990. Estimating dynamic random effects models without modelling the initial condition will bias the estimation results of the lagged coefficients (see e.g. Arulampalam et al., 2000; Heckman 1981a, 1981b; Honoré & Kyriazidou, 2000; Stewart & Swaffield, 1999). Given the potential endogeneity of the first period's outcome due to a correlation with the time-invariant individual effect, state dependence is likely to be overestimated (see Chay & Hyslop, 2014). This requires modelling the initial condition, which we will address below. The individual- and state-specific random effect is modelled using the Wooldridge approach:

$$\epsilon_{ik} = a_{1k}y_{ik,1990} + a_{2k}\bar{x}_i + \alpha_{ik} \quad (3)$$

where  $\bar{x}$  presents individual time averages of all time varying variables,  $y_{ik,1990}$  is the initial state in the first period and  $\alpha_{ik} \sim N(0, \Sigma_\alpha)$ .

To model across-regime state dependence, we include a vector  $\Gamma_i$  that contains indicator variables for 1–3 years of cumulated low-wage employment and more than 3 years of cumulated low-wage employment prior to Unification. To account for the fact that low-wage histories may to some extent reflect interrupted employment biographies, we additionally control for cumulated labour market interruptions. In our data, these capture all kinds of interruption such as child-care and illness. We calculate the number of months of interruptions between labour market entry and 1989 and test in the empirical model whether a high versus low number of interruptions is correlated with the probability of being low paid (out-of-employment).<sup>18</sup>

The main identifying assumption of our empirical strategy is that  $\Gamma_i$  and  $\epsilon_{ik}$  are uncorrelated. Our approach to assess this assumption is twofold. As a first piece of supporting evidence, we complement our analysis by setting up a joint dynamic random effects model of low pay over the whole sample period. This may provide important insights into the relevance of observed and unobserved factors and the difference in the estimated parameters across the different regimes. For the sake of expositional brevity, we would like to highlight two noteworthy results from this supplementary analysis, which are delegated to online Appendix G. First, unobservables driving the stochastic process of low pay appear to be regime-specific. Second, at least for males, unobservables affecting the low-pay status are uncorrelated across the regimes, whereas for females the correlation is found to be positive.<sup>19</sup>

<sup>18</sup>See online Appendix A for the possible economic states in the dataset. To allow for flexible dependence, we construct labour market interruption intervals that differ across males and females. Due to institutional settings and sociocultural norms, male individuals typically exhibit rather few interruptions. Therefore, the reference category for males is zero interruptions. Between 1 and 6 months and more than 6 months are defined as the medium and high interruption category, respectively. The reference category for females is up to 12 months. The medium category comprises 12–48 months, whereas more than 48 months is defined as the high interruption category.

<sup>19</sup>More specifically, in Online Appendix G, Table G.3, it is shown that in a dynamic probit specification over the period between 1980 and 1999, the individual specific random effects are regime-specific and in addition uncorrelated for male individuals. For females, we find a significant correlation between the unobservables of about 0.45. The results, therefore, suggest that the identifying assumption is likely to be met for males, whereas for females the coefficient  $\varphi_k$  may still be upward biased.

The second piece of evidence stems from modelling the initial condition. We follow Wooldridge (2005), and more recently, Prowse (2012) and model the density of  $y_{it}$  for all  $t = 1990, \dots, T$  given covariates  $x_{it}$ , start at  $t = 1991$  and condition the density of  $y_{it}$  for  $t = 1991, \dots, T$  on  $y_{i1}$  and  $x_{it}$ .<sup>20</sup> Given that the model starts directly at the time of Unification, the initial condition relates to the transformation year 1990. As set out above, the motivation of modelling the initial condition is generally to account for selection in the first period. As a result, its significance may help us to assess the randomness of the initial allocation to the low-wage sector during transition. Usually, a (positive) significant value of the respective coefficient would indicate that the start of the modelled stochastic process is correlated with unobservables governing low pay after Unification. Therefore, if the coefficient on the initial condition was insignificant, the allocation of individuals to the low-wage sector in 1990 could be considered close to random in terms of market-regime unobservables. Concerning our identifying assumption, we argue that such a random allocation to the low-wage sector, conditional on observables, would render a correlation between  $\Gamma_i$  and unobservables after Unification very unlikely. The reason is that – with pre-unification low-pay and unobserved productivity being correlated given observed characteristics – a random allocation to the low-wage sector should have occurred only in the case of extreme asymmetric information about individuals' productivity during the transformation process.<sup>21</sup>

## 6 | EMPIRICAL RESULTS

For expositional purposes, we confine the presentation of the results to the main variables of interest. The upper part of Table 3 shows the predicted probabilities conditional on the lagged indicators of low-wage employment and out-of-employment after Unification (short-run dependence). For male workers, the probability of being low paid conditional on low-wage employment in  $t - 1$  amounts to 17.6%, compared to only 3.2% conditional on high pay in  $t - 1$ . The difference between these two estimates shows that low-wage workers in  $t - 1$  exhibit a 14.4% points higher probability of being low paid in period  $t$  compared to formerly highly paid employees. For females, the estimate of true state dependence is about 4% points higher. The interrelation between out-of-employment and low-wage employment is also found to be statistically significant and is in line with the previous literature pointing to a low-pay no-pay cycle. The lower part of the table shows the predicted probabilities of the pre-unification variables ( $\Gamma_i$ ). Over the time period between 1990 and 1999, we do not find any across-regime effects for the number of GDR low-wage years or for GDR labour market interruptions. Turning to females, having experienced more than 3 years pre-unification low-pay increases their probability of being low paid after Unification by 1.6% points (with a  $t$  value of 1.45). However, given that our supplementary analysis from online Appendix G found a positive correlation of the random effects across the regimes, the coefficient may still be upward biased.

Table 4 shows the results for the initial condition using the Wooldridge approach. Although there is a positive association between low pay in 1990 and low pay thereafter, none of the coefficients turns out to be significant at any conventional level. This is an interesting result and has to our knowledge

<sup>20</sup>This approach is comparable to the correlated random effects model put forward by Chamberlain (1984) (see also Prowse, 2012). To account for a potential correlation between the unobserved individual effect and observed explanatory variables, we follow Mundlak (1978) and Chamberlain (1984) and model the individual effect as a function of time-variant averages of explanatory variables over the observation window and the labour market realizations in 1990.

<sup>21</sup>Moreover, selection into low pay based on unobserved productivity should have given rise to an increase in across-regime persistence over time. In Section 6, we demonstrate that there is no evidence for such an increase over time.

**TABLE 3** Predicted probabilities of multinomial logit models with random effects, by gender

|  | Males<br>(1)        |                          | Females<br>(2)      |                          |
|--|---------------------|--------------------------|---------------------|--------------------------|
|  | <i>Low-wage</i>     | <i>Out-of-employment</i> | <i>Low-wage</i>     | <i>Out-of-employment</i> |
| Within-regime dynamics                   |                     |                          |                     |                          |
| (1.1) $Low-wage_{t-1} = 1$               | 0.176               | 0.240                    | 0.254               | 0.415                    |
| (1.2) $Low-wage_{t-1} = 0$               | 0.032               | 0.207                    | 0.066               | 0.326                    |
| (1.1) – (1.2)                            | 0.144***<br>(0.014) | 0.033<br>(0.025)         | 0.188***<br>(0.014) | 0.090***<br>(0.022)      |
| (1.3) $Out-of-employment_{t-1} = 1$      | 0.119               | 0.309                    | 0.182               | 0.454                    |
| (1.4) $Out-of-employment_{t-1} = 0$      | 0.043               | 0.209                    | 0.108               | 0.331                    |
| (1.3) – (1.4)                            | 0.076***<br>(0.012) | 0.101***<br>(0.008)      | 0.073***<br>(0.012) | 0.124***<br>(0.017)      |
| Across-regime dependence                 |                     |                          |                     |                          |
| Number of GDR low-wage years             |                     |                          |                     |                          |
| (2.1) 0 years                            | 0.048               | 0.222                    | 0.115               | 0.362                    |
| (2.2) 1–3 years                          | 0.052               | 0.226                    | 0.119               | 0.364                    |
| (2.2) – (2.1)                            | 0.004<br>(0.006)    | –0.004<br>(0.006)        | –0.004<br>(0.007)   | –0.002<br>(0.008)        |
| (2.3) >3 years                           | 0.046               | 0.237                    | 0.135               | 0.371                    |
| (2.3) – (2.1)                            | –0.002<br>(0.012)   | 0.010<br>(0.007)         | 0.016<br>(0.012)    | 0.007<br>(0.005)         |
| Number of GDR interruptions <sup>a</sup> |                     |                          |                     |                          |
| (3.1) <i>No interruptions</i>            | 0.052               | 0.226                    | 0.117               | 0.366                    |
| (3.2) <i>Medium interruptions</i>        | 0.051               | 0.226                    | 0.118               | 0.363                    |
| (3.2) – (3.1)                            | –0.001<br>(0.005)   | 0.000<br>(0.008)         | 0.001<br>(0.007)    | 0.003<br>(0.007)         |
| (3.3) <i>High interruptions</i>          | 0.044               | 0.222                    | 0.131               | 0.361                    |
| (3.3) – (3.2)                            | –0.008<br>(0.006)   | –0.004<br>(0.005)        | 0.013<br>(0.010)    | –0.002<br>(0.006)        |
| Controls                                 | Yes                 |                          | Yes                 |                          |
| Observations                             | 16,312              |                          | 16,465              |                          |
| Individuals                              | 2,165               |                          | 2,267               |                          |
| Log-likelihood                           | –5,330.4            |                          | –5,748.2            |                          |

*Note:* The table reports predicted probabilities from a multinomial logit model. Robust standard errors are in parentheses. All estimations contain a constant, the specified Mundlak–Chamberlain device, and control for missing values in the education variable. Control variables include age, education, occupation and experience dummy variables, as well as time and regional dummy variables. The out-of-employment equation includes lagged white-collar, skill and simple occupation dummy variables. Before Unification, the low-wage threshold is the first decile, while after Unification two thirds of the median is used. The predicted probabilities are estimated by averaging over 100 Halton draws. Online Appendix C presents all included explanatory variables in the model. Asterisks next to coefficients indicate significance levels as follows: \*\*\* 1%, \*\* 5%, \* 10%. Detailed estimation results are available from the authors upon request.

<sup>a</sup>The reference category differs by gender. For males, the reference is zero labour market interruptions; medium: up to 6 months; high: more than 6 months. For females, the reference is zero to 12 months; medium: 12–48 months; high: more than 48 months.

*Source:* BASiD 2007, weighted sample.

**TABLE 4** Initial conditions 1990, by gender

|                              | Males<br>(1)     |                          | Females<br>(2)   |                          |
|------------------------------|------------------|--------------------------|------------------|--------------------------|
|                              | <i>Low-wage</i>  | <i>Out-of-employment</i> | <i>Low-wage</i>  | <i>Out-of-employment</i> |
| <i>IC: low-wage</i>          | 0.020<br>(0.014) | −0.000<br>(0.006)        | 0.014<br>(0.010) | −0.001<br>(0.007)        |
| <i>IC: out-of-employment</i> | 0.011<br>(0.015) | −0.009<br>(0.007)        | 0.009<br>(0.017) | 0.007<br>(0.008)         |

*Note:* The table shows the marginal effects of the initial condition *low-wage*<sub>1990</sub> and *out-of-employment*<sub>1990</sub> of the specified model in Equation (1). Asterisks next to coefficients indicate significance levels as follows: \*\*\* 1%, \*\* 5%, \* 10%. Detailed estimation results are available from the authors upon request.

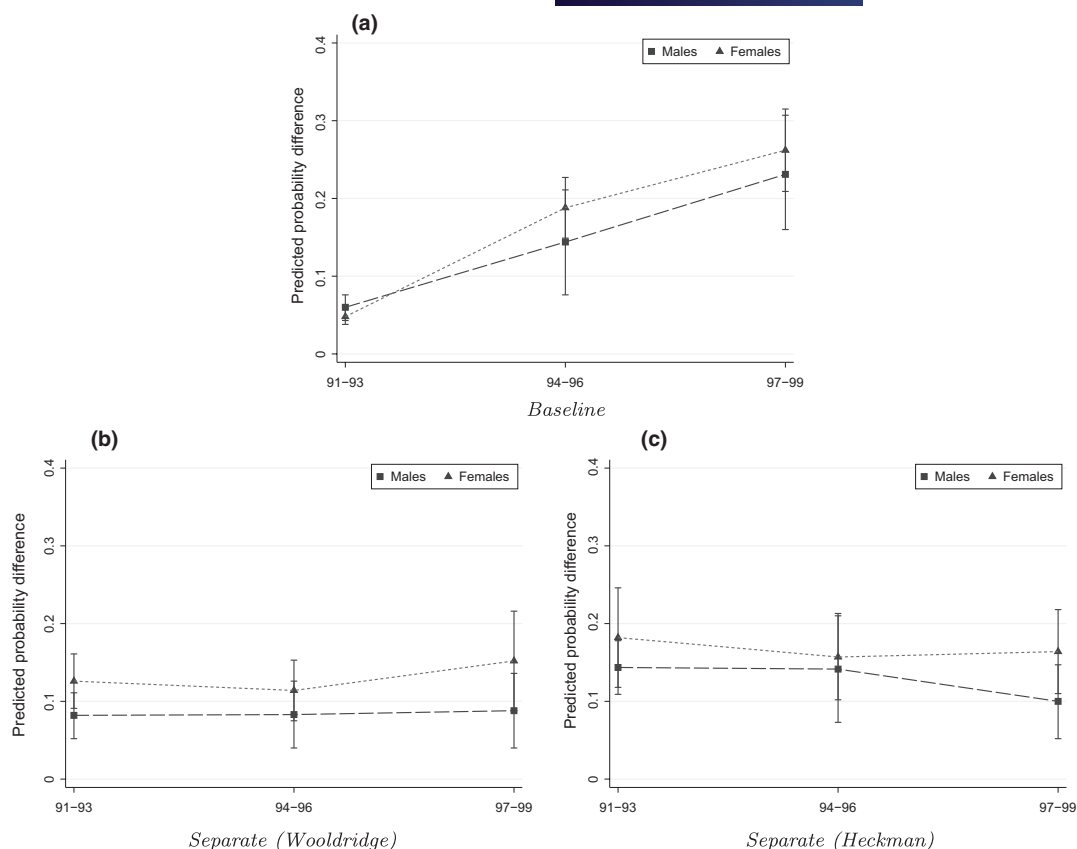
*Source:* BASiD 2007, weighted sample.

not been established in any other typical empirical low-wage application. It indicates that the modelled stochastic process of low-wage employment is independent from the outcome in the first year 1990. This provides some first evidence of a random initial allocation to the low-wage sector in 1990.

## 6.1 | Heterogeneity across time

Thus far, our findings have not provided any evidence of across-regime economic dependence. Given that the results refer to the whole post-unification period until 1999, it might be conceivable that our estimates mask heterogeneity of across-regime state dependence over time. The same is true for within-regime state dependence. Addressing such heterogeneous effects is particularly interesting, as it may help us to disentangle the human capital depreciation from the productivity signalling explanation. Given that individual restrictions with respect to qualification and occupational choices decreased after Unification, individuals may have faced increasing opportunities to acquire skills in the market economy. Therefore, if state dependence was the result of human capital depreciation, such a catching up process should have resulted in a decline in (across-regime) state dependence over time. On the other hand, if across-regime state dependence was the result of signalling low productivity levels, high initial uncertainty after Unification might have hampered the selection into low-wage jobs based on individual productivity. To the extent that uncertainty has been declining over time, such a mechanism should have resulted in an increase in (both within and across-regime) state dependence after Unification.

To explore these issues, we estimate the same empirical model including interaction effects for the sub-periods 1994–1996 and 1997–1999 for the within and across-regime state dependence variables and the initial conditions. Panel (a) of Figure 3 shows the results for the within-regime low-pay dynamics ( $t-1$ ). Over time, within-regime persistence increased from about 6% (3%) for males (females) in the first period (1991–1993) after Unification to 23% (26%) during the last 3 years of the decade. A major concern with this specification is the potential presence of a dynamic selection process, as the pool of low-wage individuals in the last 3 years might significantly differ from those in the first 3 years. One way of establishing dynamic selection is to estimate the dynamic processes separately by sub-period. Note that separate estimations involve a different interpretation of the respective initial conditions, with the initial years now corresponding to 1990, 1993 and 1996, respectively. A potential concern, however, is that Monte Carlo results suggest that the Wooldridge estimator is biased when



**FIGURE 3** Effect heterogeneity – within-regime dynamics. (a) Baseline, (b) Separate (Wooldridge), (c) Separate (Heckman). The figure shows the differences in predicted probabilities conditional on low-wage and high-wage employment and the corresponding 90% confidence intervals of the probability of being low paid using a multinomial logit model with random effects separately by time and gender. Panel (a) shows the results from estimating the baseline model including period interaction effects. Panels (b) and (c) are based on separate estimations for the three sub-periods distinguishing between the Wooldridge and the Heckman approach. Probabilities are estimated by averaging over 100 Halton draws. Each regression for the male (female) sample is based on 16,312 (16,465) observations with 2,165 (2,267) individuals. Detailed estimation results are available from the authors upon request

Source: BASiD 2007, weighted sample.

using less than 5–6 periods (Akay, 2012). To address this issue, we also estimated the models using the Heckman approach, with identification of the model relying on functional form assumptions.<sup>22</sup> Irrespective of the adopted approach, Figure 3b,c shows that the probability of being low paid for both males and females is higher for workers who have been low paid in  $t - 1$  and this probability is rather constant over time. These findings highlight that the former documented increase in within-regime state dependence is likely to reflect a strong selection process after Unification in the sample.

To assess the randomness of the initial allocation to the low-wage sector, our previous results have shown that the coefficient on the initial condition is not significant. This indicates that the

<sup>22</sup>Specifically, we model the initial condition using a multinomial logit specification and allow the state-specific random effects to be correlated with the states in the first period.



modelled stochastic post-unification low-wage process is independent from the low-wage status in 1990. Analogous to interacting the lagged endogenous variable with two sub-period dummy variables, we also interact the initial condition variable with these dummies. Table 5 shows the results. The point estimate of the initial condition in 1990 for the first period (1991–1993) becomes somewhat larger compared to Table 4, but is still insignificant. This basically supports our previous findings, suggesting that the initial allocation to the low-wage sector is close to random. For female workers, the initial condition has a  $t$  value of slightly below 1.6, suggesting a (weak) correlation between the low-wage state in 1990 and the individual-specific random effects. This is in line with the finding presented in online Appendix G showing that the random effects are correlated for females. The estimates in the last two columns show the importance of the initial condition from separate estimations by sub-period. While the positive coefficient on the initial condition is small and insignificant for males and female workers in the first period, it becomes larger and strongly significant in the second period (1994–1996). The same holds true for the last sub-period with even higher point estimates. The strong increase in the initial condition's importance again provides evidence of a dynamic selection process.

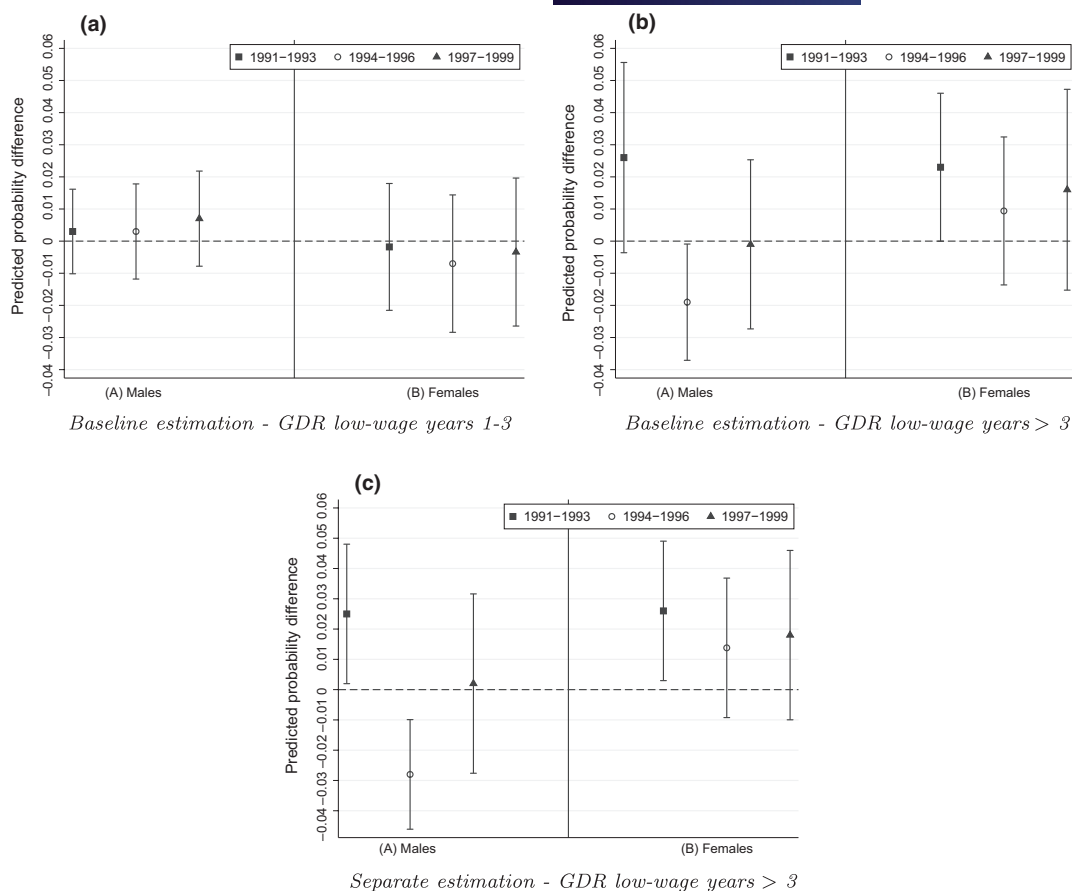
Turning to across-regime dependence, Figure 4 illustrates the effect of the cumulative number of low-wage years between 1980 and 1989 on the probability of being low paid after Unification. The figure depicts differences in predicted probabilities conditional on *1–3 years below the first decile* and *more than 3 years below the first decile* relative to zero GDR low-wage years. It suggests that there is no heterogeneity by sub-periods with respect to the first variable. For the second one, Panel (b) shows that having experienced more than three GDR low-wage years raises male workers' low-wage probability in the first sub-period by about 2.5% points ( $t$  value: 1.5), whereas the effect vanishes after 1993. For females, the point estimates are positive throughout the post-unification period. Even though the estimate is (weakly) significant only for the first sub-period, the results indicate that across-regime dependence appears to be more persistent for female workers. The separate estimations (Panel (c)) by sub-period support these findings. In fact, the results from using interacted specifications or from the separate estimations by sub-periods do not differ from each other, indicating that shortening the observation window does not lead to biased estimates. Overall,

**TABLE 5** Initial condition for the low-wage equation, by gender and period

| <i>Initial Condition:<br/>low-wage</i> | <b>Males<br/>Baseline</b> | <b>Females<br/>Model</b> | <b>Males<br/>Separate</b> | <b>Females<br/>Estimation</b> |
|--|---------------------------|--------------------------|---------------------------|-------------------------------|
| 1991–1993                              | 0.035<br>(0.022)          | 0.022<br>(0.014)         | 0.016<br>(0.013)          | 0.022<br>(0.014)              |
| 1994–1996                              | –0.009<br>(0.017)         | 0.006<br>(0.016)         | 0.226***<br>(0.077)       | 0.194***<br>(0.046)           |
| 1997–1999                              | –0.026<br>(0.017)         | –0.025*<br>(0.013)       | 0.294***<br>(0.079)       | 0.224***<br>(0.063)           |

*Note:* The table displays the marginal effects of the initial condition *low-wage*<sub>1990</sub> of the stochastic low-wage process. In the first two columns, the initial condition is interacted with two sub-period dummies. The coefficients for the second (third) period referring to 1994–1996 (1997–1999) measure changes relative to the first period (1991–1993). The marginal effects are estimated by averaging over 100 Halton draws. The last two columns report the results from estimating the model separately by sub-period. The initial conditions for the three periods refer to 1990, 1993 and 1996, respectively. Each regression for the male (female) sample with interactions is based on 16,312 (16,465) observations with 2,165 (2,267) individuals. Asterisks next to coefficients indicate significance levels as follows: \*\*\* 1%, \*\* 5%, \* 10%. Detailed estimation results are available from the authors upon request.

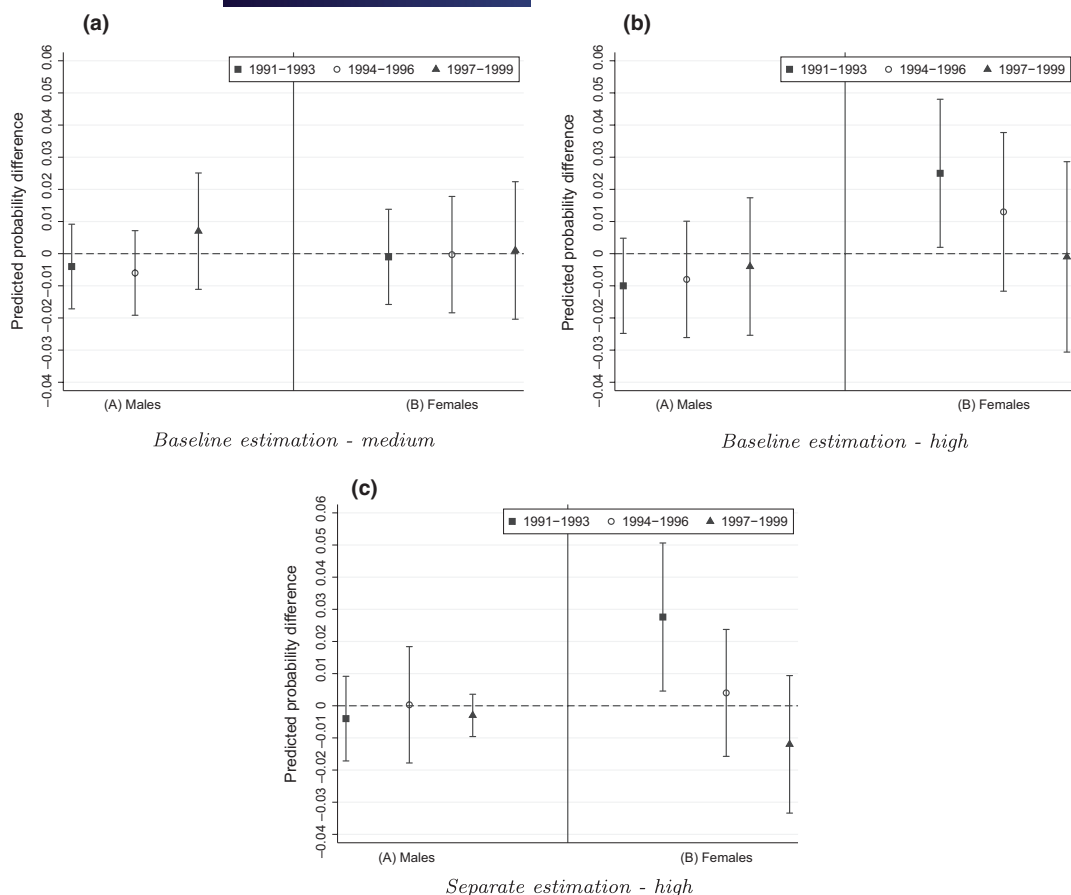
*Source:* BASiD 2007, weighted sample.



**FIGURE 4** Low-wage probability conditional on the number of GDR low-wage years. (a) Baseline estimation – GDR low-wage years 1–3. (b) Baseline estimation – GDR low-wage years > 3. (c) Separate estimation – GDR low-wage years > 3. The figure shows differences in predicted probabilities of being low paid and the corresponding 90% confidence intervals given the across-regime persistence variables ‘number of low-wage years between 1980 and 1989’ using a multinomial logit model with random effects distinguished by time and gender. Probabilities are estimated by averaging over 100 Halton draws. Each regression for the male (female) sample is based on 16,312 (16,465) observations with 2,165 (2,267) individuals. Detailed estimation results are available from the authors upon request

Source: BASiD 2007, weighted sample.

we find (weak) evidence of across-regime dependence for workers who experienced many pre-unification low-wage years and that this effect disappears for males. We wish to note, however, that according to our discussion above, the estimates for female workers might still be upward biased. Finally, Figure 5 shows the impact of pre-unification labour market interruptions on the low-pay probability after Unification. While there is no effect for males, females exhibit a 2.6% points higher low-pay probability during the first 3 years if they experienced more than 4 years of cumulated labour market interruptions relative to the reference group. The effect vanishes in the second and third sub-period. Repeating the regressions separately (Panel (c)) by sub-period shows similar results with a positive significant impact of ‘high’ GDR labour market interruptions for female workers for the first sub-period. Overall, there appears to be no effect for male workers and a temporary effect for females.

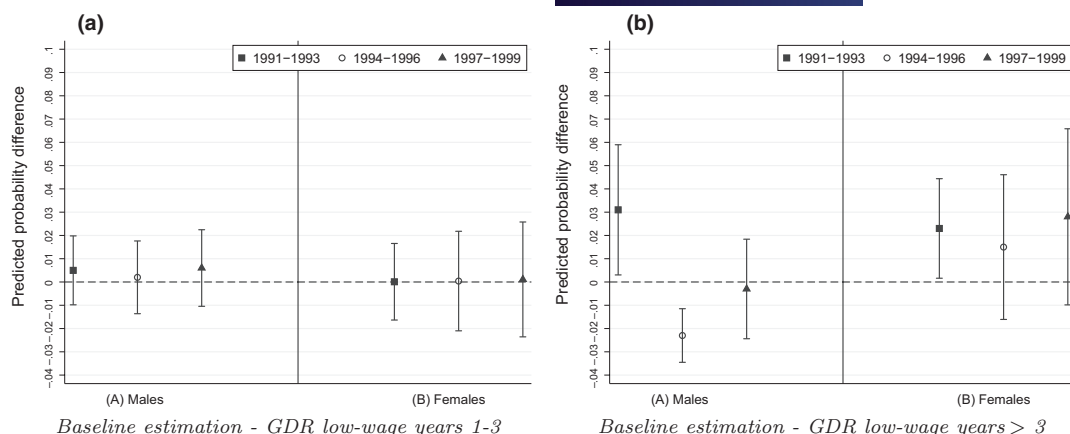


**FIGURE 5** Low-wage probability conditional on GDR labour market interruptions. (a) Baseline estimation – medium, (b) Baseline estimation – high, (c) Separate estimation – high. The figure shows differences in predicted probabilities of being low paid and the corresponding 90% confidence intervals given the across-regime persistence variables ‘number of labour market interruptions between 1980 and 1989’ using a multinomial logit model with random effects distinguished by time and gender. Probabilities are estimated by averaging over 100 Halton draws. The reference category differs by gender. For males, the reference is zero labour market interruptions; medium: up to 6 months; high: more than 6 months. For females, the reference is zero to 12 months; medium: 12–48 months; high: more than 48 months. Each regression for the male (female) sample is based on 16,312 (16,465) observations with 2,165 (2,267) individuals. Detailed estimation results are available by the authors upon request. Source: BASiD 2007, weighted sample.

## 6.2 | Heterogeneity across educational groups

Thus far, the across regime effects have been assumed to be equal across all educational groups. To the extent that the established across-regime dependence in Figure 4 results from human capital depreciation, one might expect a stronger effect for high-skilled individuals. To address this issue, we exclude individuals without any level of education and repeat our regressions for the sub-population of medium and high-skilled individuals.<sup>23</sup> Figure 6 illustrates the results for the sub-periods (based on the baseline

<sup>23</sup>Repeating the regressions 5a and 5b of Table G.3 on the subsample of skilled individuals shows that the covariances of the regime-specific random effects are similar. For males, the estimate of the covariance is 0.006 and for females 0.285, albeit insignificant. The variances of the post-unification random effects are larger for both groups.



**FIGURE 6** Low-wage probability conditional on the number of GDR low-wage years for skilled individuals. (a) Baseline estimation – GDR low-wage years 1–3. (b) Baseline estimation – GDR low-wage years >3. The figure shows differences in predicted probabilities of being low paid and the corresponding 90% confidence intervals given the across-regime persistence variables ‘number of low-wage years between 1980 and 1989’ for skilled individuals using a multinomial logit model with random effects distinguished by time and gender. Probabilities are estimated by averaging over 100 Halton draws. Each regression for the male (female) sample is based on 14,327 (11,778) observations with 1,895 (1,607) individuals. Detailed estimation results are available from the authors upon request. Source: BASiD 2007, weighted sample.

model). Compared to the results above, the experience of one to three pre-unification low-wage years has again no effect on post-unification low-pay probability. However, the effects of more than three pre-unification low-wage years point to the same pattern with different confidence intervals. While the previously established significant estimates for female workers lose their precision, the picture for male workers becomes more pronounced especially for the first period (1991–1993) after Unification. Their low-pay probability increases by 3.3% points if the number of GDR low-wage years exceeds three. The effect, however, is not long lasting and turns out to be significantly negative during the second period. While these findings lend support to the hypothesis that genuine state dependence results from human capital devaluation, they also suggest that formerly low paid men have been able to catch up with their highly paid counterparts within a relatively short period of time.

## 7 | ROBUSTNESS CHECKS

### 7.1 | Definition of the low-wage threshold

In this section, we conduct some robustness checks. A first issue is that we used the conventional low-wage threshold of two thirds of the median after Unification, while using the first decile prior to Unification. To address this issue, we re-ran our specifications from Section 6 by adopting the more restrictive first decile threshold after Unification. The results are presented in online Appendix F.1. The overall pattern of the across-regime effects turns out to be similar to that documented earlier. The same is true for the coefficients on the initial conditions, even though for females the coefficients are now significant in the first 3 years after Unification. The within-regime results ( $Low-wage_{t-1}$ ) differ from those in Section 6, though. While in the baseline model state dependence is constant, the results from the separate estimations even point to a slightly decreasing tendency (albeit not significantly

so). Note that this provides evidence of an even stronger dynamic selection process compared to our earlier results.

## 7.2 | Short-time work

A second concern is the potential presence of short-time work, which we cannot identify in our dataset. The associated mobility patterns along with the fact that short-time work may give rise to systematically lower earnings in our data may affect our estimates of state dependence. To assess the robustness of our findings, we therefore excluded the sectors that were particularly heavily affected by short-time work (manufacturing, agriculture and water, energy and mining) from our estimations. The results (presented in online Appendix F.2) are similar to the findings from Section 6. Within-regime state dependence after 1990 tends to be slightly lower but not significantly different from the baseline estimation. The pattern of the coefficients on the initial conditions as well as the across-regime persistence effects are again found to be similar to our earlier results.

## 7.3 | Part-time employment

A third concern is that we do not observe individuals' working time decision prior to Unification. In particular, the extent of across regime dependence might be biased if low-wage employment before Unification captures systematics in working time decisions. This would bias estimation results if for example part-time employment before Unification were correlated with individuals' low-wage status after Unification. In our baseline specification, we excluded all individuals who are part-time employed after Unification. This is based on the assumption that part-time employment decisions might be correlated across regimes. In online Appendix F.3, we provide robustness checks, by including all part-time employees in our analysis. For males, the results turn out to be robust to including part-time employees. Short-run state dependence after Unification amounts to about 10% points. The coefficients on the initial condition as well as on the across regime indicator variables of GDR low-wage incidence are similar to the baseline results. For females, however, the coefficient on the initial condition in 1990 becomes significantly positive. This, however, can be shown to arise as a result of working time preferences as the last two columns show that – when explicitly modelling part-time employment as an additional labour market state – the coefficient on the initial condition is again similar to that from our baseline specification (without including part-time employees). The coefficients on the number of GDR low-wage years are also estimated to be larger, with the effect decreasing over time. Given that part-time employees are more likely to be in low-wage employment and given that part-time decisions are correlated across the regimes, this result is likely to reflect a correlation of post-unification low-pay between pre-unification working time decisions instead of true low-wage persistence. However, the main pattern of results remains the same; short-run state dependence is constant during the 1990s and across regime dynamics suggest that GDR low-wage males are catching up with their high-wage counterparts.

## 8 | DISCUSSION AND CONCLUSIONS

Focussing on the economic and political transformation in Eastern Germany, the aim of this study was to investigate how one's pre-unification relative economic position determined one's fortunes after

Unification. In answering this question, we attempt to improve our understanding about whether the transition from a centrally planned to a market economy offers fundamentally new perspectives for those who, in economic terms, were relatively deprived under the old regime. To address these issues, we use a novel administrative dataset, the *BASiD* dataset, focussing on individuals with a sufficiently long period of labour market experience during the pre-unification regime. The dataset provides an ideal basis for our analysis as it allows us, first, to identify individuals living in Eastern Germany before Unification and, second, to track individual employment histories both before and after the fall of the Iron Curtain. To measure individuals' relative economic position, we exploit information on the incidence and duration of their position in the bottom part of the pre-unification wage distribution.

To quantify the extent of genuine low-wage state dependence during economic and political transition, we estimate a dynamic multinomial random effects model starting in the transition year 1990 that accounts for the labour market states low- and high-wage employment as well as out-of employment. To measure across-regime dependencies, the model includes cumulative pre-unification low-wage histories as the main explanatory variable of interest. The main identifying assumption is that pre-unification low-wage histories and unobservables governing low pay in a market-economy are uncorrelated. Our approach to assess this assumption is twofold. Based on supplementary dynamic random effects probit specifications, we first establish the result that – at least for males – unobservables that determine the low-wage probability appear to be regime-specific and uncorrelated across the different regimes. The second piece of supporting evidence stems from modelling the initial condition in the transition year 1990. Our results from the multinomial model suggest that the initial condition is not significant, indicating that the allocation to the low-wage sector in the market economy was close to random in terms of market-regime unobservables. We then proceed by quantifying the impact of individuals' pre-unification low-wage histories on post-unification low-pay probabilities. Overall, our results suggest that, consistent with theoretical considerations, economic state dependence across different political and economic regimes is only weakly present. An individual with more than three GDR years of experience below the first decile of the wage distribution during 1980 and 1989 exhibits a 2.5% points higher probability of being in low-wage employment during the first 3 years after Unification. Across all skill groups, this effect is weak and turns negative for male and insignificant for female workers over time.

What drives these findings? As spelled out earlier, the three main explanations for state dependence refer to productivity signalling, stigmatization and human capital depreciation. In the context of across-regime state dependence, signalling considerations and the stigma-effect channel lead us to expect no major connection between the pre- and post-unification relative wage position, if the heavily regulated pre-unification labour market had precluded any selection – conditional on observables – into low-wage jobs based on workers' true productivity. The structure of the Eastern German labour market before 1990 characterized by control of labour supply and demand and its central wage and price setting system indeed suggests that individuals' unobserved productivity should have been rather unconnected to their low-wage status. Given that general skills have been shown to be transferable to the post-unification labour market, an alternative explanation for the established, albeit weak across-regime persistence might stem from a loss in general human capital. Especially for men, this hypothesis is borne out by the estimates. The empirical results show that spending a reasonable amount of time at the bottom of the wage distribution before Unification is associated with a higher probability of being low paid post-unification and that this effect is particularly pronounced for medium and high-skilled workers. However, there is also evidence that this effect was not long lasting. Taken together, our findings provide good news for those, especially males, who used to be relatively deprived under the socialist regime. Those who were at the bottom of the socialist wage distribution are not more likely to be low paid after Unification than their highly paid counterparts and, where



there is any evidence of across-regime state dependence, it is weak and appears to have vanished within a relatively short period of time.

## ACKNOWLEDGEMENTS

Financial support from the German Research Foundation (DFG) is gratefully acknowledged. We also thank Andrea Weber, Andreas Peichl, Francois Laisney, Arne Uhlendorff, and seminar participants at the Society of Labor Economists, European Society for Population Economics, Paris School of Economics Università Cattolica del Sacro Cuore, Verein für Socialpolitik, Centre for European Economic Research, Institute for Employment Research (IAB), AIEL and the DFG Summer School on Labor Markets in a Globalized World for many helpful comments and suggestions. Maria Bidenko and Vanessa Lindenmaier provided excellent research assistance.

## CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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## SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

**How to cite this article:** Gürtzgen, N, Diegmann (né Nolte), A. Does low pay persist across different regimes? Evidence from German Unification. *Econ Transit Institut Change*. 2020;28:413–440. <https://doi.org/10.1111/ecot.12244>