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Social Science Research

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Suggested Citation: Dieckhoff, Martina; Giesecke, Johannes (2024) : Growing or declining penalties? A cross-temporal analysis of unemployment scars in the German labor market, Social Science Research, ISSN 1096-0317, Elsevier, Amsterdam, Vol. 121, pp. 1-17, https://doi.org/10.1016/j.ssresearch.2023.102960

This Version is available at: https://hdl.handle.net/10419/310923

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Social Science Research



Growing or declining penalties? A cross-temporal analysis of unemployment scars in the German labor market

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ARTICLE INFO

Keywords: Unemployment scarring Cross-temporal analysis German labor market Institutional change

ABSTRACT

We know that unemployment leaves scars. Unemployment scars are the penalties in terms of employment outcomes that workers experience due to past unemployment. To date we lack a long-term longitudinal account which examines how unemployment scarring has developed over time. The aim of this article is to fill this gap. We draw on longitudinal data from the German Socio-Economic Panel spanning a period of more than 30 years, from 1985 to 2020, and investigate long-term time trends of unemployment scarring. The German labor market has experienced profound structural and institutional change over the past decades. These changes have been associated with increased inequalities in the labor market. We examine whether the substantial transformation of the German labor market also had repercussions for the extent of postunemployment penalties. We focus on employment probabilities and wages, and consider both short-term (two years after the unemployment incidence) and mid-term outcomes (four years after the unemployment incidence). Changes in the amount of unemployment scarring over time can also occur due to changes in the composition of the unemployed. Our analyses therefore do not only investigate how macro-economic and institutional change are associated with varying amounts of unemployment scarring, but also control for and examine the role of compositional change.

1. Introduction

Few things are as damaging for an individual's future labor market outcomes as a spell of unemployment. For some unemployed workers it becomes impossible to re-enter the labor market, and for those who manage to escape unemployment, substantial disadvantage persists: past unemployment, on average, significantly increases the risk of future unemployment (e.g. Arulampalam et al. 2000), incurs substantial and enduring (relative or absolute) wage losses¹ (Gangl 2006; Gregg and Tominey 2005), and leads to a reduction in job quality also when non-pecuniary properties of jobs are concerned (Brand 2006; Dieckhoff 2011). It has also been

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https://doi.org/10.1016/j.ssresearch.2023.102960

Received 15 March 2022; Received in revised form 6 November 2023; Accepted 28 November 2023

Available online 31 May 2024



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¹ Wage scars are typically conceived as relative wages losses, meaning that the average wage growth of workers entering a spell of unemployment is lower than the average wage growth of workers not entering a spell of unemployment. However, spells of unemployment can also be related to absolute wage losses, meaning that post-unemployment wages are actually lower than pre-unemployment wages. In the following, we refer to wage scars in the former meaning and operationalize them accordingly in our analyses.

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shown that unemployment can spur downward social mobility and restrict upward mobility: middle-class individuals who experience a spell of unemployment have a higher probability of descending to lower class positions and a lower probability of moving to a higher social class than their continuously employed counterparts (Gebel 2016). Unemployment is hence understood to be a crucial life-course event with often adverse repercussions for affected individuals' future lives (DiPrete and McManus 2000; Gangl 2006) and sociologists emphasize the central role unemployment plays in producing stratification (Brand 2006; Gangl 2004, 2006; Mooi-Reci and Ganzeboom 2015; Dieckhoff 2011).

The phenomenon that unemployment does not only affect individuals while they are unemployed, but also exerts detrimental effects at and after labor market re-entry is referred to as 'unemployment scarring'. Existing work has also revealed the extent of unemployment scarring to vary cross-nationally (Gangl 2006) and demonstrated that institutional differences play an important role in explaining this variation. This comparative work analyzed wage scars in Europe and the US (based on data from the mid-1990s until 2001). In this analysis the German labor market, which has used to serve as prime exemplar of a conservative welfare state and a highly coordinated labor market, takes up an intermediate position in terms of scarring intensity. It fares better than countries classified as liberal regimes such as the US or the UK, but less well than the Scandinavian countries representing social-democratic regimes (ibid.: 1009).

Over the past decades the German labor market has undergone a profound restructuring process, inter alia it has experienced substantial labor market and welfare reforms as well as important changes in industrial relations. Germany has experienced a move towards a more liberal market economy and welfare state. Against this backdrop, this contribution asks whether these liberalization processes were accompanied by increased unemployment scarring. So while existing cross-nationally comparative work has shown that countries representing liberal welfare state regimes fare worse in terms of scarring, we take a cross-temporal perspective and focus on liberalization processes within one country and their implications.

To our knowledge this is the first study concerned with long-term time trends in unemployment scarring in a Western economy. Germany makes for a very interesting case for such a study given the profound restructuring and reforms it has experienced. We investigate how scar effects in Germany have evolved over time and aim to identify the institutional, macro-economic as well as compositional dynamics behind observed cross-temporal scarring patterns. Our study addresses three central questions: 1.) Does the size of the scar effect of unemployment vary over time? 2.) To which extent is this affected by the composition of the unemployment inflow and outflow population? 3.) Which role do institutional and structural developments but also economic cycle play in explaining temporal change or fluctuations in the severity of unemployment scars?

We address these questions based on longitudinal data from the German Socio-Economic Panel (SOEP) spanning 36 years (1985–2020). These data come from a nationally representative longitudinal panel survey (Wagner et al. 2007). We estimate the effects of an unemployment experience (of at least two months) on subsequent employment outcomes. In particular, we focus on the effects of unemployment on future employment probabilities and (conditional on being re-employed) on wages. The longitudinal nature of the data affords us with the possibility to examine the employment outcomes for workers who experience a spell of unemployment and compare them to those of (otherwise similar) workers who did not experience unemployment. We examine unemployment scars shortly after the unemployment spell (two years after the unemployment incidence) as well in the mid-term (four years after the unemployment incidence). We estimate average treatment effects by combining a (still relatively) new matching method called 'Coarsened Exact Matching' (hereafter: CEM) proposed by Iacus et al. (2012) with the difference-in-differences approach (Heckman et al. 1997). This analytical strategy allows us to control for selection based on observable and (time constant) unobservable characteristics. The role of composition in explaining change over time is investigated by means of decomposition via a multivariate reweighting method (Hainmueller 2012). Finally, we use two-step multi-level models (Lewis and Linzer 2005) to test the association between the scar effects and macro-economic as well as institutional change.

2. Background

2.1. Empirical evidence on unemployment scarring

Existing work has shown repeatedly that unemployment has detrimental effects for future labor market outcomes for affected workers in advanced Western economies. Much of this work has focused on earnings losses, which have been found to be significant and persistent (e.g. Addison and Portugal 1989; Cha and Morgan, 2010; Eliason and Storrie 2006; Gangl 2006; Gregory and Jukes 2001; Möller and Umkehrer 2015; Ruhm 1991; Voßemer 2019a). Research has also shown that unemployment has a substantial negative effect on future employment probability (e.g. Arulampalam et al. 2000; Biewen and Steffes 2010; Gangl 2004, 2008; Voßemer 2019a). These effects are partly driven by affected individuals' difficulty of re-entering the labor market, but are also due to the jobs entered after unemployment being less stable (Gangl 2004) leading to a comparatively high risk of repeated unemployment spells. Schmillen and Umkehrer (2017) show that even youth unemployment has long-term implications and increases unemployment volume for adult workers. Compared to earnings losses and re-employment probabilities, non-pecuniary job-quality outcomes (e.g. type of contract, authority, autonomy, subjective job security) have received considerably less attention. But those who focused on these post-unemployment outcomes have shown a substantial negative impact as well (e.g. Brand 2006; Voßemer 2019b, Dieckhoff 2011).

2.2. Theoretical explanations for unemployment scars

How are scar effects of unemployment explained? Early accounts trying to explain why past unemployment predicts future

unemployment asked whether unemployment in itself causes future unemployment or whether unobserved worker characteristics explain this phenomenon (Heckman and Borjas 1980). In the meantime, empirical research has presented strong evidence for genuine state dependence (as reviewed in section 2.1), i.e. evidence that unemployment itself is harmful and leaves scars. The focus has therefore shifted to discussing the underlying mechanisms of scar effects. There exist various theoretical explanations for unemployment scarring. Some refer to mechanisms located at the level of the employer and others point to mechanisms that are located at the level of the unemployed jobseeker.

The explanations focusing at the employer level pertain to employers' perceptions of the unemployed: one explanation is building on considerations of human capital theory (Becker 1964). If employers believe that human capital and skills depreciate during unemployment - especially during long spells – this will cause scarring. Another theoretical mechanism is that employers deploy unemployment (and/or its duration) more generally as a signal for unobserved characteristics. Unemployment is believed to signal undesirable worker traits such as low effort, commitment and motivation (Lockwood 1991). This perspective is also referred to as the stigma explanation (e.g. Viswanath 1989). A different variant of the signaling theory is the rational herding approach (e.g. Kübler and Weizsäcker 2003): longer unemployment spells indicate to potential future employers that other recruitment managers have previously already decided against hiring this applicant. Following the judgement of prior recruiters rather than scrutinizing the applicant themselves is considered to be rational and efficient.

Some of the central mechanisms assumed to drive scarring are located at the level of the unemployed jobseeker. One potential mechanism is actual human capital loss: previously unemployed workers have lost all firm-specific human capital (Hamermesh 1987), while their occupation-specific or sector-specific human capital is lost if they do not obtain re-employment in their previous occupation/sector. Other models focus on the job search process. They emphasize that unemployed workers' job search takes place under financial constraints (Burdett 1979). In addition, when receiving a job offer, the unemployed can never be sure if and when a better job offer will arrive in the future (Mortensen 1970). The combination of financial constraints and this uncertainty forces the unemployed to accept 'low-quality' job offers. These are jobs that do not match their pre-unemployment qualifications, which offer significantly lower wages than their pre-unemployment jobs, or which are of a precarious, fixed-term nature (e.g. Addison and Blackburn 2000; Gangl 2004) and may thus lead to an increased risk of repeat unemployment.²

There thus exists quite a range of possible explanations for the phenomenon that unemployment leaves scars. However, direct empirical tests of these mechanisms are difficult to construct. While some work has started trying to determine which (demand-side) mechanisms are at work (e.g. Oberholzer-Gee 2008; Van Belle et al. 2018), evidence is still scarce and the relative importance of the different mechanisms located at the level of the employer and at the level of the unemployed job-seeker is still an open question.

2.3. The role of institutions and macro-economic context

While most work on unemployment scarring has focused on single countries, some have studied post-unemployment outcomes in a comparative perspective and revealed notable cross-national differences in the extent of unemployment scars (Gangl 2004, 2006; Voßemer 2019b). Some of these studies present evidence clearly suggesting that labor market and welfare state institutions – specifically unemployment insurance and employment protection – play a central role in moderating the detrimental effect of unemployment (Gangl 2004, 2006). One account, by contrast, finds surprisingly little support for the moderating effect of labor market policies (Voßemer 2019b).

Besides institutional context, the role of macro-economic climate has also been examined. Existing work addressing the question of how economic climate affects the scar effect of unemployment arrived at diverging conclusions. Earlier studies suggest that the extent of scarring does not vary between times of economic growth and times of recession (e.g. Farber 2005), while more recent analyses find scarring to be more severe during recessionary periods (e.g. Couch et al. 2011). This diverging evidence may be attributable to changing labor market dynamics or different estimation strategies, as conjectured by Gonalons-Pons and Gangl (2022: 172). Very recent work has also demonstrated that institutional setting and macro-economic conditions interact in determining the extent of unemployment scarring (ibid).

Existing work has thus presented important evidence that institutions and macro-economic climate matter for unemployment scarring. It has analyzed the influence of macro-level factors by means of a cross-nationally comparative approach. Against this backdrop, our contribution takes a cross-temporally comparative approach focusing on long-term developments and institutional change in one country. It seeks to examine whether changes in the institutional dimensions deemed relevant by earlier cross-nationally comparative research have resulted in different scarring outcomes in Germany, while also taking into account macro-economic development. Given that the German labor market has undergone substantial change (as outlined in detail in the subsequent section), it makes for a particularly fruitful case for a such a long-term cross-temporal analysis.

² Some authors have also focused on the psychological effects of unemployment and these psychological scars may then of course also contribute to future employment and wage scarring. Some authors have put forward the possibility that the unemployment spell may change individuals' attitude to work (Lynch 1989) or shown that unemployment can trigger a loss of self-esteem (e.g. Goldsmith et al., 1996). Other studies have shown that unemployment reduces well-being and mental health in a long-lasting manner providing evidence for a long-term effect even after re-employment (Clark et al., 2001; Daly and Delaney 2013; Young 2012).

2.4. The German labor market in transformation

For a long time, the German labor market served as the main exemplar of a coordinated market economy and a conservative welfare state with strong unions, high levels of coordination, and strong employment as well as unemployment protection (Hall and Soskice 2001). However, the model came increasingly under strain with the beginning of the 1980s and this encouraged the first attempts to deregulate the German labor market, which took place in the mid-1980s. These first reforms extended the possibilities for non-standard employment (Eichhorst and Marx 2011) and marked the beginning of labor market dualization in Germany (e.g. Brady and Biegert 2017; Eichhorst et al. 2015). While the initial reforms left the core workforce untouched, the government initiated more comprehensive labor market reforms following the German re-unification and the 1993 economic crisis (cf. Fig. 1). These measures included first marginal cuts to unemployment insurance and unemployment assistance benefits (Ebbinghaus and Eichhorst, 2009). The liberalization processes also included industrial relations with unions losing much of their power (Eichhorst and Marx 2011).

In the second half of the 1990s further, more substantial, steps towards the deregulation of the unemployment benefit system took place. At the same time, the waning of union power and the decline of collective bargaining coverage continued steadily (e.g. Visser 2019) during the 1990s and the low-wage sector started growing substantially from 1997 onwards (Grabka and Schröder 2019).

The peak of the liberalization process occurred in the early-mid-2000s. In the context of an economic downturn and a drastic upsurge of unemployment (see Fig. 1), the so-called Hartz reforms were introduced (Eichhorst and Marx 2011). The different components of these very extensive labor market reforms were introduced step-wise between the beginning of 2003 and 2005 (see e.g. Kemmerling and Bruttel 2006 p. 93 ff. for an overview and detailed depiction of the Hartz legislation). The aim of the reforms was to reduce (long-term) unemployment and encourage employment growth.

The initial set of reforms inter alia substantially deregulated temporary work agencies, tightened eligibility and job acceptance regulations for benefit receipt, eased firms' use of fixed-term contracts, and encouraged employment in the low-wage sector. The final reform, Hartz IV, entailed that entitlement periods for earnings-related unemployment benefits were shortened notably. After benefit depletion, unemployed workers receive means-tested minimum income support only (Kemmerling and Bruttel 2006). Receipt of this minimum income support is linked to strict eligibility criteria and increased conditionality: the long-term unemployed are obliged to accept almost any job (ibid.). This fourth reform, which drastically weakened the social policy principle of status-protection is often characterized as the most central departure from the principles of the pre-Hartz German labor market policy (e.g. Möller 2015). Some argue that the view of the unemployed and unemployment has changed because of the reforms, with unemployment increasingly seen as being the result of individual behavior and short-comings rather than a structural economic problem (e.g. Bothfeld 2007).

Unemployment fell drastically in the years after the final reform was implemented in 2005, and even the great economic recession (2007–2009) with its clearly visible negative impact on GDP growth did not entail a growth in unemployment figures (see Fig. 1). After the recession unemployment rates continued to decline and were below four percent at the end of our observation window (cf. Fig. 1). There is little consensus, though, as to whether this was an effect of the Hartz reforms (e.g. Möller 2015) or not (e.g. Dustmann et al. 2014). Union power and impact continued to decline substantially after the reforms (Eichhorst and Marx 2011).³ The growth of the low-wage sector, which started in 1997 continued until 2008, but has stagnated since at a level of 25 percent (Grabka and Schröder 2019). Following the recession, German GDP growth since 2009 was positive each year – except in 2020 when it was negative (at a rate of 5 percent) because of the pandemic (cf. Fig. 1).

3. Aims and expectations

Our aim is to examine how unemployment scars have developed over time and investigate whether or not there is variation over time or even a clear time trend towards reduced or increased scars. We are also interested in whether any observed trends differ depending on which type of scar we look at, i.e. whether we examine wage outcomes or employment probabilities. It is likely that the institutional and structural changes the German labor market experienced have had repercussions for the extent of unemployment scarring. It can also be expected that the level of scarring would depend on labor market conditions and hence vary over the business cycle. While there are good reasons to expect variation over time, the direction of the effect, which structural and institutional change as well economic climate may have on the severity of scarring is hard to determine a priori. Any prediction hinges on the actual causes of unemployment scarring, i.e. on which of the potential mechanisms discussed earlier are actually at work or – assuming that several processes are at work simultaneously – on their relative weight in determining the labor market disadvantages following unemployment.

3.1. Deregulation and unemployment scarring

Which of the afore discussed theoretical mechanisms would predict reduced scarring in the context of continuous deregulation and which ones would instead point to increased scars? What would demand-side mechanisms, i.e. those *mechanisms located at the level of the employer*, predict? Assuming that employers' concern about human capital depreciation is central in explaining scar effects, the overall trend of deregulation in the German labor market should have resulted in reduced scars. The liberalization of employment regulation (specifically also the deregulation of temporary work) facilitates labor market re-entry for the unemployed with employers

 $^{^{3}}$ In fact, from the beginning until almost the end of our observation window, collective bargaining coverage has declined from 85 to 56 percent (Visser 2019).



Fig. 1. GDP growth and unemployment rates in Germany, 1985–2020. Source: Statistisches Bundesamt (Federal Statistical Office) 2022: Fachserie 18 Reihe 1.5

being generally less conservative in their hiring behavior due to lowered dismissal costs. This makes it more likely that the unemployed are hired despite excepted human capital losses. With increased deregulation, the average unemployed job-applicant should thus spend less time in unemployment than beforehand. Consequently, we would expect increased employment probabilities of previously unemployed individuals. Moreover, if employers associate shorter unemployment spells with lower levels of human capital depreciation, we would also predict a time trend of reduced wage scars following deregulation.

Models, which consider the signaling effect of unemployment spells to be central in determining unemployment scarring, would arrive at very similar predictions. In this explanatory approach, the risk attached to the hiring decision (e.g. hiring workers with low productivity levels) is the central mechanism. Given the lower risk associated with any hire in less regulated labor markets, we would expect a quicker re-entry of the unemployed following deregulation. It should also imply reduced wage scars as short spells of unemployment are a less negative signal than long spells of unemployment. A focus on the signaling approach could also lead to the contrary prediction, however. In the process of deregulation, and most notably upon the introduction of the Hartz reforms, the perception of unemployment may have changed. Unemployment may be increasingly understood as being due to individual fault, as has been argued by some. If this is indeed the case, then the negative signal attached to unemployment will likely have become more pertinent over time instead, leading to the expectation of increased scar effects, both in terms of employment probabilities as well as in terms of wages. This would mean that in terms of the "signaling mechanism" positive and negative reform effects could off-set each other (see also Voßemer 2019b for a similar argument with view to different institutional effects).

What predictions about temporal trends would arise based on the different supply-side explanations, i.e. those *theoretical mechanisms located at the level of the unemployed individual*? If human capital explanations located at the level of the unemployed job-seeker have strong explanatory power, i.e. those pertaining to actual sector- and occupation-specific human capital losses and devaluation, deregulation and benefit reforms will likely have resulted in more pronounced wage scarring. Increased conditionality and pressures surrounding job search and benefit receipt make it more likely that workers (have to) accept jobs in another sector or occupation which means that their occupation- or sector-specific human capital lost all its value and that their (relative) wage losses are likely more pronounced and long-lasting than prior to deregulation. Higher employment rates of previously unemployed workers hence come at the price of relative or even absolute wage loss. Likewise, job search models emphasizing the financial constraints and the uncertainty about future job offers unemployed job-seekers are confronted with would predict deregulation, and specifically the Hartz reforms, to have resulted in lowered reservation wages and hence increased employment rates, but also increased (relative) wage losses.

More generally, and irrespective of any potential micro-level mechanisms explaining post-unemployment outcomes, deregulation has also entailed structural change over time with increased dualization (as deregulation of employment protection mainly and most substantially affected non-standard employment), a larger low-wage sector (Grabka and Schröder 2019), higher earnings disparities (Card et al. 2013; Dustmann et al. 2009) and increased employment levels (OECD 2019). These developments should have made it easier over time to re-enter the labor market after unemployment, but made it harder to obtain a job that is of comparable worth to the one held pre-unemployment, both in terms of wages but also in terms of job stability. Especially the rise in non-standard employment is a crucial factor here as it is known to be associated with lower wages (Giesecke 2009).

3.2. Economic climate and unemployment scarring

Aside from institutional and structural change, economic fluctuations can also be expected to affect the extent of scarring. Again, any prediction about the direction of this effect is difficult and hinges on which of the theoretical mechanisms is actually at work (see also Tumino 2015) or – if indeed several mechanisms are at work – on their relative weight. And, as noted earlier, empirical evidence is mixed. For example, there seems to be no mechanical relationship between aggregate unemployment and the employment probability of the unemployed (or the wage outcomes of the previously unemployed). One central perspective holds that the negative signal of unemployment becomes less relevant when aggregate levels of unemployment increase (e.g. Lockwood 1991) leading to the expectation of reduced scars in times when labor market conditions are unfavorable. At the same time, adverse labor market conditions reduce hiring levels, which may increase the average length of unemployment spells and hence result in more severe scarring (both in terms of employment probabilities and also wages). These two mechanisms might counterbalance each other.

Turning to the rationale and behavior of the unemployed job-seeker, in times of slack demand s/he may be more likely to accept job offers outside of their previous sector or occupation (Gangl 2006). This would mean that his/her specific human capital lost all its value. If human capital explanations are central in explaining scarring, job loss and job search when labor market conditions are adverse should increase scars – especially wage scars. Job search models would also predict lower reservation wages in such a scenario leading to the expectation of increased wage scars.

3.3. Declining or Increasing Scars over time?

As the discussion so far has highlighted, it is difficult to develop hypotheses about time trends in the severity of unemployment scars. The discussion has shown that there are mechanisms whereby we would expect deregulation to have encouraged time trends of reduced unemployment scars as well as mechanisms, which would lead us to expect the opposite. The same ambivalence is true for scar effects in recessionary periods. Rather than developing and testing directional hypotheses, our study will provide a nuanced explorative account of the temporal developments of unemployment scars in the German labor markets and the underlying macro-level mechanisms. Moreover, the above discussion referred to macro-level developments leading to possible changes in the estimated average scar effect by affecting how deleterious unemployment is for future outcomes. Yet, macro-level developments could also affect the extent of estimated scars merely by changing the composition of those who become unemployed (or of those who re-enter the labor market) if there are group-specific scar effects. While work on group-specific effect heterogeneity is still rather scarce, existing evidence clearly suggests that the extent of scars tends to vary group-specifically (e.g. Brand 2006; Mooi-Reci and Ganzeboom 2015), so changes in composition would be enough to observe changes in average (treatment) effects without the severity of the scars as such having changed. Our study will be able to analytically separate "true" changes in scar effects from changes that are due to compositional change.

4. Data and method

4.1. Data and sample

We use the German Socio-Economic Panel (SOEP) from 1984 to 2020, which provides nationally representative longitudinal data for Germany (Goebel et. 2019). The rich and annually collected SOEP data with monthly calendar data on economic activity allow us to identify individuals who are employed at T and enter a spell of unemployment between time points T and T+1. The data also provide us with information collected prior to time point T and subsequent to time point T+1. In particular, we use information stemming from the last SOEP wave prior to wave T (i.e. wave T-1) and from SOEP waves two years and four years after time point T (i.e. wave T+2 and T+4, respectively). Accordingly, our sample is comprised of respondents, who are observed at least in four (six) consecutive waves of the SOEP.

Furthermore, our sample is restricted to respondents aged 25–55 (at time point T). This means that our study focuses on individuals of prime working age, thereby excluding younger and older persons, whose employment situations often are influenced and shaped by specific work arrangements such as early retirement schemes, training contracts and active labor market programs, which would require a separate analysis. Moreover, we restrict our sample to persons who are in dependent employment at time point T (i.e., excluding the self-employed) and who did not participate in general or vocational education (e.g. apprentices or university students).⁴ To minimize the impact of statistical outliers, we also exclude respondents reporting hourly wages lower than three Euro or higher than 200 Euro (in constant prices of 2015, see below).⁵ Finally, to address the specific economic situation in East Germany after re-unification in 1990, we include respondents residing in East Germany only from wave 1995 onwards. The time between 1990 and 1995 was characterized by a major restructuring of East Germany's economy and labor market. It thus constitutes a very unique and specific situation when it comes to analyzing individual labor market trajectories. Therefore, this specific period would call for a separate analysis of unemployment scarring.

 $^{^{4}}$ Results do not substantially change if we exclude those respondents, who participate in general or vocational education in T+2 or T+4, respectively.

⁵ Averaged across all waves and applying our sample restrictions, the share of individuals with wages below three Euro (in constant prices of 2015) is less than one percent; the share of individuals with wages above 200 Euro is below 0.1 percent.

We use survey weights throughout our analyses to address the SOEP's specific sampling strategies (e.g., disproportional sampling of certain social groups) as well as panel attrition. In particular, we use cross-sectional survey weights at time point T and multiply them with longitudinal weights that capture the individual probability of staying in the sample (at T+1, T+2, etc.).

Our two outcome variables are employment status and wages. These are measured as follows: *Employment Status* at T+2 and T+4 is based on self-reports of the respondents. Respondents gainfully employed on full-time or part-time basis as well as self-employed respondents are coded as employed, while respondents are coded as non-employed if they reported to be either unemployed (registered with the Federal Employment Agency) or economically inactive. Moreover, respondents participating in employment-creation measures offered by the Federal Employment Agency are also coded as non-employed.⁶ The variable *Wages* at T, T+2 and T+4 measures respondents' hourly gross wages by combining information on gross monthly labor earnings and weekly actual working hours. To keep wages comparable across waves we use the consumer price index and calculate wages in constant 2015 prices. Based on this information we calculate an individual's wage growth between T and T+2 as well as between T and T+4. In our analyses, we use log-wages – a common practice when modelling wages as dependent variable.⁷

The key explanatory variable captures information of whether or not a respondent indicated to have entered a spell of unemployment between the interviews in wave T and in wave T+1. This information is based on retrospectively collected calendar data provided by respondents' self-reports. In this calendar data, respondents indicate on a monthly basis whether or not they have been unemployed at any point from January to December in the year prior to the current interview. Combining this information across all available waves, we are able to identify those respondents, who entered a spell of unemployment between T and T+1. Very short-term unemployment spells of less than two months are not counted as "becoming unemployed" as these short spells are likely to reflect a transition phase from one job to another.⁸

Entering unemployment is not a random process. We therefore use an extended list of individual characteristics that are known to be determinants of both unemployment and future trends in baseline outcomes and condition on these in our empirical analyses. These characteristics include gender, age, residence in East/West Germany, education, tenure, previous unemployment experience, wages, health status – all measured at time point T.⁹ Moreover, we use information about the individual wage growth between T-1 and T to account for potentially diverging wage dynamics of those becoming unemployed and those not becoming unemployed (the so-called Ashenfelter dip, see Ashenfelter 1978). We also control for changes from un/non-employment to employment between T-1 and T.

Given two of our core sample selection criteria - respondents, who are observed at least in four (six) consecutive waves of the SOEP; respondents aged 25–55 (at time point T) - the share of missing data is very low (less than one percent). Against this background, we refrain from using imputation models for missing data and use listwise deletion instead.¹⁰

4.2. Analytic strategy

To identify and estimate (causal) effects of unemployment for future employment outcomes, we combine matching approaches with the analysis of difference-in-differences. In particular, we use coarsened exact matching (CEM, see Iacus et al. 2012). CEM is a matching method which comes close to the ideal of exact matching. In contrast to exact matching, which is often not empirically feasible, CEM does not use all variables in their original format but uses coarsened versions when exact matching is not realizable. By using CEM we assure that treated (i.e. individuals becoming unemployed between T and T+1) and control (i.e. individuals not becoming unemployed between T and T+1) cases are strictly comparable with respect to gender and East/West Germany residency as well as to coarsened pre-treatment information (measured at T) on wages (five categories), age (two categories), education (three categories), and tenure (two categories, see Appendix Table A.1.1 for more details). Combining all these characteristics results in a total of 240 cells, within which treated and control cases are matched. If cells contain only treated or only control cases, then these cells and the corresponding cases are discarded.¹¹ To ensure a sufficient number of treated cases, in some instances we had to resort to pooling pairs of adjacent waves. This was mostly necessary in the waves before the mid-1990s as the number of SOEP-respondents (and

⁶ We decided to do so as we are interested in scar effects pertaining to regular employment; job creation is part of the policy, not the outcome. Additional analyses counting these individuals as employed did not change the results drastically and are available upon request.

⁷ Logarithmization transforms right-skewed wage dispersion in such a way that the dependent variable is approximately normally distributed, which – inter alia – helps reduce heteroscedasticity problems. Through the transformation $[exp(\beta_x)-1]*100$ the coefficients of linear regression models can be interpreted as percentage change in the (delogarithmized) dependent variable, which corresponds more to a concept of social inequality that stresses relative rather than absolute differences (Petersen 1989).

⁸ Restricting the minimum length of unemployment spells even further (e.g. to at least three or four months) results in a significant drop in the number of cases experiencing unemployment. Thus, to maintain a sufficient number of cases, we decided to apply the rather mild restriction of considering spells of at least two months.

⁹ These characteristics enter the analyses in either a coarsened or uncoarsened version. For more details see Appendix A1.

¹⁰ Only in case of wage information we observe a slightly increased share of missing data (about six percent). However, imputing this wage information does not seem to be useful, as we are employing this wage information as dependent variable (wage growth), at least in one of your two model specifications. As shown by von Hippel (2007), imputing the dependent variable and using these imputed values in linear models induces needless noise in the estimates.

¹¹ By using this approach, CEM is able to guarantee common support for the matched sample. Moreover, in our application, CEM achieved a close-to-perfect balancing between treated and control cases (i.e. with respect to the coarsened versions of the variables entering the matching procedure). According to all imbalance measures reported by CEM, balance has been achieved in all SOEP waves for all of our treatment specifications (i.e. employment and wages at T+2 and T+4, respectively).

of people observed as entering unemployment) was substantially lower than in later waves (see Table A.2 for the number of treated by year as well as for information on which waves were pooled).

Based on these matched data we then run regression models, which take remaining imbalances between treated and controls into account. These models control for all matching variables outlined above (but this time in their uncoarsened form) *plus* information on prior unemployment experience, health status and pre-treatment wage growth to estimate future wages and employment chances (see Table A.1.2). In these regression models we regress employment status at T+2 and T+4 and (given employment) wage growth between T and T+2/4 on the treatment indicator (having become unemployed or not) and the extended list of control variables. This setup mirrors the well-known difference-in-differences (DID) estimator (Heckman et al. 1997) that compares differences in the outcome variable between treated and control cases before and after treatment. In our case, pre-treatment differences are either zero by design (all cases are employed at T) or close to zero by matching/conditioning on pre-treatment levels of the outcome (i.e. pre-treatment wages measured at T) and other individual pre-treatment characteristics. Accordingly, causal effects of unemployment can be identified and estimated by our approach if our models sufficiently condition on observables (known as conditional independence assumption) and/or we can assume that – given conditioning on control variables – trends in employment probability and wages had been the same for treated and control cases in the absence of treatment (known as common trends assumption). Given the extended list of pre-treatment characteristics that we condition on in our models as well as our data structure and research design we are confident that at least one of these assumptions holds.¹²

It is important to note that based on our empirical strategy we estimate average treatment effects on the treated (so called ATTs). To the extent that treatment (i.e. scarring) effects are not homogenous across all treated persons, changing ATTs across time might purely represent a changing composition of the treated population (see also discussion in sub-section *Declining or Increasing Scars over Time?*). If, for example, we expect scar effects to be different for different levels of education, ATTs might change across time simply due to the fact that the treated population (i.e. those who become unemployed) is changing with respect to its educational composition. To address comparability problems arising from heterogenous treatment effects and compositional changes in the treated population, we recalculate and standardize ATTs by assuming the same composition of the treated at every time point of our observation period. This is done by using a multivariate reweighting method that was introduced by Hainmueller (2012). In particular, we calculate the "average composition" of the treated population by averaging distributions of all matching and further control variables across all waves. Next, we recalculate ATTs based on this "average composition" using the reweighting approach to change the empirical distribution of each matching and control variable to its average counterpart. These reweighted ATTs allow for a better analysis of time trends in unemployment scarring as their calculation is based on a time-constant composition of the treated population.

Finally, we directly investigate time trends in unemployment scarring and examine the relationship between macro-level change and unemployment scarring. We use the estimated ATTs (and their standardized counterparts) and regress them on a linear time trend as well as on an indicator of economic growth (growth rate of gross domestic product at T) and an indicator of current labor market conditions (unemployment rate at T). This allows us to purge temporal change in unemployment scars of economic and labor market conditions that have substantially varied over the observation period (see Fig. 1 above) and that might be confounded with long-term trends in unemployment scars. Moreover, to explicitly test for a structural break in the time series of unemployment scars, we include a variable that distinguishes periods before the implementation of major welfare reforms (before 2003) from periods thereafter (i.e., from 2003 onwards).

To account for the fact that in these models the dependent variable (ATTs) contains estimated entities we use the associated standard errors of each ATT and estimate these regressions by a feasible generalized least square (FGLS) as suggested by Lewis and Linzer (2005). This two-step procedure allows us to integrate estimation uncertainty at the first step (i.e. estimation of ATTs) into the second analytical step, i.e. estimation of models regressing unemployment scars on time trends and macro controls. Moreover, to allow for a heteroscedastic and autocorrelated error structure we employ the variance estimator suggested by Newey and West (1987). This estimator produces consistent variance estimates when there is autocorrelation as well as heteroskedasticity. Given the time-series nature of our second-step data, it is likely that both heteroskedasticity and autocorrelation are present in the error structure. For example, heteroskedasticity (i.e. non-constant error variance) may result from the fact that our model fits the data differently well over some or even all years of observation. Autocorrelation would, for example, result if error terms in T (i.e. difference between measured and predicted ATTs) are correlated with error terms in T+1, T+2, and so forth. In our estimation, we allow for an autocorrelation of the order 1.

These two-step models allow us to investigate time trends more directly and to relate them to institutional and macro-economic change. However, with the data and research design at hand, we cannot estimate the causal effect of macro-level change and especially we cannot provide a rigorous evaluation of the labor market reforms either.

¹² Both assumptions are, unfortunately, empirically untestable in a rigorous manner. However, in the appendix, we present some results of testing for common trends in employment trajectories between treatment and control group prior to T (see Figure A2). Moreover, to check the robustness of our results, we re-ran all models using three alternative matching approaches (multivariate-distance matching, propensity-score matching, and inverse probability weighting). We are able to show that results based on these alternative matching approaches are very similar to the results that are based on CEM and conclusions drawn from these models would not be different from our conclusions reported in the main text of the paper. Detailed results of the robustness checks can be found in Appendix B.

5. Results

5.1. Developments of scar effects over time

Fig. 2 examines the estimated causal effects of past unemployment on employment status and wages at T+2. As discussed in section 4.2, these effects of unemployment are estimated net of observed individual characteristics of those becoming unemployed and in our estimations we went as far as possible with the data at hand to remove potential sources of bias. Our estimates can thus be regarded as (close-to) causal effects of unemployment. The estimated causal effect of unemployment (ATT) is plotted on the Y-axis, the X-axis refers to time. This graph as well as the ensuing figures have been smoothed with *LOWESS* applying a bandwidth of 0.25 (the standard errors have been smoothed as well).¹³ The dashed line displays the estimated ATTs of unemployment on affected individuals' future employment chances. This average treatment effect of unemployment on the treated shows the difference in the employment probability between the unemployed and the control group and refers to a time-point approximately two years after entry to unemployment and repeat unemployment. It is thus plausible that any decrease/increase in employment scars we observe is attributable to shortened/ lengthened spell length.

The horizontal dashed line describes the average "penalty" throughout our entire observation window and it shows that two years after entry to unemployment, the employment rate of affected workers was on average almost 30 percentage points below that of comparable workers in the control group. Importantly, our graph shows substantial variation over time in the extent of scarring suggesting that macro-level changes and/or the composition of the unemployed population affect the extent of scarring. At the beginning of our observation period, in 1985, the scar effect amounts to 40 percentage points. The estimated re-employment chances are improving somewhat throughout the late 1980s until the year 1990 (when scars are just above 30 percentage points). The re-employment chances then seem to deteriorate again until the year 1995 where they stay at a rather high level until the early 2000s. Despite these fluctuations, the scar effect in the period until the early 2000s remains strong and always above 30 percentage points. From the early-mid 2000s onwards the scar effect of unemployment appears to have continuously as well as steeply declined until around 2007 where we observe scar effects in the order of 20 percentage points. The development of the ATTs plateaus from then onward and remains at the level of 20 percentage points until the end of our observation window.

Can these developments in the extent of unemployment scarring be related to the macro-economic, structural and institutional change the German labor market underwent throughout the period under study? The small decline in the extent of unemployment scarring until the early 1990s occurs during a time of economic growth following re-unification (cf. also Fig. 1), the ensuing intensification of unemployment scarring co-occurs with the economic recession of the early 1990s. The trend of increasing unemployment penalties continues until 1995 and stays at this high level until the 2000s. This phase of growing unemployment scars is mirrored by a growth of the unemployment rate and the following period of stagnation at a high level of scarring is also mirrored by a rather high level of aggregate unemployment of between 7 and 8 percent (see Fig. 1). The following steep decline in the extent of scarring from the early-mid-2000s onwards is paralleled by the introduction of the Hartz reforms (2003–2005) as well as the strong economic upsurge in 2006/2007. Even after the economic recession in 2009 the level of unemployment scarring remains at 20 percentage points and does not intensify again. Thus, even though the German labor market has undergone continuous deregulation throughout our observation period and seen several economic downturns (which are also visible in terms of fluctuations in the ATTs), our analysis suggests that the turning point when it comes to scars in terms of affected workers employment probabilities was between 2000 and 2007. In terms of the exact timing, it seems that this change is more likely attributable to the Hartz reforms than to the economic upturn in 2006/07.

How have wage scars developed during this time period? The estimated causal effect of unemployment on wages is displayed by the solid line. Again, we also show the horizontal line (solid) representing the average scar effect on wages throughout the entire observation window, which is at the level of almost 9 percentage points.¹⁴ This level of scarring is in line with what earlier work has found for wage penalties in Germany (Gangl 2006). In contrast to what we have seen for re-employment probabilities, the effect of unemployment on wages shows less substantial temporal variation and, thus, seems to be less affected by macro-economic, structural and institutional change. The most pronounced change in the extent of wage scars can be found in the mid-2000s, where wage scars seem to start to increase but then quickly returned to the prior average levels and from 2013 onward decline even beyond that.¹⁵

We have up to now focused on the temporal development of rather short-term unemployment scars, but what picture do we see when we turn to more mid-term scars? Fig. 3 presents the estimated mid-term scar effects of unemployment, which were measured, on average, four years after entry to unemployment. Panel A presents the ATTs of unemployment on future employment probability. The black dashed line refers to the mid-term scars, the short-terms scars are presented here as a grey dashed line to serve as a reference point. The comparison to the grey line indicates, first of all, that there seem to be clear recovery effects: the estimated scar effects on

¹³ Detailed results of all models estimating employment and wage scar effects of unemployment can be found in Tables A.3.1-A.3.4.

¹⁴ In our models, wage scars are calculated as differences in the growth rate of wages of treated and control cases between T and T + X. A wage scar of 9 percentage points thus means that wages of those who became unemployed (and re-entered the labor market) on average grew by a factor of $(1+\tau$ -0.09) whereas wages of those who did not become unemployed on average grew by a factor of $(1+\tau)$. Of course, this implies that at T + X wages of individuals who became unemployed (and re-entered the labor market) on average are 9 percent lower than wages of individuals who did not become unemployed, if wages of both groups were the same at T.

¹⁵ The impression of a notable decline towards the end of the observation period is induced by an outlier in the year 2017 where scar effects are estimated to be positive but not statistically significant (cf. Table A.3.3).



Employment and Wage Scars of Unemployment

Fig. 2. Employment and Wage Scars of Unemployment at T+2, 1985-2018

Notes: estimated ATTs have been smoothed with *LOWESS* applying a bandwidth of 0.25; bands depict 95%-confidence intervals. Source: SOEP 1984–2020; our own calculations.

employment probability at T+4 are, on average, substantially smaller than at T+2. Nevertheless, the scar effects at T+4 are still large: the employment rate of affected workers was on average more than 20 percentage points below that of comparable workers in the control group. If we compare time trends between T+2 and T+4, we see, as one would expect, a broadly similar pattern at least until 2005. Moreover, as was the case for the T+2 measurement, we also observe for T+ 4 that the early-mid 2000s seem to be a turning point from which onward scar effects are substantially declining.

Two things are most notable in terms of trend comparison of short-term and mid-term scar effects: First, from the early 2000s onwards the improvement in post-unemployment employment probabilities appear to be steeper for T+2 than T+4 which also entails a narrowing of the gap between these two indicators until 2007 when the level of scarring at T+2 and T+4 is almost the same. Second, from 2007 onward, the level of scars measured at T+2 plateaus at a level of around 20 percentage points, while the scars measured at T+4 still continue declining until they reach a level of around 10 percentage points in 2012/2013. After this, we observe some indication that they may increase somewhat again. As noted earlier, scar effects on employment probabilities capture both: still ongoing unemployment (i.e. long duration of unemployment spells) and repeat unemployment. Considering this, T+2 is likely comprised more heavily of the former and T+4 of the latter. With this in mind, the finding that the reduction in scarring from the early 2000s onward was more pronounced for our short-term (T+2) rather than for our mid-term measures (T+4) could suggest that the Hartz reforms were more successful at facilitating a quick labor market re-entry than at creating pathways into long-term, stable employment relationships.¹⁶ Moreover, there is some empirical evidence that the Hartz reforms increased transition-to-employment probabilities only for those unemployed with short unemployment duration, while re-employment chances of long-term unemployed were not positively affected by the reforms (Nagl and Weber 2014). This duration-dependent impact of the reforms could also help in explaining why the temporal decline of scarring is more pronounced for short-term (T+2) rather than mid-term (T+4) scars.

Panel B of Fig. 3 displays the medium-term wage scars of unemployment. The comparison of medium-term (the black solid line) and short-term (the grey solid line) wage scars reveals that – in contrast to re-employment chances – there are no notable recovery effects at least for the larger part of our observation window. There are only a few periods where scarring appears to be substantially less pronounced at T+4, most notably from the late 1980s to early 1990s (where in fact some years with zero wage scars at T+4 are observed).

5.2. Accounting for compositional change in the in- and outflow population

As discussed earlier, temporal variation or time trends in unemployment scarring could also be observed if macro-level changes merely affected the composition of the unemployed (or in the case of wage scarring the composition of the unemployed that re-enter

¹⁶ In Figure A.1, we provide some more evidence on this claim. There we show that non-employment at T+2 is more likely to be comprised of continuous unemployment when compared to the situation at T+4. Moreover, we show that the share of continuous un/nonemployment has declined over time for both T+2 and T+4 and that, at least for T+2, the decline seems to have started in the early-mid 2000s.









Fig. 3. Employment and Wage Scars of Unemployment at T+2 and T+4, 1985-2018 Notes: estimated ATTs have been smoothed with *LOWESS* applying a bandwidth of 0.25; bands depict 95%-confidence intervals.

Source: SOEP 1984-2020; our own calculations.

employment) as the severity of scarring varies group-specifically. Conversely, this also entails that not accounting for compositional change could prevent us from observing changes in the extent of scarring. In a next step, we therefore apply the multivariate reweighting approach (described in sub-section 4.2), which shows us what the estimated ATTs would have looked like over time had the composition of the unemployed population stayed constant. Fig. 4 (panels A–D) presents these recalculated ATTs.

First, we compare re-weighted (black dashed line) and actually observed ATTs (grey dashed line) of unemployment on affected individuals' future employment probabilities. Panel A presents this for time T+2. In terms of future employment probabilities, accounting for composition does not seem to be too crucial. Before the mid-late 1990s, the re-weighted and the actually observed ATTs diverge somewhat, but as of the late 1990s the re-weighted and the actually observed ATTs fully converge. Panel B then presents the same exercise for time T+4 also suggesting no substantial difference between the two indicators. These findings could indicate that the composition of the unemployed has not changed too substantially over time and/or that in terms of re-employment chances effect

heterogeneities play no significant role.

In a next step, we turn to post-unemployment wages. Panel C compares ATTs of unemployment on wages at T+2 with (black solid line) and without (grey solid line) the reweighting approach. In contrast to our evidence on post-unemployment employment probabilities, we now observe that composition matters. We see that the picture of predominantly rather time-constant wage scars conveyed previously by Fig. 2 is partly due to composition effects. A time-constant average composition of the unemployed throughout our observation period would have resulted in substantially less pronounced wage scarring until the mid-2000s, in fact for a substantial number of time points until the early 2000s there would have been no wage scars to speak of. As of the mid-2000s ATTs with reweighting and the actually observed ATTs converge. This suggests that until the early-mid 2000s, groups that tend to experience the greatest scarring were overrepresented amongst the unemployed population that re-entered the labor market, and those with less wage-scarring underrepresented.

In terms of time trends, we see that the estimated re-weighted ATTs are starting to increase from the mid-1990s onwards until 2007 when they plateau (just like the actual ATTs) at the level of 10 percentage points. The growth appears to be particularly steep between the early 2000s and the mid-2000s where wage scars grow from 4 to 10 percentage points. The timing of the most notable increase in wage scars – based on our reweighted ATTs – thus coincides with the introduction of the Hartz reforms. Panel D presents the same exercise for time T+4. The picture is – with some exceptions – broadly similar to the corresponding pattern for time point T+2. The main differences are: before the early 1990s, there were several years where the re-weighted ATTs appear to be substantially larger than the actually observed ones, the reweighted and the actually observed ATTs start to converge somewhat earlier (as of 2003) than was the case for time T+2 (but also at 10 percentage points), and finally the reweighted ATTs start declining towards the very end of our observation period, while the actually observed scars increase again.

Accounting for changing composition of the unemployed seems to be more crucial for scars on wages than for scars on employment prospects. One possible explanation for this finding is that effect heterogeneities play more of a role for wages than for re-employment. Additionally, it is likely that the composition of the unemployed who were able to find re-employment changed more substantially over



Fig. 4. Actual and reweighted Employment and Wages Scars of Unemployment

Notes: estimated ATTs have been smoothed with *LOWESS* applying a bandwidth of 0.25 with *LOWESS* applying a bandwidth of 0.25; reweighting is done by using an "average composition" of the treated population across all waves. Source: SOEP 1984–2020; our own calculations.

time than the composition of the unemployed. Based on our evidence thus far, we would carefully arrive at the interim conclusion that the Hartz reforms constitute a turning point in the German labor market not just for re-employment prospects, but also for unemployment scarring on wages. While re-employment prospects seem to have substantially improved, this is not the case for postunemployment wages. Controlling for compositional change, our evidence suggests that the wage penalties of unemployment have in fact notably increased with the introduction of the reforms.

5.3. Institutional change and the severity of unemployment scars

To complement our descriptive discussion of the cross-temporal trends of unemployment scarring in the German labor market, we conduct two-step multi-level models (Lewis and Linzer 2005) to investigate time trends and analyze the association between the scar effects and macro-economic as well as institutional change. The dependent variables of these models are the estimated scar effects of unemployment that are regressed on a linear time trend (model I), a linear time trend plus macro-economic controls (GDP growth rate and unemployment rate, model II), and a variable that distinguishes periods before the implementation of the major welfare and labor market reforms (the "Hartz" reforms) from periods thereafter (i.e. before/after 2003) (model III). The previous analyses have demonstrated the importance of accounting for compositional changes in the treated populations across time, we therefore also calculate all models using the estimates from the reweighted samples. In total, these models allow us to gauge long-term trends and potential breaks in the temporal evolution of unemployment scars and to test for the statistical significance of the trends and breaks.

Table 1 panel A presents these regression results for unemployment scars on individuals' employment probabilities at T+2. We find clear evidence that re-employment chances of people who became unemployed have substantially increased over the observation period (model I). The gap in employment probabilities between treated (those who became unemployed between T and T+1) and controls (those who did not become unemployed between T und T+1) has on average narrowed by a rate of about 0.6 percentage points per year. This holds even after accounting for macro-economic conditions (model II). Moreover, as results of the full model (model III) reveal, employment chances of the unemployed have been much better in the periods from 2003 onward when compared to the periods before 2003: on average, the gap in employment probabilities was about 12 percentage points smaller in the periods after implementation of the Hartz reforms. Once the variable separating the time periods before and after the major reforms is included, the linear time trend is no longer statistically significant and in fact turns negative suggesting that the positive linear time trend in the reduced models I and II was probably solely driven by the periodic break before/after 2003.

Turning to panel B of the same table we see that results are fairly similar when looking at unemployment scars on individuals' employment probabilities at T+4. Here too the employment gap between treated and controls has narrowed over time, although there

Table 1

Macro-level determinants	of emp	loyment scars	of	unemployment.
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Panel A) Employment Scars of Unemployment, T+2							
	Model I	Model II	Model III	Model I reweighted	Model II reweighted	Model III reweighted	
	reduced	reduced	full	reduced	reduced	full	
Year	0.00617***	0.00580***	0.000331	0.00522***	0.00506***	-0.000919	
	(6.76)	(4.84)	(0.14)	(5.27)	(3.69)	(-0.49)	
GDP Growth		0.00123	0.00118		0.00412	0.00483	
		(0.13)	(0.15)		(0.40)	(0.53)	
Unemployment Rate		-0.00781	-0.0110		-0.00392	-0.00960	
		(-0.95)	(-1.61)		(-0.46)	(-1.36)	
Time Break (gt $2003 = 1$)			0.122*			0.130**	
			(2.46)			(2.89)	
Constant	-12.63***	-11.84***	-0.932	-10.72^{***}	-10.39***	1.559	
	(-6.90)	(-4.84)	(-0.20)	(-5.41)	(-3.72)	(0.42)	
Ν	34	34	34	34	34	34	
R^2	0.494	0.523	0.660	0.395	0.418	0.591	
Panel B) Employment Scars o	of Unemployment,	T+4					
Year	0.00376**	0.00282*	0.000450	0.00597***	0.00513***	0.00119	
	(2.81)	(2.38)	(0.19)	(5.75)	(4.92)	(0.64)	
GDP Growth		-0.00959*	-0.00942*		-0.00391	-0.00407	
		(-2.26)	(-2.62)		(-0.82)	(-0.97)	
Unemployment Rate		-0.0133*	-0.0141*		-0.0105*	-0.0139**	
		(-2.27)	(-2.29)		(-2.42)	(-3.18)	
Time Break (gt $2003 = 1$)			0.0522			0.0799*	
			(1.31)			(2.24)	
Constant	-7.718**	-5.737*	-1.010	-12.14***	-10.38***	-2.508	
	(-2.89)	(-2.41)	(-0.22)	(-5.83)	(-4.92)	(-0.67)	
Ν	32	32	32	32	32	32	
R ²	0.296	0.436	0.488	0.555	0.615	0.697	

Notes: *p < .05, **p < .01, **p < .01, **p < .01, t-values in parentheses. Second step (macro-level) estimation results with a correction for the insecurity of the estimated dependent variable. The error structure is allowed to be heteroskedastic and possibly autocorrelated with a lag of order 1. Source: SOEP 1984–2020; our own calculations.

is some evidence that the improvement of employment chances of the unemployed at T+4 has been a little weaker when compared to the situation at T+2. This also holds if periods from 2003 onward are compared to periods before 2003 (model III). As argued earlier, this could possibly be explained by the reforms being more successful at ensuring a quick labor market re-entry than at encouraging entry into stable long-term employment (which is a conjecture results of additional analyses – shown in Fig. A1 – seem to support).

Finally, for both T+2 and T+4, adjusting for compositional differences in the treated population (models I-III reweighted) does not alter the results in a substantial way (though the coefficients pertaining to the linear time trend and to the time break are a bit stronger in the reweighted version of models I-III for T+4). This is very much in line with our descriptive evidence (cf. Fig. 4 panel A and B).

The results also provide some indication that scarring becomes more severe when the unemployment rate increases: gaps in employment probabilities are estimated to increase by about one percentage point if the unemployment rate increases by one percentage point. However, the estimated coefficients reach statistical significance only for the T+4 models (panel B). Moreover, economic conditions (measured by GDP growth at T) do not appear to have an impact on the extent of scars in terms of future employment chances at T+2, but there is some indication that GDP growth increases scarring at T+4 (though only in the models without reweighting).

With respect to wages at T+2, the results of our regression models – presented in Table 2 panel A – indicate no clear linear increase in the scars of unemployment. Wage gaps between treated and controls at T+2 are estimated to have increased by a rate of about 0.1 percentage points per year, but the corresponding coefficients are clearly below conventional significance levels (model I and II). When accounting for compositional changes in the treated populations across time (models I-II reweighted), linear time trends appear more pronounced, but the coefficients are still (though slightly) below conventional significance levels. However, comparing average wage scars before 2003 with average wages scars from 2003 onwards reveals almost six percentage points increase in the latter period (model III). Moreover, using the reweighted version of model III reveals that average wage scars in the periods from 2003 onwards are estimated to be more than eight percentage points higher than in the periods before 2003. Thus, the effect for the time-break indicator "before/after 2003" is larger in the models accounting for compositional change (in line with our descriptive evidence, cf. Fig. 4 panel C). In sum, these results suggest that the Hartz reforms could be associated with a rather substantial increase in post-unemployment earnings losses.

Results from the regression models investigating wages scars at T+4, presented in panel B of the same table, are mixed. Although there is some indication of increasing scar effects of unemployment over time, we cannot find robust evidence for this time trend. This also holds if we account for the changing composition of the treated. Moreover, in contrast to our findings for T+2, the results indicate that average wage scars at T+4 before 2003 were roughly the same as in the period from 2003 onwards (model III). So, while we find evidence of increased short-term wage scars after the Hartz reforms, this does not seem to be the case for mid-term wage scars.

Table 2

	Model I	Model II	Model III	Model I reweighted	Model II reweighted	Model III reweighted		
	reduced	reduced	full	reduced	reduced	full		
Year	-0.000303	-0.000629	0.00180	-0.00142	-0.00183	0.00197		
	(-0.34)	(-0.87)	(1.36)	(-1.72)	(-1.75)	(1.40)		
GDP Growth		0.00561*	0.00568		0.000346	-0.000134		
		(2.04)	(1.75)		(0.20)	(-0.09)		
Unemployment Rate		-0.0119*	-0.0115**		-0.00429	-0.00210		
		(-2.16)	(-2.86)		(-0.85)	(-0.61)		
Time Break (gt $2003 = 1$)			-0.0558*			-0.0815 **		
-			(-2.31)			(-3.52)		
Constant	0.526	1.247	-3.589	2.780	3.635	-3.957		
	(0.29)	(0.85)	(-1.36)	(1.68)	(1.72)	(-1.40)		
Ν	34	34	34	34	34	34		
R^2	0.00453	0.349	0.448	0.107	0.139	0.373		
Panel B) Wage Scars of Unem	ployment, T+4							
Year	-0.00166	-0.00124	-0.00240	-0.00179	-0.00224	-0.000825		
	(-1.54)	(-1.56)	(-1.43)	(-1.50)	(-1.87)	(-0.40)		
GDP Growth		0.00437	0.00438		-0.000214	-0.000382		
		(1.04)	(1.11)		(-0.07)	(-0.12)		
Unemployment Rate		-0.0155**	-0.0155**		-0.00934	-0.00881		
		(-3.03)	(-2.98)		(-1.57)	(-1.55)		
Time Break (gt 2003 = 1)			0.0258			-0.0300		
			(0.77)			(-0.80)		
Constant	3.250	2.502	4.815	3.527	4.488+	1.672		
	(1.51)	(1.57)	(1.44)	(1.48)	(1.87)	(0.41)		
Ν	32	32	32	32	32	32		
R^2	0.0740	0.379	0.397	0.0710	0.133	0.150		

Macro-level determinants of wage scars of unemployment.

Denal A) Maga Coors of Unomployment T + 2

Notes: *p < .05, **p < .01, **p < .01, **p < .001, t-values in parentheses. Second step (macro-level) estimation results with a correction for the insecurity of the estimated dependent variable. The error structure is allowed to be heteroskedastic and possibly autocorrelated with a lag of order 1. Source: SOEP 1984–2020; our own calculations.

However, it is important to note, that all of our results on wage scars (i.e. T+2 and T+4) clearly speak against the notion of reduced wage scars over time.

Finally, in line with our analyses focusing on employment probabilities, the wage scar models suggest that increased unemployment rates seem to increase wage scarring (though only in the models without reweighting). Wage scars are estimated to increase by about one percentage point if the unemployment rate increases by one percentage point. In addition, GDP growth is associated with reduced wage scars, but only at T+2 (though only in the models without reweighting).

6. Discussion

Our study of unemployment scarring in the German labor market complements and extends previous research by focusing on the temporal variation of unemployment scars from a macro-level perspective. It examines the role institutional and structural changes may play in this variation. We conclude this article by highlighting and discussing three central findings of our analyses as well as the resulting implications for theory development, future research and policy-making.

First, our results clearly indicate that scars of unemployment show temporal variation. This is most evident in case of the reemployment chances of the unemployed that have substantially improved throughout our observation window. Our analysis of this temporal variation reveals that, alongside a moderate influence of the general labor market conditions (i.e. unemployment rate), the strong and lasting improvement of individuals' re-employment chances appeared to be associated with the major welfare and labor market reforms that took place in Germany in the early 2000s. Although our study does not constitute a rigorous evaluation of these reforms and more generally is not able to estimate the causal effect of macro-level change, the empirical evidence suggests a substantial association between these reforms and the re-employment chances of the unemployed. While improved re-employment chances might be considered a positive development, there might also be a downside to it: Pushing the unemployed back into the labor market more quickly can increase the risk of job-mismatches and substantial wage losses upon re-employment. Indeed, we find no indication of declining wage scars. Thus, even if the German welfare and labor market reforms seem to have improved re-employment chances of the unemployed, spells of unemployment are still associated with individual wage losses. Even more, there is some evidence that wage scars have grown over time. These results might be interpreted as mirroring the problem of job search under (increased) financial constraints and the (increased) risk of subsequent lower job quality - a finding that complements the results reported in previous research (Gangl 2006). With view to the theoretical explanations of unemployment scarring, this finding suggests that mechanisms located at the level of the unemployment job-seeker (specifically their job search behavior and their job offer acceptance behavior) probably have a lot of weight in explaining scar effects – especially those pertaining to wages.

Second, while our findings indicate that it might be worthwhile to consider temporal variation in the extent of unemployment scars, we theoretically discussed and empirically demonstrated the importance of considering the (changing) composition of those who become unemployed as well as of those who re-enter the labor market whenever we want to compare unemployment scars over time (or across space). Because of potential group-specific treatment effects, not taking into account changes in the composition of the unemployment inflow and outflow population could generate misleading interpretations of actual trends in average unemployment scars. Our results showed that in terms of the inflow population and their re-employment chances, adjusting the analyses for compositional change does not alter the results in any substantial way. However, accounting for the changing composition of the outflow population turned out to be important for the analysis of trends in scars on wages. The results indicate that if the composition of the unemployed who were able to find re-employment had been stable over the whole observation period, wage scars would have grown rather notably over time. In turn this suggests that the composition of the unemployed who were able to return to the labor market changed more substantially over time than the composition of those becoming unemployed. Moreover, as compositional changes would not matter if unemployment scars had the same magnitude for all individuals of the outflow population, the results also point to the existence of group-specific scar effects of unemployment. These findings underline the importance of considering groupspecific effects (or more technically: heterogenous treatment effects) as well as compositional changes in the analysis of temporal variation of unemployment scars. Furthermore, these findings more generally underscore the importance of effect heterogeneities for advancing our theoretical understanding of unemployment scarring. Advancing our insights into the underlying mechanisms that drive unemployment scarring (i.e. into the causes of observed effects) is only possible if these effect heterogeneities are firmly integrated in our theoretical models and theoretical understanding.

Third, even if re-employment chances have improved over time, there still remains a substantial gap in the employment probabilities of people with and without prior unemployment. In light of this and also in light of the persisting wage scars, unemployment hence continues to be a very detrimental life-course event. Reforms like those of the early 2000s in Germany may end up being ambivalent success stories if they are not complemented by targeted policies that support specific groups among the unemployed population. Such targeted policies would have to reflect empirical evidence on the heterogeneity of the unemployed population as well as on group-specific unemployment scars.

Unfortunately, research to date has not paid sufficient attention to the heterogeneity of the unemployed and the question of how the implications of unemployment vary across different socio-demographic groups, life course stages and labor market segments. Most work has focused on estimating unemployment outcomes for the total population of the unemployed. One reason for this scarcity is the relatively high requirements on data structure and quality that are needed to investigate such group differences (longitudinal data, large number of cases etc.). Most longitudinal surveys do not provide a sufficient number of cases to allow for nuanced group-specific analyses of the unemployed. Furthermore, in-depth research is needed to better understand the dynamics and mechanisms underlying the process of unemployment scarring. We focused on post-unemployment labor market outcomes measured at discrete time points. To fully grasp the dynamics of unemployment disadvantage and its implications for individual life-courses, analyses focusing on longterm

post-unemployment employment and career trajectories are necessary. This would also allow for a better assessment of the German welfare reforms. Our analysis suggests that the reforms are associated with increased short- and mid-term re-employment chances, but not with lowered wage penalties upon re-employment. Investigating long-term wage and employment dynamics would help us to better judge whether these reforms can overall be assessed as positive or negative from a welfare perspective. If such analyses find that long-term employment trajectories are more unstable than previously and wage losses are persistent, then from a welfare perspective the reforms should be assessed as negative.

Declaration of competing interest

None.

Acknowledgements

We would like to thank the two anonymous reviewers as well as the editor of Social Science Research, Stephanie Moller, for their insightful feedback.

Appendix A & B. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ssresearch.2023.102960.

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