Institute for Employment Research

The Research Institute of the Federal Employment Agency

IAB

IAB-Discussion Paper 26/2014

Articles on labour market issues

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How close are the ties?

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ISSN 2195-2663

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Mit der Reihe „IAB-Discussion Paper“ will das Forschungsinstitut der Bundesagentur für Arbeit den Dialog mit der externen Wissenschaft intensivieren. Durch die rasche Verbreitung von Forschungsergebnissen über das Internet soll noch vor Drucklegung Kritik angeregt und Qualität gesichert werden.

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Contents

Abstract

We analyze the relation between population aging and the decline of unemployment in East Germany for the years from 1996 to 2012. To this we scrutinize both a direct and an indirect effect of aging on unemployment. The direct effect includes a decomposition of the East German unemployment rate into three components considering changes in the workforce's age structure, labor market participation, and age-specific unemployment rates. Results show that changes in the age structure of the workforce counteracted unemployment decline since 2005. Spatial panel regressions on the small-scale regional level, however, point towards an indirect effect of aging on unemployment that works through the increasing competition for labor. Overall results show that the declining unemployment rate in East Germany is indeed affected by aging as evidenced by a declining youth share and an increasing old-age share. This indicates that a reversed cohort crowding effect has taken place.

Zusammenfassung

Wir untersuchen den Zusammenhang zwischen der Alterung der Bevölkerung und der Veränderung der Arbeitslosigkeit in Ostdeutschland für die Jahre von 1996 bis 2012. Hierfür unterscheiden wir einen direkten und einen indirekten Effekt. Die Berechnungsergebnisse für den direkten Effekt zeigen anhand der Zerlegung der Erwerbslosenquote in einen Altersstruktur-, Verhaltens- und Arbeitsmarkteffekt, dass die Alterung der Bevölkerung einen sehr geringen Beitrag zum Rückgang der Erwerbslosigkeit geleistet hat. Anhand räumlicher ökonometrischer Panelschätzungen auf der Ebene der ostdeutschen Kreise kann jedoch eine indirekte Wirkung der Alterung der Bevölkerung auf die Entwicklung der Arbeitslosigkeit bestätigt werden. Demnach steht die seit 2005 sinkende Arbeitslosigkeit in Zusammenhang mit einem sinkenden Anteil der jüngeren Bevölkerung bzw. einem steigenden Anteil der Älteren. Die Alterung der Bevölkerung - sowohl getrieben durch weniger Jüngere als auch mehr Ältere - wirkt sich damit positiv auf den Rückgang der Arbeitslosigkeit aus.

JEL classification: C33, J11, J64, O18

Keywords: unemployment, demographic change, cohort crowding, spatial panel

Acknowledgements: We thank conference participants in Matrei, St. Petersburg and Ljubljana for helpful comments and discussions.

1 Introduction

Many European countries are challenged by profound demographic changes that manifest themselves in the decline and aging of the population. East Germany is among those regions that have been most severely hit by these processes. Major reasons are the drop in the East German fertility rates by about half directly after German reunification in 1990 (Goldstein/Kreyenfeld, 2011) and the high degree of out-migration mainly to West Germany. Since population aging is likely to exacerbate in the next decades throughout Europe (Lanzieri, 2011), East Germany can be regarded as a forerunner in how to cope with the implications of demographic change in many socioeconomic respects.

As concerns the implications for the labor market, demographic change foremost alters labor supply via the decline and the aging of the population of working age, i. e., between 15 and 64 years. In East Germany, the working-age population declined from 12.1 million in the year 1996 to 10.7 million in 2012. This implies a decrease of 11.6%, while at the same time West Germany experienced an increase of 1.0%. Contemporaneously, the youth share that relates the number of inhabitants aged 15 to 24 years to those aged 15 to 64 years dropped from 19.0% in 2004 to 13.8% in 2012. In turn, the old-age share of the inhabitants aged 55 to 64 years to those aged 15 to 64 years increased from 19.2% to 21.8%.

Around the year 2005, the small after-reunification cohorts started to enter the East German labor market that for many years had been characterized by high unemployment. After a rise of the unemployment rate to 20% in 2005, this negative trend reversed, however, and by 2012, the unemployment rate receded to 9%. During this period, substantial changes in the labor force participation took place, leading to an increase of the labor force as opposed to the general decrease of population. Moreover, substantial labor market reforms were started in Germany that have further spurred employment. Given these divergent developments, the question arises if and to what extent demographic change has contributed to the declining unemployment rate in East Germany. Because the aging process intensified at around the same time when unemployment started declining, an answer to this question is of high relevance not only for science but also for politics.

This paper aims at answering the question of the ties between demography and unemployment in East Germany and to this end draws on the concepts of the cohort crowding literature. As to the central cohort crowding hypothesis, Easterlin (1961) argues that workers are worse off on the labor market if they belong to larger cohorts. In particular, members of baby-boom cohorts have a higher risk of becoming unemployed after labor market entry if labor demand does not rise in the same amount as labor supply. Shimer (2001), on the other hand, makes an argument against this mechanism by modelling how enterprises have an incentive to create even more jobs in regions with large labor market entry cohorts. Since empirical evidence does not provide a clear answer to the theoretical dispute (see, e. g., Nordström-Skans, 2005, Foote, 2007, or Biagi/Lucifora, 2008), the relation between demography and unemployment remains open a priori. Applying Easterlin's cohort crowding argument to the case of East Germany leads to the hypothesis that shrinking cohort sizes lead to a decrease in unemployment. We scrutinize this relation by analyzing both a direct and an indirect effect of population aging on unemployment for the years from 1996 to 2012. The direct effect is determined by decomposing the unemployment rate into three components considering changes in the workforce's age structure, labor market participation and age-specific unemployment rates. The indirect effect that a declining youth share exerts on unemployment is analyzed with econometric methods.

Our analysis adds to the existing literature on the effects of demographic change on unemployment in several ways. First, we take a broad view on the impact of aging on unemployment by explicitly taking into account the large increase of older workers on the labor market. To this, we not only consider the youth share as is usually done in the empirical studies, but also the old-age share. Second, to the best of our knowledge this is the first comprehensive study on the link between aging and unemployment for East Germany. Studies on Germany have so far mainly dealt with West Germany (Zimmermann, 1991, Garloff/Pohl/Schanne, 2013) or focused on single Federal States within Germany (*Bundesländer*) for the calculation of the direct effect only (e. g., Fuchs et al., 2013a). Importantly, since East and West Germany share the same legal and political institutions, a comparison of both parts of the country can be regarded as a natural experiment and thus prove very insightful as to the role of demography for the labor market. Third, we explicitly account for the profound regional disparities within East Germany. In order to capture spatiotemporal interdependencies between local labor markets, we extend the existing literature methodologically by applying a spatial panel model with fixed region-specific effects. This way, we also incorporate the spatial dimensions in demographic processes, as postulated by Matthews/Parker (2013).

Our central findings confirm the existence of close ties between demography and unemployment, working through both the decreasing youth share and the increasing old-age share. We provide sound evidence for a negative cohort crowding process in East Germany in that aging is closely associated with unemployment decline. However, it can be statistically confirmed only for the years after 2005. We furthermore find distinct spatial interdependencies within East Germany that have changed profoundly over time.

The remainder of the paper is structured as follows. Chapter 2 gives an overview of theoretical approaches on the influence of demographic change on unemployment and summarizes central empirical findings. In chapter 3, the data sets used for the empirical analyses are presented. The calculation of the direct effect of aging on unemployment in East Germany is at the center of chapter 4. We discuss the regression results for the indirect effect in chapter 5, and chapter 6 concludes.

2 Theoretical considerations

In order to analyze the impact of demographic change on unemployment, we base our research design on the literature that deals with the impact of changes in the relative size of age cohorts on the labor market.[1] According to the so-called cohort crowding literature

[1] In general, the impact of demographic change on labor market outcomes can be analyzed in various ways. Fertig/Schmidt/Sinning (2009), for example, investigate whether and to what extent demographic change

going back to Easterlin (1961), Perry (1970) or Flaim (1979), there is a negative relation between cohort size and labor market prospects. Workers belonging to a large labor market entry cohort are confronted with more competitors for jobs on the labor market due to an increase in the labor supply. If labor demand does not rise in the same magnitude as labor supply, as a consequence unemployment should increase.

For the empirical investigation of the cohort crowding hypothesis two approaches have been developed over time that either focus on a direct or an indirect effect of demography on unemployment. As to the direct effect, the central research question is to which extent changes in the unemployment rate can be attributed to changes in the composition of the labor force (Perry, 1970; Flaim, 1979; Flaim, 1990). The unemployment rate is hereby defined as the sum of various components involving the age structure of the population and the labor force participation rates of the various age groups. Consequently, changes in the unemployment rate can be ascribed to changes in the weight of the single components. In order to quantify the impact of demographic change on unemployment, counterfactual unemployment rates are calculated by utilizing the actual age-specific unemployment rates of a specific year, while holding the values of one or more components fixed at a base year. The corresponding differences between the changes in the actual unemployment rates and the counterfactual rates can then be attributed to the compositional impact.

The direct effect of demography on unemployment was calculated for the United States already in the 1970s (Perry, 1970). Flaim (1979) considers the period from 1957 to 1977, when the youth share of the labor force experienced a large increase due to the entry of the post-World-War-II baby-boom cohorts into the labor force. He finds that about 0.8 percentage points of the increase in the overall unemployment rate (from 4.3% to 7.0%) can be attributed to the resulting shifts in the age structure of the population. In turn, the subsequent maturing of the baby boomers during the 1980s put considerable downward pressure on the unemployment rate. According to Flaim (1990), the decline of the American unemployment rate from 5.8% in 1979 to 5.3% in 1989 can almost entirely be attributed to the decline in the share of the young adults in the labor force. Similarly, Shimer (1999) examines the period from 1948 to 1998 and concludes that the entry of the baby-boom cohorts into the labor market in the 1960s and 1970s raised the aggregate unemployment rate by about 2 percentage points, while the subsequent aging of the baby boomers reduced it by roughly 1.5 percentage points. Taking a look into the future, Fallick/Fleischman/Pingle (2010) expect that the shifting age distribution of the population induced by the baby boomers will maintain its downward pressure on the unemployment rate for the next years to come.

For Germany, the direct effect of demography on unemployment was first investigated by Garloff/Pohl/Schanne (2013). They focus on West Germany for the years from 1991 to 2009 with an increase of the unemployment rate from 4.7% to 7.8%. Results for 2009 show that the unemployment rate would have been 0.2 percentage points higher than the actual rate had the age structure of the population not changed since 1991. Hence, the findings

has an impact on human capital accumulation in Germany. Michaelis/Debus (2011) develop a general equilibrium model of a unionized economy to analyze the equilibrium effects of workforce aging on the labor market in Germany. Likewise, Lisenkova/Merette/Wright (2013) use a dynamic overlapping generations computable equilibrium model to examine the impact of population aging on the Scottish labor market.

for the U.S. labor market are corroborated in that aging exerts a slightly negative effect on unemployment. As to East Germany, the direct effect has so far only been calculated for single federal states (Fuchs et al. 2013a; 2013b; 2013c). Although in the regions under consideration the aging of the population progressed in a much more pronounced way than in West Germany between 1993 and 2011, the demographic component exerted only a small effect and even partly counteracted the decline in unemployment.

The indirect effect of demography on unemployment is basically identified by estimating the partial correlation between indicators of demography and the labor market over time (see Korenman/Neumark, 2000 for an overview). The empirical literature comes to ambiguous results, which might largely be due to the consideration of different observation periods and countries, and the use of different econometric methods. In a study on the United States, Shimer (2001) estimates the response of the unemployment rate and the labor force participation rate towards changes in the youth share of the working-age population from 1978 to 1996. The central finding is that an increase in the youth share of the population by 1% reduces the unemployment rate of all workers by more than 1%. This negative relation holds for all age-specific unemployment rates under consideration. Standard theories of unemployment (Pissarides, 2000) cannot explain these findings. According to standard matching models, the unemployment rate increases when the youth share of the population increases, because young people entering the labor market must first search for a match and it takes them time to succeed in this respect. In order to reconcile his empirical results with theory, Shimer (2001) develops a matching model with increasing returns to scale in the matching process, match-specific productivity, and on-the-job search. He shows that because young workers are more likely to be poorly matched with their current employer, they are more likely to accept other job offers. This reduces the expected search costs for firms located in such markets and can thus lead to the creation of new jobs that overcompensates the initial increase in labor supply. Hence, when the youth share increases, overall unemployment declines, suggesting a negative correlation between the two indicators.

Evidence consistent with the hypothesis of Shimer (2001) is presented by Nordström-Skans (2005). Using a panel of Swedish local labor markets from 1985 to 1999, he shows that labor market performance is affected by the composition of the working-age population and specifically that young workers benefit from belonging to a large cohort. By explicitly controlling for spatial autocorrelation in the state-level data and by extending the observation period from 1996 to 2005, Foote (2007) updates the study of Shimer (2001). Using the longer time period and controls for spatial spillover effects, he contrasts the results of Shimer in asserting a positive correlation between the youth share and the unemployment rate. Focussing on demographic effects on unemployment in Europe, Biagi/Lucifora (2008) estimate the model specification of Shimer (2001) with aggregate data for ten European countries for the years 1975 to 2002 and also find a positive elasticity between demographic shocks and unemployment.

For Germany, to our knowledge there are so far three studies that estimate the indirect effect of changes in the labor market entry cohorts on unemployment. Zimmermann (1991) resorts to time-series regressions based on national data for the period 1967 to 1988 and finds in the short run a positive impact of relative cohort size and relative cohort age on unemployment. In the long run, however, the cohort crowding hypothesis cannot be supported. Ochsen (2009) conducts his analysis on the level of all NUTS 3-regions in Germany using monthly data for 2000 and 2001. He estimates the relation between aging of the labor force and unemployment with the help of a Beveridge curve and a job creation curve, taking explicitly into account spatial interactions between neighbouring regions. According to his results, especially in the East German regions unemployment rates increase when the share of the younger population declines in the local as well as in the surrounding areas. Hence, he refutes the cohort crowding hypothesis. Garloff/Pohl/Schanne (2013) consider a long time span from 1978 to 2009, but confine their analysis to labor market regions in West Germany. The econometric findings confirm Easterlin (1961) in that the labor market entry of small cohorts leads to a reduction of unemployment.

Our paper adds to the existing literature by analyzing the direct and indirect effect of aging on unemployment for East Germany. To the best of our knowledge, we provide first-time evidence on the direct effect for East Germany. With respect to the indirect effect, we extend the existing empirical literature by capturing both ends of the population aging process. As argued by Easterlin (1961), when the size of labor market entry cohorts decreases, enterprises will have to increasingly recruit among the unemployed in order to meet a constant labor demand. Another adjustment mechanism might well work through the recruitment of older workers, whose share of the total population as well as whose labor force participation has moreover risen over time.[2] Hence, we not only consider the relation between the youth share and unemployment as usually done in the literature, but also the link between the old-age share and unemployment. Furthermore, we follow the argument of Foote (2007) and resort to spatial panel modelling in order to capture spatial spillovers working at the small-scale regional level. Importantly, this way we are able to complement the only existing study on the indirect effect for East Germany by Ochsen (2009).

3 Data

Our empirical analyses cover the years from 1996 to 2012 and rest on several data sources. For the calculation of the direct effect we resort to data from the German Microcensus provided by the Federal Statistical Office.[3] It consists of a one-percent random representative sample of the population in Germany. Each year, about 830,000 persons from 370,000 households are questioned on a variety of subjects. From this data source we use information on the activity status that is compliant with the labor force concept of the International Labour Organization (ILO). In addition, the Labour Force Survey of the European Union (EU Labour Force Survey) which is harmonised in all EU member states is integrated into the Microcensus. The majority of the variables covered by the Labour Force Survey are also Microcensus variables.

Since we are interested in the relation between the shifting age distribution of the population

[2] So far, the increasingly important role of elder persons on the labor market seems to be discussed rather with respect to productivity issues (see Bloom/Sousa-Poza, 2013).

[3] See https://www.destatis.de/EN/Meta/abisz/Mikrozensus_e.html for further details.

of working age and changes in the unemployment rate in East Germany only, we limit our data set to persons between 15 and 64 years living in East Germany. For the calculation of the direct effect, they are split into ten age groups, each consisting of five cohorts. By using such a fine delineation, we minimize the risk of missing some subtleties in the development of the age-specific unemployment rates. Garloff/Pohl/Schanne (2013), for example, consider only seven age groups in their analysis, pooling the population aged 40-49 and 50-59 into two groups. Flaim (1990) uses the same age groups as we do, with an additional group covering 65 years and older.

One drawback of the Microcensus data is that it is not available in detail on a regionally disaggregated level. However, in order to account for the profound regional disparities in the East German labor market, the analysis of the indirect effect requires information on a small-scale regional level. For the estimation of the indirect effect we use different data sources to make the best possible use of the information available. The number of unemployed per region comes from the Federal Employment Agency.[4] Due to restrictions in the unemployment data, we cannot use the years prior to 1996. Population data for the 77 districts (*Landkreise und kreisfreie Städte*) in East Germany that correspond to the German NUTS 3-regions is taken from the Federal Statistical Office. A detailed description of the specific variables used as well as descriptive statistics are given in chapter 4.1 for the direct effect and in chapter 5.1 for the indirect effect. Although we use different data sources for the analysis of the direct and indirect effect, the aggregated East German data basically draws the same picture with regard to the serial trends of the population as a whole, the younger and older cohorts of the population as well as the unemployment rate. A simple correlation analysis always yields values above 95 percent.

4 Direct effect

In this chapter, we analyze the direct effect of demography on unemployment by scrutinizing the relation between changes in the age structure of the population and changes in the unemployment rate. To this end we statistically decompose the unemployment rate into three components. Special interest is not only given towards the size of the direct effect that demography exerts, but also towards its relevance in comparison to effects emanating from both changes in the labor force participation rates and changes in the age-specific unemployment rates. Before we present the decomposition results, we provide an overview of the variables used, some descriptive statistics and the precise decomposition method.

4.1 Variables and descriptives

The calculation of the direct effect is based on information regarding the labor market participation of the East German population for single age groups. For the purposes followed here we use yearly data from the Microcensus (see chapter 3). Table 1 provides an overview of the variables used for the calculations and their definitions.

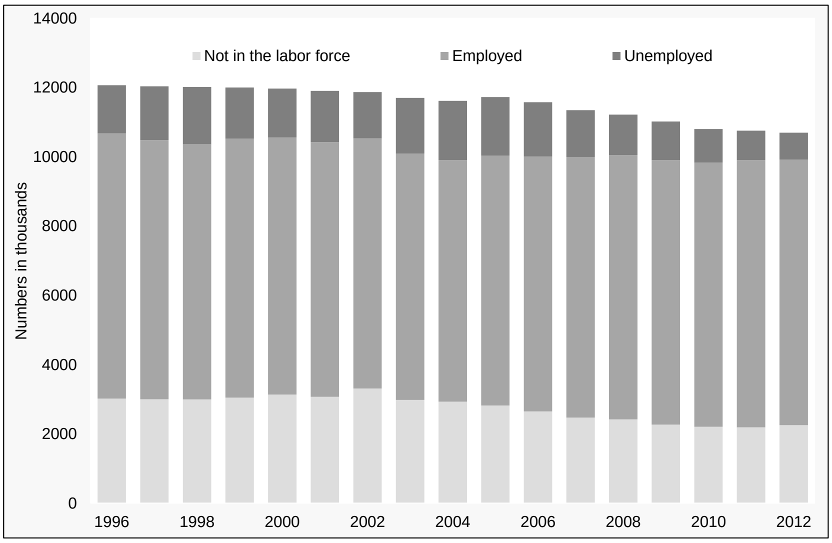
[4] The definition of unemployment varies slightly between the survey data from the Microcensus and the official data from the Federal Employment Agency (see Kruppe et al., 2008 for further details). The differences with respect to our purposes are very small, however.

Table 1: Variables used for the calculation of the direct effect

Variable	Abbreviation	Definition
Population	POP	Number of inhabitants aged 15 to 64 years
Labor force	LF	Employed plus unemployed
Employed	E	Each person working as employee or self-employed
Unemployed	U	Each person not working and having looked for a job in the last four weeks before the survey
Unemployment rate	UR	U / LF
Labor force participation rate	$LFPR$	LF / POP

In East Germany, there were profound changes in demography and labor market participation between 1996 and 2012.[5] The number of inhabitants of working age as a fundamental determinant of labor supply declined from 12.1 to 10.7 million (see figure 1). Several trends in labor force participation have helped offsetting the overall population decline, however. Starting in 2005, the number of employed increased, whereas the number of persons either unemployed or not in the labor force declined. As a result, in spite of the decline of the total population the labor force increased in the last years. These shifts also manifest themselves in compositional changes of the working-age population. Between 2004 and 2012, the employment rate rose from 60.1% to 71.8%, while inversely the unemployment rate declined from 19.7% to 9.2%. As a consequence, the $LFPR$ increased from 74.8% to 79.1% in 2012. The broad picture in figure 1 hides pronounced age-group specific changes

Figure 1: Labor market participation of the East German working-age population



Source: Federal Statistical Office of Germany.

in the single variables of interest. First of all, the population decline went along with a distinct upward shift of the age structure (see table 2). In 1996, 17.0% of the East German population of working age were less than 25 years and 20.6% more than 55 years old. These shares shifted to 13.8% and 21.8%, respectively, in the year 2012.

Furthermore, the labor force participation rates of the younger and elder labor market participants underwent major changes (see figure 2). Among the younger persons, the $LFPR$

[5] These processes are much more pronounced in East Germany than in the Western part of the country. See table A.1 in the Appendix for descriptive statistics on West Germany.

Table 2: Age structure of the working-age population in East Germany

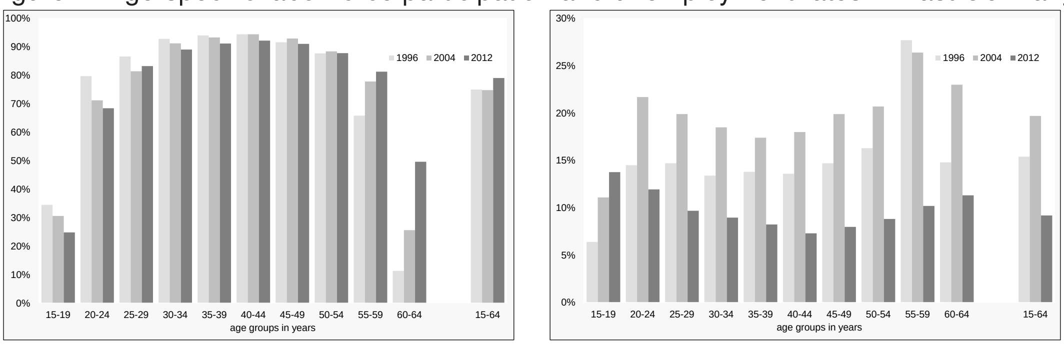
Year	Age group										
	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	15-64
	Absolute values (in 1,000)										
1996	1.126	932	1.182	1.439	1.361	1.329	1.083	1.127	1.405	1.084	12.069
2004	1.121	1.082	909	991	1.254	1.447	1.317	1.268	915	1.311	11.615
2012	556	918	1.079	1.003	905	1.188	1.362	1.343	1.243	1.086	10.683
	Age-group shares (in %)										
1996	9.3	7.7	9.8	11.9	11.3	11.0	9.0	9.3	11.6	9.0	100.0
2004	9.7	9.3	7.8	8.5	10.8	12.5	11.3	10.9	7.9	11.3	100.0
2012	5.2	8.6	10.1	9.4	8.5	11.1	12.7	12.6	11.6	10.2	100.0

Source: Federal Statistical Office of Germany, own calculations.

declined, which is mainly due to them spending more time in the educational system. Among the persons over 55 years of age, on the other side, the $LFPR$ increased considerably. Reasons for this increase can be seen in the disposition to work longer, better health conditions or the wish to improve on the retirement pension. Also, the labor market reforms undertaken in Germany between 2002 and 2005 brought with them a tighter handling of regulations on early retirement.

The increase in overall unemployment until 2004 and the ensuing strong decrease as evidenced in figure 1 is principally visible for each of the ten age groups under consideration in figure 2. Special attention in this respect merit the persons aged 55 years and more, whose unemployment rates in 2012 accounted for only about one fourth to one third of those in 1996.

Figure 2: Age-specific labor force participation and unemployment rates in East Germany



Labor force participation rate | Unemployment rate

Source: Federal Statistical Office of Germany, own calculations.

4.2 Method

We calculate the direct effect of aging of the East German population on unemployment by applying statistical decomposition methods in the line of Flaim (1979) and Garloff/Pohl/Schanne (2013). The aggregate unemployment rate UR_t at time t ($t = 1996, ..., 2012$) can be decomposed into three components, each containing information on ten age groups ($age = 1, ..., 10$):

$$UR_t = \sum_{age=1}^{10} \frac{POP_{age,t}}{POP_t} * \frac{LFPR_{age,t}}{LFPR_t} * \frac{U_{age,t}}{LF_{age,t}}, \quad (1)$$

where $\frac{POP_{age,t}}{POP_t}$ denotes the age-specific population shares, and $\frac{LFPR_{age,t}}{LFPR_t}$ stands for the relative age-specific labor force participation rates. $\frac{U_{age,t}}{LF_{age,t}}$ is the age-specific unemployment rate.

If one or two of the three components in equation (1) are held constant at the levels of a certain base year and for the second and/or third component the actual values are used, it is possible to calculate how high the overall unemployment rate would have been if those components held constant had actually not changed over time. This counterfactual unemployment rate reflects a situation where there would have been no changes in either the age structure of the population, the age-specific labor force participation rates or in the age-specific unemployment rates. A comparison with the actually realized unemployment rate answers the question which part of the changes in the unemployment rate can be attributed towards each of the components held constant over time.

4.3 Results

We calculate two counterfactual unemployment rates. In column A of table 3, the actual unemployment rates are depicted. For the ease of calculation, in column B the unemployment rate of the base year 1996 is reported. Column C contains counterfactual unemployment rates with constant weights of the labor force, i. e., with both the age-specific population shares and the relative age-specific $LFPR$ fixed at 1996 levels. Hence, only the age-specific unemployment rates as denoted by the last component in equation (1) are allowed to change. The counterfactual unemployment rates in column D of table 3 are computed with fixed weights for the age structure of the population only.

Table 3: Decomposition results for the direct effect in East Germany, base year 1996 (effects in percentage points)

Year	Unemployment rate		Rate based on constant...		Total	Effect of changes in...		
	actual	base year	age-specific labor force	age structure of the population	effect (A - B)	population (A - D)	participation (D - C)	labor market (C - B)
	A	B	C	D	E	F	G	H
1996	15.4	15.4	15.4	15.4	0.0	0.0	0.0	0.0
1997	17.2	15.4	17.1	17.3	1.8	-0.1	0.2	1.7
1998	18.4	15.4	18.2	18.6	3.0	-0.2	0.4	2.8
1999	16.5	15.4	16.5	16.9	1.1	-0.4	0.5	1.1
2000	16.0	15.4	15.9	16.4	-0.8	-0.5	1.3	-1.6
2001	16.7	15.4	16.8	17.3	1.3	-0.6	0.5	1.4
2002	15.6	15.4	17.5	18.5	0.2	-2.9	1.0	2.1
2003	18.4	15.4	18.4	19.0	3.0	-0.6	0.6	3.0
2004	19.7	15.4	19.6	20.2	4.3	-0.5	0.5	4.2
2005	18.9	15.4	18.9	19.1	3.5	-0.2	0.2	3.5
2006	17.5	15.4	17.5	17.0	2.1	0.5	-0.5	2.1
2007	15.2	15.4	15.1	15.1	-0.2	0.1	0.0	-0.3
2008	13.3	15.4	13.3	13.1	-2.1	0.2	-0.2	-2.1
2009	12.8	15.4	12.7	12.5	-2.6	0.3	-0.2	-2.7
2010	11.3	15.4	11.2	11.0	-4.1	0.3	-0.2	-4.2
2011	9.9	15.4	9.8	9.7	-5.5	0.2	-0.2	-5.6
2012	9.2	15.4	9.2	8.9	-6.2	0.3	-0.3	-6.2

Source: Federal Statistical Office of Germany, own calculations.

The results for the two counterfactual rates reveal only slight differences in comparison to the actual unemployment rates. The counterfactual value in column C for 2004, for example, indicates that the unemployment rate would have amounted to 19.6% had the age structure of the population as well as the labor force participation of the single age groups not changed since 1996. Permitting only changes in demography (column D) results in an unemployment rate of 20.2%. Since this value exceeds the realized rate of 19.7%, this means that the unemployment rate would have been higher had there been no changes in the age structure of the population since 1996. Hence, demographic change exerted a mitigating effect on the increase of the unemployment rate in that year.

Based on the two counterfactual unemployment rates in table 3 it is now possible to determine which part of the changes in the overall unemployment rate can be attributed to the respective changes in its components. The total effect of the change in the overall unemployment rate with respect to the base year (column E in table 3) can be split up into an

- effect of population changes that is due to changes in the age structure of the population (column F),
- effect of participation changes that stems from changes in the labor force participation rates of the various age groups (column G),
- effect of labor market changes based on changes in the age-specific unemployment rates (column H).

The total effect of changes in the overall unemployment rate was positive until 2006 and turned negative thereafter due to the marked decline of unemployment. The direct effect of demography on unemployment as depicted by the effect of population changes (column F) was negative until the year 2005. This implies that in the period from 1996 to 2006, aging of the population worked against the increase in unemployment. In 2002, the direct effect of population change was largest in the observation period and also exceeded the other two effects in magnitude. To put it precisely, without changes in the age structure of the population the unemployment rate would have exceeded the actual unemployment rate by 2.9 percentage points in 2002. In 2006, the sign of the population effect changed from negative to positive, providing evidence that changes in the age structure now counteract the decline in unemployment. Without population aging, the unemployment rate would have been below the actual rate by 0.3 percentage points in 2012.

The effect stemming from changes in the age-specific labor force participation rates (column G) features mostly opposite signs compared to the effect of population changes, with values of roughly the same magnitude. Hence, the effect of demography is almost completely compensated by the participation effect. This might be especially the case for the older age groups whose population shares as well as labor force participation rates increased. The most eminent impact can be ascribed to the effect of labor market changes as evidenced by the decline of the age-specific unemployment rates (see also figure 2). Since the population and the participation effect cancel each other out over the whole observation period, the decline in the unemployment rate of 6.2 percentage points is solely attributed to the labor market effect. One possible explanation might be given by improvements in the labor market situation in the last years that were not least the result of extensive reforms.[6]

To sum up, changes in the age structure of the population slightly attenuated the increase in the overall unemployment rate until 2005. Since then, they rather worked against the ensuing decline of the unemployment rate.[7] This result stands in contrast to the findings for the United States by Flaim (1990) and Shimer (1999), who report a negative effect of aging on unemployment. Moreover, a comparison with the results of Garloff/Pohl/Schanne (2013) for West Germany shows that evidently population aging had an opposite impact in the two parts of the country. This can be attributed to the still existing differences between the two labor markets and to the high degree at which the labor market conditions in East Germany have changed in the last years (see, e. g., Fuchs/Weyh/Wesling, 2014). The direct effect of demography on unemployment, however, is rather low in both parts of Germany. Changes in the participation rates are also of secondary relevance. The most important effect results from a reduction of the age-specific unemployment rates that is due to the improved labor market situation.

5 Indirect effect

We now turn to the estimation of the indirect effect, that is how the entry of small cohort sizes into the labor market affects unemployment. As discussed in chapter 2, if labor demand does not decline to the same extent as labor supply, according to the central hypothesis of Easterlin (1961) unemployment should fall in reaction to a decline of the youth share. In our empirical analysis we follow the approach of Shimer (2001) and regress the youth share on unemployment. Additionally, we scrutinize the impact of the old-age share in order to capture both ends of the population aging process. In the following, we first present the variables used for the estimation and some descriptive evidence, then turn to the econometric model, and finally discuss the regression results.

5.1 Variables and descriptives

The variables for the estimation of the indirect effect are based on the number of unemployed and on the population in the East German NUTS 3-regions. Our dependent variable is the unemployment ratio UR_{it} in region i $(i = 1, ..., 77)$ at time t $(t = 1996, ..., 2012)$ that relates unemployment to the population of working age:

$$UR_{it} = \left(\frac{unemployed(15-64)}{population(15-64)}\right)_{it}. \quad (2)$$

We measure the youth share $(young)$ as the share of the population between 15 and 24 years on the working-age population:

$$young_{it} = \left(\frac{population(15-24)}{population(15-64)}\right)_{it}. \quad (3)$$

6 A recent study by Klinger/Rothe (2012) confirms the large impact of the labor market effect. The authors show that the labor market reforms have supported the decline of long-term unemployment in Germany.

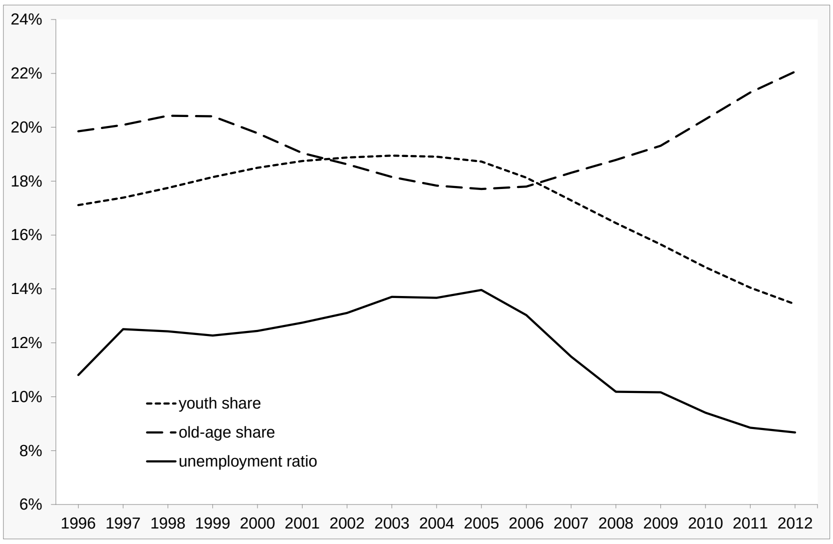
7 These results also hold when omitting Berlin from East Germany.

Likewise, the old-age share (old) relates the share of the population between 55 and 64 years on the working-age population:

$$old_{it} = \left(\frac{population(55-64)}{population(15-64)}\right)_{it}. \qquad (4)$$

Figure 3 depicts the development of the unemployment ratio and the age structure of the population in East Germany during the observation period. In accordance with figure 1, unemployment increased until 2005 and then decreased sharply. Paralleling this development, the youth share reached 18.9% in 2004 and then declined to 13.4% in 2012, because the small after-reunification cohorts had by then joined those 15-24 years of age. The old-age share, in contrast, increased steadily from 17.7% in 2005 to 22.1% in 2012.[8]

Figure 3: Unemployment ratio, youth share and old-age share in East Germany



Source: Federal Statistical Office of Germany, Federal Employment Agency, own calculations.

There are large regional differences with respect to the three variables under consideration. In 2012, the unemployment ratio varied between 3.9% in the *Landkreis* Sonneberg and 14.3% in the *Landkreis* Uckermark. Similarly, the youth share ranged from 10.7% (*Landkreis* Spree-Neisse) to 19.6% (Jena), and the old-age share from 16.6% (Dresden) to 28.7% (Suhl). Table A.2 in the Appendix contains descriptive statistics, and figure A.1 provides a graphical overview of the spatial disparities in the unemployment ratios as well as in the youth and the old-age shares.

The distinct spatial patterns give rise to the assumption that the effects of aging are not necessarily confined to the region they are observed in, but might as well influence unemployment in adjacent regions they share intense economic interrelations with. If characteristics of nearby regions are correlated either in a positive or negative way with those in the region under observation and thus show a systematic pattern in their spatial distribution, they are spatially autocorrelated (Cliff/Ord, 1981). If this is the case, the independence

[8] Although in West Germany the unemployment ratio and the old-age share did not exhibit such marked changes, their development broadly paralleled that in East Germany. The youth share, in contrast, increased until 2008 to 17.6% and since then decreased only slightly to 17.2% in 2012.

assumptions of the standard statistical techniques are violated, leading to biased results (Anselin, 1988). Spatial regression models that explicitly account for spatial dependence should then be applied (see also Matthews/Parker, 2013).

In order to test for spatial autocorrelation in our data, we apply the Moran's *I* statistic, popularized in the work of Cliff/Ord (1981). Table 4 depicts the results, confirming statistically the existence of spatial dependence. Averaged across all years, Moran's *I* is positive and significant, indicating that regions with high observational values are surrounded by regions with likewise high values. For the unemployment ratio and the old-age share, positive spatial autocorrelation holds for each single year. For the youth share, in contrast, the test statistics reveal profound changes in the spatial pattern over time. Until 2005, the test statistics feature positive and highly significant results, albeit with decreasing values. Since 2009, Moran's *I* is negative and significant at the 10 percent level, indicating that now regions with high youth shares are surrounded by regions with low youth shares and vice versa. Obviously, the spatial clustering of regions with similar youth shares has changed towards a pattern where the neighboring regions have become more unlike. This might at least partly be rooted in the distinctive population growth in cities and simultaneous population losses in the non-metropolitan regions. The increase in net migration into urban regions of younger adults in search for education and employment has had a substantial impact on these processes (Sander, 2014). The rapidly decreasing youth share in East Germany since 2005 might well have aggravated these developments. In fact, between 2005 and 2012 the youth share decreased only slightly in the East German metropolitan regions from 18.0% to 15.6%, whereas in the rural regions it fell considerably from 19.3% to 12.0%.

Table 4: Measuring spatial autocorrelation: Moran's I 1996 – 2012

	unemployment ratio	youth share	old-age share
1996	0.228***	0.305***	0.171***
1997	0.255***	0.319***	0.173***
1998	0.316***	0.292***	0.136**
1999	0.407***	0.303***	0.158**
2000	0.397***	0.307***	0.173***
2001	0.413***	0.285***	0.207***
2002	0.368***	0.277***	0.215***
2003	0.358***	0.245***	0.255***
2004	0.373***	0.203***	0.301***
2005	0.313***	0.177***	0.358***
2006	0.301***	0.118**	0.410***
2007	0.322***	0.043	0.417***
2008	0.337***	-0.060	0.375***
2009	0.266***	-0.121*	0.299***
2010	0.295***	-0.137*	0.228***
2011	0.357***	-0.134*	0.168***
2012	0.318***	-0.128*	0.116**
1996 – 2012	0.334***	0.141**	0.368***

Levels of significance: *** 1 %, ** 5 %,* 10 %.
Source: Federal Statistical Office of Germany, Federal Employment Agency, own calculations.

5.2 Method

Our regression model relates the unemployment ratio UR_{it} to the youth share and the old-age share of the working-age population and has the following basic panel form (Shimer, 2001):

$$UR_{it} = \alpha_i + \beta_t + \gamma demo_{it} + \epsilon_{it}, \tag{5}$$

where $demo_{it}$ stands for the youth and the old-age share, respectively. α_i captures region fixed effects, and β_t represents time fixed effects. ϵ_{it} is the random disturbance term with $\epsilon_{it} \sim (0, \sigma_\epsilon^2) i.i.d.$ In order to correct for biases in the impact of large and small regions we weight each observation with the share of the region's working-age population on the total working-age population in East Germany. Additionally, in all estimations we apply the Huber-White-Sandwich procedure in order to obtain heteroskedasticity-robust standard errors (White, 1980).

In a first step, we estimate equation (5) with Ordinary Least Squares (OLS) in natural logarithms as a basic consistency check.[9] Special interest is given to the coefficient γ that indicates the elasticity of UR_{it} with respect to the demographic situation in region i. We also check for possible endogeneity by regressing the exogenous variables $demo_{it}$ lagged one and five years ($demo_{i,t-1}$, $demo_{i,t-5}$).[10]

In a second step, in order to capture spatial dependence and to avoid biased and inefficient estimates, we transform equation (5) into a spatial panel model (see Elhorst, 2003 and Lee/Yu, 2010 for an overview). Spatial dependence can be modelled and incorporated into the standard linear regression model in several ways (Anselin, 1988; LeSage/Pace, 2009). First, in the case of the spatial lag (spatial autocorrelation) model (SAR), the endogenous variable depends on its values in neighboring regions, resulting in spatial lag dependence. Second, spatial error models (SEM) incorporate spatial dependence not explicitly through an additional variable, but instead through the error term of the regression, thus affecting the covariance structure of the random disturbance terms. The idea behind this is that non-modelled effects spill over across units of observation, resulting in spatially correlated errors. Third, according to the spatial Durbin model (SDM) spatial relations not only exist in the dependent variable, but also in the independent variables. In our case the demographic setting in the neighboring regions influences unemployment in the region under consideration and vice versa.

We set up our spatial panel data model in the following general form in order to capture

[9] The estimation of fixed and random effects panel models yields similar results as the OLS estimation with respect to significance and sign. Results are available from the authors upon request.

[10] Results are available from the authors upon request. In order to avoid endogeneity problems, Shimer (2001), Nordström-Skans (2005) and Garloff/Pohl/Schanne (2013) use birth rates lagged 15 up to 24 years as instruments for the youth share. Unfortunately, we cannot use data before 1991, because regional delineations and information for the German Democratic Republic cannot be made consistent with the present-day NUTS-3-demarcations. However, Shimer (2001) finds no significant differences between the instrumental variables estimates and those found by OLS, and a specification test even fails to reject the exogeneity of the youth share of the population. The same holds for the results of Biagi/Lucifora (2008).

each of the spatial transmission mechanisms:

$$UR_{it} = \rho \sum_{j=1}^{77} W_{ij} UR_{it} + \gamma demo_{it} + \theta \sum_{j=1}^{77} W_{ij} demo_{it} + \alpha_i + \beta_t + \nu_{it}, \qquad (6)$$

with

$$\nu_{it} = \lambda \sum_{j=1}^{77} W_{ij} \nu_{it} \epsilon_{it}. \qquad (7)$$

W denotes the spatial weights matrix indicating the kind of spatial relatedness for which we use a binary contiguity matrix.[11] The elements w_{ij} in the *N*x*N* matrix W take on the value of one in each row i for those columns j that are neighbours of region i. The spatial coefficient ρ pertaining to the spatial lag of the dependent variable indicates whether the unemployment ratio in region i depends on the unemployment ratios in the neighbouring regions. The second spatial transmission mechanism is denoted by the spatial coefficient λ and captures spatial effects in the error terms. The impact of demography in the adjacent regions on unemployment in region i is defined by θ. In the case of the SAR, $\theta = \lambda = 0$, and spatial dependence works only through the spatially lagged observations of the dependent variable. In the SEM, $\rho = \theta = 0$, and in the SDM, $\lambda = 0$.

Since in empirical practice there are often no strong a priori reasons to consider a specific spatial model (Anselin et al., 1996), we estimate all three models and in our model selection procedure resort to hypothesis testing (see also Debarsy/Ertur, 2010). For each of the two independent variables, we first estimate a SDM, since it contains the most information regarding spatial spillover channels. To test the hypothesis whether it can be simplified to the SAR ($H_0 : \theta = 0$), we perform a Wald test. If H_0 is rejected, we choose the SDM, otherwise the SAR is sufficient. In a further step, we analyze if unobserved spatial effects play a role and test the SDM versus the SEM (simplified $H_0 : \rho = 0$) with a Wald test. Finally, based on the Hausman specification test, we decide on a fixed effects (FE) or random effects (RE) model. Due to the structural break in the data evident in figure 3 in the year 2005 (see chapter 5.1 for a discussion) we estimate the models for the whole observation period of 1996 to 2012 and separately for the periods from 1996 to 2004 and from 2005 to 2012. For estimation purposes, we use the XSMLE Stata command by Belotti/Hughes/Mortari (2013) that fits fixed and random effects spatial models for balanced panel data via maximum likelihood for a wide range of specifications.

5.3 Results

In the following, we first discuss the results on the impact of the youth share and the old-age share for the whole observation period and then proceed with the two separate periods of time. Table 5 contains the OLS and spatial panel results for the years from 1996 to 2012. The OLS results feature a positive and highly significant correlation between the youth share and the unemployment ratio. A decrease in the youth share of one percent

[11] The spatial weights matrix W can be specified in various ways. However, Stakhovych/Bijmolt (2009) show that spatial models estimated using a first-order contiguity matrix often perform better on average than others.

is associated with a decrease in the unemployment ratio of roughly 0.46 percent. This result confirms the reversed cohort crowding hypothesis in that smaller cohorts entering the labor market improve the conditions for the unemployed. A comparison with the OLS results of Garloff/Pohl/Schanne (2013) for West Germany and with Biagi/Lucifora (2008) for the European case hints towards a slightly smaller magnitude of the effect.[12]

Concerning the spatial panel model selection procedure, we first test whether the SDM can be simplified to the SAR. The results of the Wald test reported in the third column of table 5 indicate that the H_0 hypothesis that $\theta = 0$ must be rejected, giving preference to the SDM. Similarly, the hypothesis that the SDM is a SEM has to be rejected as well. Since the Hausman specification test points towards a FE panel model in all our specifications, our preferred spatial panel model for the impact of the youth share on the unemployment ratio is the SDM with fixed effects (SDM FE).

Table 5: The effect of the youth share and the old-age share on the unemployment ratio, 1996 – 2012

	OLS	SDM FE	OLS	SDM FE
ln(young)	0.456***	0.519***		
W x ln(young)		-0.215*		
ln(old)			-0.444***	-0.431***
W x ln(old)				0.110*
ρ		0.721***		0.786***
time dummies	yes		yes	
region dummies	yes		yes	
R^2	92.1	44.6	92.0	21.3
Number of observations	1,309	1,309	1,309	1,309
Hausman test		17.36***		33.04***
Wald test SDM vs. SAR		3.75*		2.93*
Wald test SDM vs. SEM		12.90***		32.35***

Levels of significance: *** 1 %, ** 5 %,* 10 %. Observations are weighted with population shares. Estimations are calculated with robust standard errors.
Source: Federal Statistical Office of Germany, Federal Employment Agency, own calculations.

As in the OLS specification, the SDM FE appoints the youth share a positive and highly significant coefficient.[13] It is higher than the OLS coefficient, suggesting that the disregard of spatial dependence in the data leads to downward biased estimates. The results indicate that when the youth share decreases by 1%, the unemployment ratio decreases by around 0.52%. This correlation is about twice as high as that found by Garloff/Pohl/Schanne (2013). However, they consider West Germany, where changes in labor market and demography have not been as severe as in East Germany. The spatially lagged unemployment ratio is positively associated with unemployment in the own region. This relation illustrates general strong spatial interdependencies between local labor markets. The coefficient of the spatially lagged youth share indicates the magnitude of demographic spillover effects between regions. An explanation for this spatial pattern might be provided by the above mentioned migration patterns of younger people between rural and urban regions.

Concerning the relation between the old-age share and the unemployment ratio, the OLS

[12] Garloff/Pohl/Schanne (2013) present an elasticity of 0.396 and Biagi/Lucifora (2008) an elasticity of 0.345.
[13] The result of the SDM FE model is also confirmed by Lottmann (2013) with additional explanatory variables.

coefficient in table 5 is negative and highly significant. It only decreases slightly in magnitude in our preferred spatial model, which again is SDM FE. Evidently, an increase in the old-age share of 1% is accompanied with a decrease of the unemployment ratio of 0.43%. This finding is consistent with the distinctive increase in the $LFPR$ of the persons aged 55 to 64 (see figure 2). As discussed in section 4.1, labor market prospects clearly improved for the elder during the observation period. The importance to take spatial dependence into account is also highlighted in the case of the old-age share. The spatial lag coefficient indicating spatial spillover effects between the unemployment ratios even slightly exceeds that of the youth share regression. In contrast, spatial spillover effects of the old-age share in neighboring regions are positive, but only of weak significance.

The separate consideration of the two time periods before and after 2005 demonstrates that the ties between demography and unemployment have undergone profound changes. Table 6 depicts the regression results for the years from 1996 to 2004. Both the OLS and the SDM FE feature a statistically insignificant correlation between the youth share and the unemployment ratio. The indicators of spatial dependence are significant, however. The spatial lag coefficient has the same sign and roughly the same size as for the whole observation period, whereas the spatial lag of the exogenous variable is positive. This gives weak evidence that until 2004 an increase in the average youth share in adjacent regions went along with an increase in the unemployment ratio in region i. There is no significant impact of the old-age share, either. In the spatial panel case, the Wald test on the SDM versus the SAR yields no significant result. Hence, $H_0 : \theta = 0$ cannot be rejected, and the SDM can be simplified to the SAR. Again, the spatial lag parameter points towards positive spatial spillover effects emanating from averaged unemployment ratios in adjacent regions.

Table 6: The effect of the youth share and the old-age share on the unemployment ratio, 1996 – 2004

	OLS	SDM FE	OLS	SAR FE
ln(young)	-0.168	-0.286		
W x ln(young)		0.642*		
ln(old)			0.016	0.060
W x ln(old)				
ρ		0.788***		1.044***
time dummies	yes		yes	
region dummies	yes		yes	
R^2	91.0	9.0	91.0	7.6
Number of observations	693	693	693	693
Hausman test		11.38***		109.82***
Wald test SDM vs. SAR		3.68*		1.49
Wald test SDM vs. SEM		8.86***		3.96**

Levels of significance: *** 1 %, ** 5 %,* 10 %. Observations are weighted with population shares. Estimations are calculated with robust standard errors.

Source: Federal Statistical Office of Germany, Federal Employment Agency, own calculations.

The regression results for the second time period from 2005 to 2012 stand in sharp contrast to the first time period (see table 7). All coefficients are significant at least at the 5% level and take on larger values than for the whole period. Evidently, the strong correlations characterizing the years since 2005 dominate the results for the whole observation period as depicted in table 5. In both the OLS and the preferred SDM FE specifications, the youth share is positively associated with the unemployment ratio. Likewise, the old-age share features a strong negative correlation with the unemployment ratio. In both cases, the spatial spillover coefficient ρ points to strong interrelations between adjacent regions. Remarkably, the impact of the spatially lagged demographic variables is quite strong and surmount the impact observed for the whole period under observation.

Table 7: The effect of the youth share and the old-age share on the unemployment ratio, 2005 – 2012

	OLS	SDM FE	OLS	SDM FE
ln(young)	0.489***	0.553***		
W x ln(young)		-0.245**		
ln(old)			-0.454***	-0.573***
W x ln(old)				0.308**
ρ		0.742***		0.829***
time dummies	yes		yes	
region dummies	yes		yes	
R^2	96.5	44.8	96.3	30.1
Number of observations	616	616	616	616
Hausman test		13.92***		31.53***
Wald test SDM vs. SAR		5.08**		4.72**
Wald test SDM vs. SEM		12.30***		6.02**

Levels of significance: *** 1 %, ** 5 %,* 10 %. Observations are weighted with population shares. Estimations are calculated with robust standard errors.

Source: Federal Statistical Office of Germany, Federal Employment Agency, own calculations.

To sum up, the regression results suggest close ties between demography and unemployment. The youth share is positively correlated with the unemployment ratio, whereas the old-age share features a negative relation. This result provides evidence for a reversed cohort crowding process on the East German labor market and is in line with Garloff/ Pohl/Schanne (2013) for West Germany and Foote (2007) for the United States. One restriction has to be made on the point in time when this process actually comes into force, however. Apparently, the results for the whole time period are dominated by those for the second time period, highlighting the large impact of the distinctive structural changes on both the labor market and the population age structure since 2005. This might also be one reason why Ochsen (2009) refutes the cohort crowding hypothesis for the East German labor market, because his period of consideration only covers the years 2000 and 2001. Furthermore, our findings clearly show the importance of taking spatial dependence into account. Otherwise, the coefficients would be downward biased in case of the youth share and upward biased in case of the old-age share.

6 Conclusions

In this paper, we have analyzed the relation between population aging and unemployment decline in East Germany between 1996 and 2012. Because of the entry of the small after-reunification birth cohorts into the East German labor market at around the same time when unemployment started declining, the investigation of this relation is of high relevance not only for science but also for politics. The empirical results show that the ties between demography and unemployment are indeed strong, providing evidence for a reversed cohort crowding process.

Our empirical approach encompasses the analysis of both a direct and an indirect effect of aging on unemployment. According to our results, the direct effect of demography on unemployment can be regarded as very low. Since 2005, the aging of the working-age population has even counteracted the decline in unemployment. This negative demographic effect was roughly compensated by the increase in labor force participation, however. The strongest impact can be attributed to general improvements in the labor market that brought with them a pronounced decline of the age-specific unemployment rates. Almost the whole decrease of the unemployment rate of 6.2 percentage points between 1996 and 2012 can be attributed to this effect.

The impact of aging on unemployment is indirect, as our regression results show. The impact of demographic change on unemployment seems to work through a general increase of competition for labor rather than through a direct change of the age structure. Our evidence assigns a positive correlation between the youth share and the unemployment rates, whereas the old-age share is negatively related to unemployment. The findings further emphasize the need to account for spatial spillover effects in the analysis of regional unemployment issues. The strong regional interdependencies are a fact that especially local policy makers should not ignore.

Another important result that emanates from both the direct and the indirect effect are the profound changes in the relation between demography and unemployment around the year 2005. Special emphasis merits the fact that around this time, the spatial pattern as well as the interrelation of aging and unemployment between the single regions changed markedly. These issues clearly warrant further research. Likewise, our analysis is limited insofar as the impact of the labor market reforms coming into force between 2002 and 2005 on labor force participation and unemployment rates cannot be isolated in an adequate way.

In view of the future demographic developments in Europe, it would be worthwhile to compare the results for East Germany with those for other regions facing rapid aging. One promising step in this direction might be an update of the cross-European study by Biagi/Lucifora (2008) in terms of the time period and the regions under consideration. Special emphasis in this respect merit the new EU member states. Due to the strong decline of fertility in response to the breakdown of Communism, they are challenged in a similar way by demographic change as East Germany.

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A Appendix

Table A.1: Descriptive statistics for age groups in West Germany

Year	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	15-64
						age group					
Population (in million)											
1996	3.322	3.620	4.925	5.362	4.914	4.423	4.209	3.940	4.836	3.598	43.149
2004	3.565	3.572	3.520	4.245	5.401	5.384	4.689	4.362	3.744	4.421	42.905
2012	3.568	3.970	3.920	3.993	3.840	5.083	5.601	5.125	4.391	3.985	43.476
Population (age-group shares in %)											
1996	7.7	8.4	11.4	12.4	11.4	10.3	9.8	9.1	11.2	8.3	100.0
2004	8.3	8.3	8.2	9.9	12.6	12.5	10.9	10.2	8.7	10.3	100.0
2012	8.2	9.1	9.0	9.2	8.8	11.7	12.9	11.8	10.1	9.2	100.0
Labor force participation rates (in %)											
1996	29.6	71.5	78.8	82.2	83.6	84.9	83.4	77.1	61.8	22.2	69.7
2004	28.4	68.7	79.3	85.0	86.8	87.9	87.5	82.0	69.4	29.6	72.0
2012	29.0	69.5	82.6	86.3	87.3	89.3	89.1	86.1	78.4	49.6	76.4
Unemployment rates (in %)											
1996	8.9	8.5	6.6	6.2	6.0	5.4	5.6	6.6	11.6	7.0	7.0
2004	10.3	11.8	9.7	8.4	7.3	7.2	7.7	8.5	10.6	9.9	8.7
2012	8.5	6.8	5.6	4.6	4.7	3.7	3.5	3.8	4.2	5.3	4.6

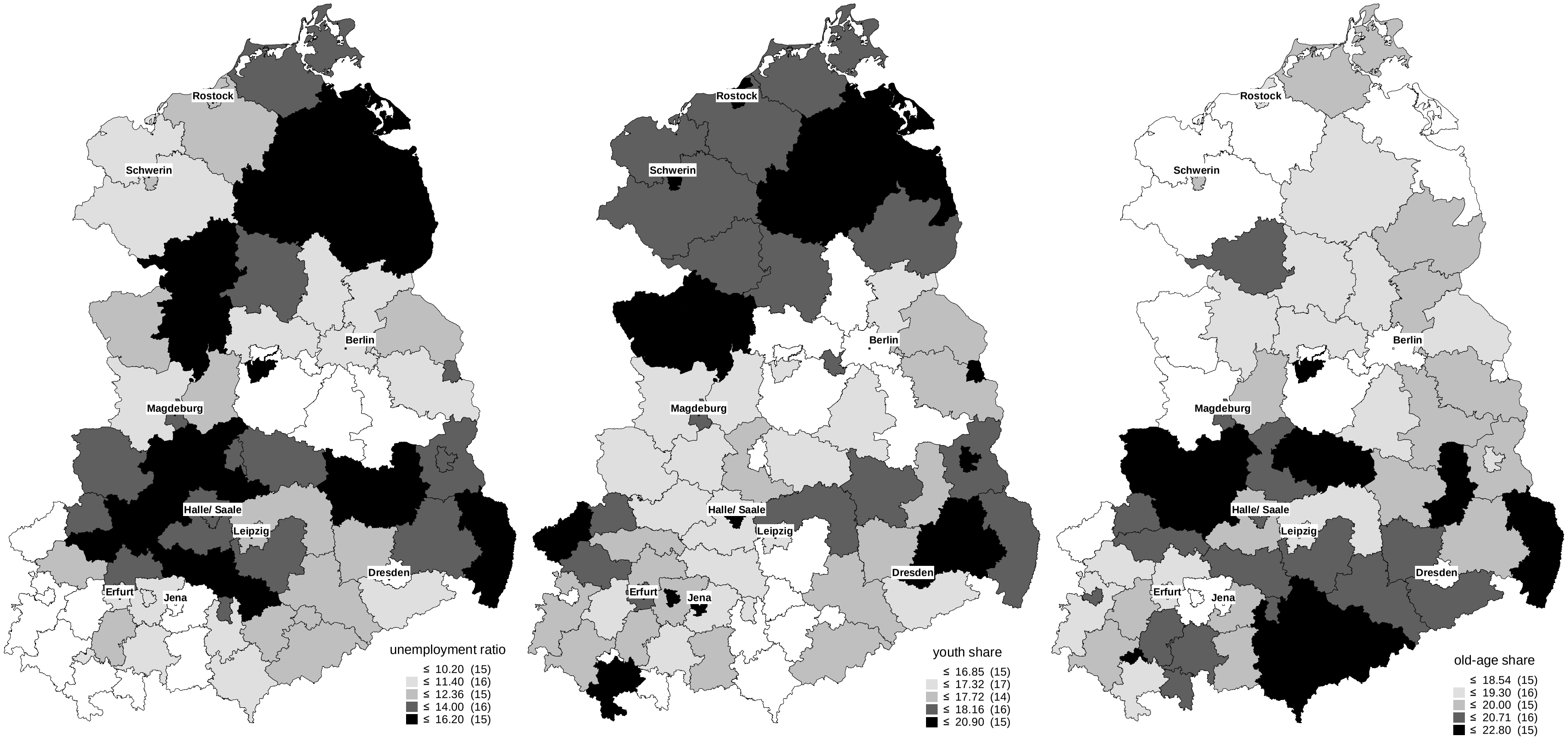
Source: Federal Statistical Office of Germany, Federal Employment Agency, own calculations.

Table A.2: Descriptive statistics for the indirect effect

	Mean	Std. Dev.	Min	Max
		Average 1996-2012		
UR	11.8	2.765	3.9	19.0
young	17.5	2.419	10.7	23.9
old	19.8	2.270	15.3	28.7
		1996		
UR	11.1	1.682	5.9	14.8
young	17.7	0.980	15.0	20.9
old	20.1	1.104	17.5	22.5
		2012		
UR	8.5	2.006	3.9	14.3
young	12.8	1.801	10.7	19.6
old	23.7	2.470	16.6	28.7

Source: Federal Statistical Office of Germany,
Federal Employment Agency, own calculations.

Figure 4: Unemployment ratios, youth shares and old-age shares in the East German regions, average 1996-2012 (in %)



Source: Federal Statistical Office of Germany, Federal Employment Agency, own calculations.
The numbers in brackets refer to the respective number of regions per group.

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Imprint

IAB-Discussion Paper 26/2014

Editorial address
Institute for Employment Research
of the Federal Employment Agency
Regensburger Str. 104
D-90478 Nuremberg

Editorial staff
Regina Stoll, Jutta Palm-Nowak

Technical completion
Gertrud Steele

Website
http://www.iab.de

Download of this Discussion Paper
http://doku.iab.de/discussionpapers/2014/dp2614.pdf

ISSN 2195-2663

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