Essays on Adult Education in Germany

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Referent:	Prof. Dr. Stephan L. Thomsen
Mitberichter:	Prof. Dr. Jens Ruhose

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Abstract

Lifelong learning and adult education are central to adapt to ageing societies, globalization, and automatization. At the same time, causal analyses are scarce in the realm of adult education, mainly because of the voluntary nature of participation and a paucity of high-quality data. After a short motivation and an overview of each chapter in the first chapter, the four essays of this dissertation contribute to understanding institutional, pecuniary, and non-pecuniary aspects of nonformal adult education in Germany.

Chapter 2 analyzes whether potential beneficiaries of an early retirement program in Germany voluntarily engage in nonformal adult education. We find that adult education activities increase substantially more after the reform in relatively old counties, i.e., counties with a higher share of older men, compared to relatively young counties, i.e., counties with a higher share of younger men. This increase in participation is observed almost exclusively in cognitively demanding courses, mostly work-related courses. Our results support the notion of an intrinsic willingness of older workers to acquire skills independent of financial incentives.

Chapter 3 explores how the most important provider of language courses in Germany, adult education centers (VHS), adapted their course supply of "German as a foreign language" (Deutsch als Fremdsprache, DAF) courses to the refugee wave of 2015/2016. Our results show that VHS reacted quickly and strongly to the refugee influx by massively increasing the number of DAF courses. However, this remarkable expansion came at the cost of offering relatively fewer other courses. In addition, we find that VHS with more resources and more prior experience in organizing DAF courses scaled up their DAF course supply more strongly, which implies path dependency. If equal (learning) opportunities across regions are a societal goal, these inequalities can be seen as problematic.

Chapters 4 and 5 make a methodical and a topical contribution to the research on adult education. First, we address empirical challenges in the evaluation of wider benefits from work-related training by transferring a flexible econometric framework from the labor economics literature into the literature that evaluates wider benefits of adult education. We improve upon existing studies by combining the regression-adjusted difference-in-differences (DiD) matching approach with entropy balancing in a multiple event study setting. Second, we apply this framework to identify the effects of work-related training on measures of civic/political, cultural, and social participation (Ch. 4), as well as life satisfaction, worries, and health (Ch. 5). We find that participation in work-related training yields positive non-pecuniary returns in the form of higher civic/political and cultural participation. Those increases do not crowd out social participation. Our results also show that work-related training decreases worries but does not affect satisfaction or (subjective) health. Lastly, Chapter 4 also provides updated estimations on the pecuniary returns to (work-related) adult education.

Keywords: adult education, early retirement, earnings, entropy balancing, generalized difference-in-differences, integration, language courses, matched difference-in-differences, non-pecuniary Returns, older workers, refugees, regional context, social capital, work-related training

Kurzzusammenfassung

Lebenslanges Lernen und Erwachsenenbildung sind von zentraler Bedeutung für die Anpassung an alternde Gesellschaften, Globalisierung und Automatisierung. Gleichzeitig fehlen Kausalanalysen im Bereich der Erwachsenenbildung, vor allem wegen der Freiwilligkeit der Teilnahme und eines Mangels an qualitativ hochwertigen Daten. Nach einer kurzen Motivation und einem Überblick über die Arbeit im ersten Kapitel leisten die vier Essays dieser Dissertation in den nachfolgenden Kapiteln einen Beitrag zum Verständnis institutioneller, monetärer und nicht-monetärer Aspekte der nicht-formalen Erwachsenenbildung in Deutschland.

Kapitel 2 analysiert, ob potenzielle Begünstigte einer Vorruhestandsregelung in Deutschland freiwillig an nicht-formaler Erwachsenenbildung teilnehmen. Wir finden, dass die Teilnahme an Kursen der Erwachsenenbildung nach der Reform in relativ alten Kreisen, d.h. Kreisen mit einem höheren Anteil älterer Männer, wesentlich stärker zunimmt als in relativ jungen Kreisen, d.h. Kreisen mit einem höheren Anteil jüngerer Männer. Dieser Anstieg ist fast ausschließlich bei kognitiv anspruchsvollen, berufsbezogenen Kursen zu beobachten. Unsere Ergebnisse stützen die Vorstellung einer intrinsischen Bereitschaft älterer Arbeitnehmer, sich unabhängig von finanziellen Anreizen weiterzubilden.

Kapitel 3 untersucht, wie die wichtigsten Anbieter von Sprachkursen in Deutschland, die Volkshochschulen (VHS), ihr Kursangebot an "Deutsch als Fremdsprache" (DAF) an die Flüchtlingswelle 2015/2016 angepasst haben. Unsere Ergebnisse zeigen, dass die VHS schnell und stark auf den Flüchtlingszustrom reagierten, indem sie die Zahl der DAF-Kurse massiv erhöhten. Diese bemerkenswerte Ausweitung ging jedoch auf Kosten eines geringeren Angebots an anderen Kursen. Darüber hinaus zeigt sich, dass VHS mit mehr Ressourcen und mehr Erfahrung in der Organisation von DAF-Kursen ihr DAF-Kursangebot stärker ausbauten, was auf eine Pfadabhängigkeit schließen lässt. Wenn gleiche (Lern-)Chancen über Regionen hinweg ein gesellschaftliches Ziel sind, können diese Ungleichheiten als problematisch angesehen werden.

Kapitel 4 und 5 leisten einen methodischen und inhaltlichen Beitrag zur Forschung über Erwachsenenbildung. Erstens gehen wir auf empirische Herausforderungen in der Messung des nicht-monetären Nutzens von berufsbezogener Weiterbildung ein, indem wir einen flexiblen ökonometrischen Ansatz aus der Arbeitsmarktökonomik auf die Bewertung des nicht-monetären Nutzens der Erwachsenenbildung übertragen. Wir bieten eine Verbesserung gegenüber bisherigen Studien, indem wir den regressionsbereinigten Differenz-von-Differenzen (DiD) Matching-Ansatz mit Entropy Balancing in einem Event Study Setting kombinieren. Zweitens wenden wir diese Methode an, um die Auswirkungen von berufsbezogener Weiterbildung auf Maße der politischen, kulturellen und sozialen Teilhabe (Kap. 4) sowie auf Lebenszufriedenheit, Sorgen und subjektives Gesundheitsempfinden (Kap. 5) zu ermitteln. Wir finden, dass die Teilnahme an berufsbezogener Weiterbildung positive nicht-monetäre Erträge in Form von höherer politischer und kultureller Beteiligung erbringt. Dies geht nicht zu Lasten

sozialer Aktivität. Unsere Ergebnisse zeigen auch, dass arbeitsbezogene Weiterbildung die Sorgen verringert, aber keinen Einfluss auf die Zufriedenheit oder die (subjektive) Gesundheit hat. Schließlich bietet Kapitel 4 auch aktualisierte Schätzungen zu den monetären Erträgen der (arbeitsbezogenen) Erwachsenenbildung.

Schlagwörter: ältere Arbeitnehmer, arbeitsbezogene Weiterbildung, Einkommen, Entropy Balancing, Erwachsenenbildung, Flüchtlinge, generalisierter Differenz-von-Differenzen-Ansatz, Integration, matched Differenz-von-Differenzen-Ansatz, nicht-monetäre Erträge, regionaler Kontext, Sozialkapital, Sprachkurse, Vorruhestand

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Chapter 1

Introduction

Lifelong learning, encompassing "all formal, nonformal, and informal learning in various learning venues from early childhood to retirement" (translated from BLK, 2004, p. 13), is relevant for individuals, firms and societies. According to the Survey of Adult Skills (PIAAC) 2015, approximately half of all adults aged between 25 and 64 years take part in some type of adult learning activity in OECD countries in a given year (OECD, 2017a, p. 327).[1] This is in line with the human capital framework in which employees acquire skills and accumulate human capital not only in school but also at work, often in work-related training and on-the-job training, which raises their (marginal) productivity and thus their wages (Becker, 1962).[2] However, as all forms of capital, human capital depreciates over time (Schultz, 1961). In order to restore – or even enhance – productivity over the lifecycle, recurring investments in adult education, e.g., in the form of work-related training, are necessary.

This dissertation contributes to understanding institutional, pecuniary, and non-pecuniary aspects of lifelong learning and specifically nonformal adult education in Germany. It illuminates four aspects over the course of the next chapters: the demand for adult education, the supply of adult education, pecuniary returns and non-pecuniary returns to adult education. Given the low participation rate in continuing education of older workers, the first essay (Chapter 2) examines whether their willingness to learn is the bottleneck for engaging in adult learning. The second essay (Chapter 3) shifts the focus to the supply side, the adult education centers (*Volkshochschulen, VHS*). It analyzes how VHS adapted to the refugee influx of 2015/2016 and highlights the relevance of crowding-out effects and regional heterogeneities. Essay three (Chapter 4) investigates pecuniary and non-pecuniary benefits of participating in work-related continuing education, specifically civic, cultural and social participation before essay four (Chapter 5) examines the effects on life satisfaction, worries, and subjective health.

[1] Adult education is a form of lifelong learning that captures all organized educational processes of adults (UNESCO, 1976), both formal, i.e., leading to a degree, and nonformal, i.e., in a structured setting but without leading to a formal qualification.

[2] Work-related training is one type of adult education and usually refers to all kinds of nonformal training that are relevant for the participant's work and are often sponsored by the employer, e.g., by taking place during work-time, being financed by the employer, or being organized and hosted by the employer (OECD, 2020; Ruhose et al., 2019).

Chapter 2 – No Mental Retirement: Estimating Voluntary Adult Education Activities of Older Workers

In the majority of OECD countries, people enjoy longer (and healthier) lives than ever before (OECD, 2019a). This implies, among other measures, longer working lifes in order to finance national (often "pay-as-you-go" or PAYGO) retirement insurance systems (OECD, 2019b, esp. pp. 37-47). Longer working lives in turn call for additional investments in (work-related) education and training to maintain productivity over the life cycle.

However, the older a person gets, the less likely she is to invest. This is due to the fact that the horizon for amortization, i.e., realizing gains from the investment, becomes shorter, the closer a person gets to retirement (Ben-Porath, 1967). This prediction is generally supported by empirical evidence. For example, results from the Programme for the International Assessment of Adult Competencies (PIAAC; see, e.g., Paccagnella, 2016, esp. Figure 7) show that participation in (nonformal) education follows an inverted u-shape. Younger employees still profit from their skills and knowledge acquired during their schooling, apprenticeship or studies, and thus need little training. Workers between 25 and 45 years are the most likely to participate in adult education and specifically work-related training. They profit from updating their skills and still have enough of their working life left to recoup theiinvestment. Participation rates then decrease monotonously for older age groups, presumably because the amortization period becomes ever shorter.

Due to the necessity of prolonging working lives, many countries and international organizations actively support and push adult education initiatives to improve participation rates, especially of older workers (OECD, 2005; Council of the European Union/European Commission, 2015). Some studies (e.g., Picchio and van Ours, 2013) already show that work-related training increases older workers' employability in certain settings. However, existing evidence on adult education activities of older workers close to retirement comes from participation behavior in continuous training activities in response to increases in the retirement age (e.g., Brunello and Comi, 2015; Montizaan et al., 2010). Participation decisions in these studies is most likely confounded by employer requirements and the financial restraints of the worker. But participation in continuing adult education can only be successful and sustainable if older workers voluntarily engage in learning. That is, older workers must still have the general willingness to learn new skills and abilities.

To investigate this intrinsic willingness to learn, Chapter 2, co-authored with Jens Ruhose and Stephan L. Thomsen, analyzes whether potential beneficiaries of an early retirement program in Germany voluntarily engage in nonformal adult education. We use the VHS statistics for West Germany[3] because adult education centers (*Volkshochschulen, VHS*) exist in almost every county in Germany due to state legislations. VHS offer nonformal courses on a

[3] The adult education sector in East Germany (and the VHS in particular) underwent substantial reconstruction efforts after the German reunification in 1990. Moreover, the West German labor market is more stable and homogeneous than the East German labor market, which has had to cope with the consequences of socialism and reunification.

variety of topics, among them work-related training that mostly takes the form of ICT courses. We link the VHS statistics with regional data on the county level. We then use the preexisting regional variation in the share of the affected population age group (i.e., men who are between 55 and 64 years old) at the county level to assess the potential uptake of adult education activities that is due to retirement reform. Using a generalized difference-in-differences approach, we estimate the effect of the reform on adult education activities by using the variation in the male population share that is between 55 and 64 years old across counties and over time for identification.

Our results show that the increase in adult education activities after the reform is substantially larger in relatively old counties, i.e., counties with a higher share of older men, compared to relatively young counties, i.e., counties with a higher share of younger men. This increase in participation is observed almost exclusively in cognitively demanding courses such as work-related courses and, to some extent, language courses. We find no effects (or much lower effects) on adult education activities in other course areas. The results support the notion of an intrinsic willingness of older workers to acquire skills and abilities independent of financial incentives. This is important because the success of retirement reforms depends not only on retaining older workers in the workforce but also on mitigating their skill depreciation through adult education and training.

Chapter 3 – Scaling Up and Crowding Out: How German Adult Education Centers Adapted Course Offers to Refugee Integration[4]

In 2015 and 2016, over 1.1 million refugees applied for asylum in Germany (Bundesamt für Flüchtlinge und Migration, 2020, p. 15). Most of them fled armed conflicts and persecution and were thus granted protection. Since they are expected to stay in Germany for a long time, it is important to foster their integration into the host society. One of the most important success factors for economic and social integration is mastering the language of the new home country (e.g., Adamuti-Trache, 2013; Aldashev et al., 2009; Hochman and Davidov, 2014). This necessitated massively increasing German-language courses (*Deutsch als Fremdsprache, DAF*) – a considerable societal challenge. So far, little is known how about this process went. Existing studies (Käpplinger, 2018, 2020; Käpplinger and Reuter, 2019; Martin et al., 2021) describe how program structure and subjects changed qualitatively and quantitatively in response to migration in general. However, they do not specifically look at the events of 2015/2016 and do not identify the causal reaction of course providers to the refugees.

Chapter 3, co-authored with Stephan L. Thomsen, therefore contributes to understanding the causal supply-adjustment mechanisms. We analyze how the most important providers of language courses in Germany, adult education centers (*Volkshochschulen, VHS*), adapted their course offers to the refugee wave of 2015/2016. VHS have been the single largest provider of integration courses, offering about one third of all integration courses (Bundesamt für

[4] This chapter has been published in Adult Education Quarterly (Thomsen and Weilage, 2022).

Flüchtlinge und Migration, 2020, p. 137). In addition, for every integration course in a VHS about one additional DAF course is hosted that is not an official integration course (Reichart et al., 2020).

We link the VHS statistics with regional data on the county level, including the number of refugees in each county. We then identify the VHS' integration efforts in response to the refugee influx because refugees could not choose their place of residence. Instead, they were assigned to German counties based on quotas and pragmatic considerations related to the availability of group accomodations. We use a first-difference estimator for the years 2013 and 2016 to capture the causal effect of the newly arriving refugees on the course supply of VHS.

Our results show that VHS reacted quickly and strongly to the refugee influx. For example, interpreted at the mean, there was a growth of 62% in the absolute number of DAF courses. However, this remarkable expansion came at the cost of offering relatively fewer other courses. It therefore reflects a partial crowding out effect and at the same time illustrates a remarkable flexibility of VHS in reallocating their resources. It also shows that the overall resources in the adult education system are limited at least in the short-term, e.g., by shortages of qualified teachers, organizational resources, or space constraints. In addition, by exploiting pre-existing regional heterogeneities, we uncover inequalities in the ability to react to the refugee influx. Specifically, VHS that had more resources and/or more prior experience in organizing DAF courses scaled up their DAF course supply more strongly. This implies path dependency, as prior resources predict present results. If equal (learning) opportunities across regions are a societal goal, these inequalities of integration opportunities can be (interpreted as) problematic and something to be addressed by policymakers.

Chapter 4 – The Benefits of Adult Learning: Work-Related Training, Social Capital, and Earnings[5]

While the political enthousiasm for adult education and lifelong learning has been strong, causal evidence on its effectiveness and efficiency is relatively scarce. This is mostly due to the fact that participation in adult learning is – in contrast to compulsory school attendance – (mostly) voluntary. As a consequence individuals expecting to gain the most from it are the most likely to engage in it. These persons are not only ahead in terms of higher average earnings but also exhibit higher earnings growth prior to the participation in adult education. Thus, selection on earnings growth is very likely (Pischke, 2001; Heckman et al., 2018). This so-called *selection problem* has been discussed for decades in the realm of adult education (e.g., Verner and Newberry, 1958) but no satisfactory solution has been found yet. Existing studies, such as Büchel and Pannenberg (2004); Lechner (1999b); Muehler et al. (2007); Pannenberg (1997, 2008) or Pischke (2001) mostly use a fixed effects difference-in-differences (DiD) strategy, controlling for selection into the treatment based on the earnings level and prior earnings growth. Overviews on the effects of work-related training on labor market outcomes (wages

[5] This chapter has been published in the Economics of Education Review (Ruhose et al., 2019).

and employment; see, e.g., Coelli and Tabasso, 2019, and De Grip and Sauermann, 2012) come to mixed conclusions.

In addition to economic arguments, non-pecuniary benefits of adult education have attracted the attention of researchers (e.g., Field, 2011; Green et al., 2006; Portes, 1998) and policy makers (e.g., Education Council, 2006; Council of the European Union/European Commission, 2015; OECD, 2005, 2020; UNESCO, 2016). Participation in lifelong learning is supposed to increase social capital,[6] which in turn is said to foster economic prosperity. In this vein, the UNESCO (2020) also stresses the role of lifelong learning (and its benefits) in solving public good problems such as climate change. Some studies (Balatti and Falk, 2002; Bynner and Hammond, 2004; Emler and Frazer, 1999; Feinstein and Hammond, 2004; Preston, 2004a,b; Rüber et al., 2018) document a positive relationship between participation in adult learning and measures of social capital such as membership in civic groups, political interest, voting, social networks, and trust. However, this evidence is almost entirely based on descriptive and qualitative studies (Blanden et al., 2010; Schuller and Desjardins, 2011; Field, 2011; OECD, 2010) and thus cannot overcome the self-selection problem described above.

Chapter 4, co-authored with Jens Ruhose and Stephan L. Thomsen, contributes to the understanding of the benefits of adult education on a methodical and a topical level. As a methodical contribution, we address empirical challenges in the evaluation of wider benefits from work-related training by transferring a flexible econometric framework from the labor economics literature into the literature that evaluates wider benefits of adult education. The analysis is based on panel data from the German Socio-Economic Panel Study (SOEP, 2015) from 1992 to 2014. The SOEP offers detailed information on pecuniary and non-pecuniary outcomes, participation in work-related training activities, and a rich set of socio-economic background variables. We use these data in a five-step framework, with a regression-adjusted matched difference-in-differences approach (Heckman et al., 1997, 1998a; Smith and Todd, 2005a) and entropy balancing to refine conventional matching weights (Hainmueller, 2012; Hainmueller and Xu, 2013) at its core. The entropy balancing ensures exact balancing between the participant and non-participant groups not only on the mean but also on higher moments such as the variance of the covariates. This increases the matching quality considerably because it accounts for the fact that the participant group is a more homogenous selection of the population than the non-participant group. We thus improve upon existing approaches by combining the regression-adjusted difference-in-differences (DiD) matching approach with entropy balancing in a multiple event study setting.

As a topical contribution, we apply this framework to identify the effects of work-related training on measures of civic/political, cultural, and social participation – measures that are related to social capital at the individual level (Putnam, 1993). Our results show that

[6] While there is no agreed-upon definition of social capital, Scrivens and Smith (2013) characterize it as social connections and interactions, which have (productive) value. In the economy, those connections and interactions lead to social networks, norms of reciprocity, and mutual trust, which have the potential to improve the efficiency of society by facilitating coordination, collaboration, and cooperation (Putnam, 1993, 1995, 2002).

participation in work-related training yields positive non-pecuniary returns in the form of higher civic/political and cultural participation. These increases do not crowd out social participation. As a last contribution, we update estimations on the pecuniary returns to work-related training. Our estimation of approximately 5% wage growth on average confirms previous findings in the literature (Lechner, 1999b; Pischke, 2001; Büchel and Pannenberg, 2004). Closer inspection reveals that the realized labor market outcomes do not mediate the observed effects. We conclude that participation in work-related training affects structural social capital, potentially yielding beneficial externalities for societies (over and above direct training effects) in the long run. These effects arise mainly as a by-product of participation in work-related training because it is more plausible that workers and firms consider the improvement of individual productive capacity to be a first-order concern when taking up training. A heterogeneity analysis documents that the results are much stronger for women than for men. It further reveals that civic/political participation increases most strongly for an affluent group of individuals (highly educated, working in better-paying occupations), which limits the expectation that participation in work-related training improves the civic/political participation of the disadvantaged. This disparity may contribute to the persistence of social inequalities and therefore raise concerns about distributional effects.

Chapter 5 – Work-Related Training and Subjective Well-Being: Estimating the Effect of Training Participation on Satisfaction, Worries, and Health in Germany[7]

Besides societal engagement, participation in adult education can also yield other non-pecuniary benefits, such as increased job satisfaction (Burgard and Görlitz, 2014; Coelli and Tabasso, 2019; Feinstein and Hammond, 2004; Georgellis and Lange, 2007) or increased life satisfaction more generally (Jenkins, 2011). This is plausible: If an employee feels more competent or valued when participating, adult education could directly influence job satisfaction and/or overall well-being. Since higher levels of well-being and job satisfaction are frequently associated with higher levels of individual productivity (Bryson et al., 2014, 2017; Judge et al., 2001; Yalabik et al., 2013), these findings are also relevant for employers and society (although the direction of causation is not beyond dispute). Moreover, participation in adult education is also positively associated with (subjective) health or health behaviors (Balatti and Falk, 2002; UNESCO, 2016). This is in line with the broader finding that higher skill levels are associated with better health outcomes (Oreopoulos and Salvanes, 2011; Heckman et al., 2018). However, self-selection problems also plague the interpretability of these strands of literature.

Chapter 5, co-authored with Jens Ruhose and Stephan L. Thomsen, contributes to this debate by applying the methodology devised in chapter 4. We analyze whether participation in work-related training has effects on (self-reported) measures of satisfaction, worries, and health. It is plausible that worries negatively impact work performance and that engaging in a skill-building

[7] This chapter has been published in the Edition ZfE 7 (Ruhose et al., 2020).

activity like work-related training could help reduce worries. However, there appears to be no prior research on adult education and worries.

The analysis is based on the SOEP (2015) for the years 2002 to 2014 and employs the five-step framework outlined in Chapter 4. We find that work-related training substantially decreases worries but does not affect satisfaction or (subjective) health. Similar to chapter 4, a heterogeneity analysis reveals that a reduction in worries has a stronger effect on more privileged groups, namely white-collar workers and public servants (compared to blue-collar workers), university-educated employees (compared to employees with a vocational degree only), and workers in large firms (compared to employees of smaller firms). The results (again) indicate that work-related training can yield non-pecuniary gains as a by-product. However, these gains are unevenly distributed and accrue mostly to persons that are already well off, thus potentially reinforcing existing economic and social disparities.

Chapter 2

No Mental Retirement: Estimating Voluntary Adult Education Activities of Older Workers *

with:
Jens Ruhose
Stephan L. Thomsen

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2.1 Introduction

The OECD (2006, 2019) estimates that the working-age population will decrease substantially in many industrialized countries in the next decades. This development is mirrored by a strong population aging in many developing countries (Kapteyn, 2010; Lee and Mason, 2010). The resulting demographic shift may lead to skill shortages, which pose a serious threat to each country's welfare and prosperity (Brunello and Wruuck, 2021; Jones, 2020; OECD, 2017b). Thus, policies that are considered to help retain older workers in the labor market longer, e.g., increasing the retirement age and enabling more flexible retirement schemes, are high on the political agenda (OECD, 2017c). Since life expectancy has increased sharply for both men and women (OECD, 2019a), these policies–if successful–may also reduce the pressure of an aging society on public finances and economic prosperity (see, e.g., Attanasio et al., 2007; Börsch-Supan, 2000; Lee and Skinner, 1999; Maestas and Zissimopoulos, 2010; Wise, 2010). However, empirical evidence suggests that workers become less productive (relative to their salaries) as they age or that they at least suffer from employers' prejudice that they do so.[1] Many employers therefore seem to prefer younger workers over older workers in the production process (Maestas and Zissimopoulos, 2010).[2] To reinvigorate and update the skills and abilities of older workers, many countries and international organizations such as the OECD and the European Union are actively supporting and pushing adult education initiatives (OECD, 2005; Council of the European Union/European Commission, 2015). However, those initiatives can only be successful if older workers voluntarily engage in learning. That is, older workers must still have the general willingness to learn new skills and abilities—a proposition that may be rejected because the human capital model (Becker, 1962) predicts that human capital investment should be less likely when the payout period is short. Yet, the evidence on this subject is rather scarce.

In this paper, we analyze adult education activities in a population that is eligible to retire early due to a generous reform of the partial retirement (henceforth PR) legislation in Germany

[1] See, e.g., Kotlikoff and Gokhale (1992); Spirduso et al. (1995); Skirbekk (2004); Belbase et al. (2016); Hudomiet et al. (2018); and Lorenz et al. (2022). The number of days absent from work due to illness rise monotonously with age (BKK Dachverband, 2019, p. 69), thus increasing costs for the employer. Older workers may also completely drop out of the workforce for health reasons (Buslei et al., 2019). Moreover, older workers may worry about future job demands and may therefore stop working earlier (Hudomiet et al., 2021). At the same time, however, many studies find limited evidence for notable productivity declines, e.g., Börsch-Supan and Weiss (2016); Colonia-Willner (1998); Göbel and Zwick (2013); Van Ours (2009). In fact, De Grip et al. (2015) find that retirees face lower declines in their cognitive flexibility than those who remain employed, although other studies (see, e.g., Mosca and Wright, 2018) confirm that there are measurable cognitive declines in retirement.

[2] Studies on discrimination against older workers show that many firms prefer to hire younger workers if they can (see, e.g., Lahey, 2008; Johnson and Neumark, 1997; Neumark, 2018; Neumark et al., 2019). Moreover, some countries have enacted retirement policies that actively encourage early retirement to make jobs 'available' for younger job-seekers (Casey, 1996; Eichhorst et al., 2014); even though there is little empirical support for the assumed substitutability of older and younger workers (Böheim and Nice, 2019; Eichhorst et al., 2014; Wise, 2010).

in 1996.[3] The majority of workers benefiting from this reform have been male full-time employees, with their share of all PR contracts ranging from a maximum of 85% in 1996 to a minimum of 60% in 2008 (see Section 2.2). In contrast to the human capital model proposition, our results show that a large fraction of the affected cohorts voluntarily participated in adult education when they retired early. In the absence of financial and employer demand effects, which should no longer matter for this group, we argue that our findings provide some evidence for the notion that older workers are still willing to learn new skills and abilities.

Adult education is highly heterogeneous because activities differ in content, quality, and availability. Moreover, people have different perceptions of what constitutes an adult education activity. Thus, individual survey data on adult education activities are very likely affected by (nonclassical) measurement error and the regional availability of adult education opportunities. To avoid these issues, we use unique administrative data on adult education activities among all German adult education learning centers (*Volkshochschulen* in German, henceforth VHS) and their yearly reports (DIE, 2020; see Huntemann and Reichart, 2018, for the 2017 report). VHS are well known in Germany and constitute the most important supplier of adult education (Wittenbrink and Frick, 2018). Financed by public authorities and charging very low fees for courses, VHS have the mandate of providing sufficient adult education opportunities at the local level. In fact, most state constitutions in Germany require local authorities to provide sufficient adult education opportunities. Low participation costs and guaranteed course availability at the regional level ensure that there are almost no restrictions on the supply side of adult education. Moreover, even though VHS are autonomous in their administration, they coordinate activities at the state and federal level, which facilities the comparability of course offers across counties and over time. VHS offer courses in the areas of work-related training, languages, health, arts & culture, politics & society, and basic education. While we examine participation behavior in all areas, we focus on courses teaching work-related training (teaching mostly ICT skills) because these courses are cognitively demanding and teach skills that would have been also useful in the labor market. By contrast, other courses may be more associated purely with pursuing a hobby (e.g., culture-related courses) or courses that may have been taken for purely informational reasons (e.g., health-related courses). Moreover, we focus on West Germany because the adult education sector in East Germany (and the VHS in particular) underwent substantial reconstruction efforts after the German reunification in 1990. Moreover, the West German labor market is more stable and homogeneous than the East German labor market, which has had to cope with the consequences of socialism and reunification.

We use the VHS data to evaluate the effect of the 1996 PR reform on adult education activities. In principle, the aim of the reform was to limit the extent (and resulting costs) of

[3] In this study, we refer to *partial retirement* as the possibility of drawing a pension early while continuing to work part-time. Kantarci and Van Soest (2008, p. 114) refer to this as *gradual retirement*. They differentiate between two types of gradual retirement: *partial retirement*, which they define as "changing to a less demanding job with usually fewer hours and lower earnings" and *phased retirement*, which implies "reducing work hours in the same job". The reform that we study is consistent with the latter characterization of retirement.

the current system. Moreover, another goal was to permit retirement schemes that were more flexible than the early retirement schemes from the 1970s and 1980s. However, instead of promoting a gradual withdrawal from the labor market and extended working lives, the so-called "block model" of PR effectively enabled workers to retire up to five years earlier than the normal retirement age of 65 years (with three years being the most common duration) in exchange for a small reduction in their wages during their part-time work period and negligible deductions in their pensions afterward. The legislation was attractive for employers as well because they were able to reduce (on average) relatively well-paid older personnel (or substitute them for younger workers) in a socially acceptable manner without having to pay expensive settlements (Casey, 1996; Gatter and Hartmann, 1995; Schmähl, 2003). Due to the popularity of the block model, which aggravated skill shortages in the late 2000s, the federal government stopped supplemental payments to employers in 2009, which massively lowered program participation rates. From a policy perspective, the adult education activities of workers aged 55 to 64 years who were affected by the reform are particularly interesting because these workers constitute a pool of workers whom the aging society would like to retain in the workforce longer. In fact, it is likely that some fraction of them would have worked longer in the absence of the reform, i.e., they would still have been working during our observation period had the reform not occurred.

While the VHS data are comparable across regions and over time, they do not report the portion of individuals who are partaking in partial retirement schemes. However, because each VHS primarily caters to one small regional area (the county or city in most cases), we use the preexisting regional variation in the share of the affected population age group (i.e., men who are between 55 and 64 years old) at the county level to assess the potential uptake of adult education activities that is due to retirement reform. Using a generalized difference-in-differences approach, we estimate the effect of the reform on adult education activities by using the variation in the male population share that is between 55 and 64 years old across counties and over time for identification.[4] We thus take into account that the reform was biased towards older male workers instead of female workers (see Section 2.7.2 for a discussion). Conditioning on year and county fixed effects as well as on the time-varying age distribution of the county, the approach allows us to estimate an intention-to-treat (ITT) reform effect, which is not affected by the overall county-specific age structure.

Our results show that adult education activities increase substantially after the reform in relatively old counties, i.e., counties with a higher share of older men, than in relatively young counties, i.e., counties with a lower share of older men. The reform effect is most pronounced in work-related courses. However, we also find significant effects in language courses, which together lead to a significant increase in the overall participation share of older persons in VHS courses. By contrast, we do not find effects (or, at best, much lower effects) on adult education activities in other, less cognitively demanding course areas. Furthermore, event studies on the

[4] Similar kinds of generalized DiDs have been used by, e.g., Berlinski et al. (2009); Havnes and Mogstad (2011), and Sandner and Thomsen (2018) in the context child care reforms.

adult education activities of two separate affected cohorts show increasing participation only during the early retirement phase. This indicates that the results are not driven by other events that may have affected the adult education decisions of older workers over time. Moreover, the results are robust to including county-specific linear time trends and are not affected by outlier counties. Because of the generosity of the reform and the choice of predominately cognitively demanding courses, it is also very unlikely that selection into partial retirement, i.e., that only those with a high preference for enrolling in adult education or with a high preference for leisure, can explain the results.

Importantly, we do not argue that the participation of early retirees in work-related courses is *only* driven by the willingness to learn of the individual; the observed behavior could as well be driven by a consumption value of participating in adult education. We also do not know to what extent the willingness to learn applies in other context. However, our conclusion is more fundamental: people do not necessarily retire mentally when they get older. In fact, the early retirees also had a variety of other options how to spend the available time. For example, they could have stayed at home, traveled, and spent time with their grandchildren, respectively. They could have also participated in other courses with a much higher consumption value (for example, a pottery class). This interpretation is in line with findings from psychology that people feel most satisfied if they can pursue productive activities or projects (Sharif et al., 2021).

Our study complements a growing literature on the behavior of older workers, which has emerged in light of drastic demographic shifts. For example, some studies show that older workers are willing to work longer, especially when job schedules are flexible (Ameriks et al., 2020), and that older workers' willingness to compete is similar to that of younger workers' (Charness and Villeval, 2009).[5] While some overview studies suggest that more generous pension systems reduce the incentives for participation in training (Bassanini et al., 2007; Fouarge and Schils, 2009), the only evidence we have on adult education behavior of older workers close to retirement comes from participation behavior in continuous training activities in response to increases in the retirement age (e.g., Brunello and Comi, 2015; Montizaan et al., 2010). However, adult education behavior in these studies is most likely confounded by employer requirements and the financial restraints of the worker.

The paper proceeds as follows. Section 2.2 offers background information on the 1996 partial retirement (PR) reform in Germany. Section 2.3 presents some theoretical considerations, and Section 2.4 summarizes the related literature. Section 2.5 describes the system of the German adult education centers (VHS) and introduces the statistics of the centers before offering some descriptions and introducing the dependent variable. Our empirical strategy is laid out in Section 2.6. Estimation results are presented in Section 2.7, which also contains a number of robustness checks and a heterogeneity analysis with respect to the course

[5] In a related experimental study, Kovalchik et al. (2005) also document that the decision behavior of elderly people (average age 82) is not very different from the decision behavior of younger individuals (average age 20).

topics. Section 2.7 briefly highlights a potential long-term effect, and Section 2.8 concludes the paper.

2.2 Background

The German statutory public retirement insurance system is financed as a pay-as-you-go (PAYGO) scheme, which covers about 80% of the workforce.[6] In the relevant time period for this paper, the normal retirement age (NRA), that is, the lowest age at which a person can claim retirement benefits without any deductions, was 65 years. However, in principle, there are many pathways into early retirement, that is, claiming retirement benefits before reaching the NRA. Thus, only about 20% of men (Lorenz et al., 2022) and 40% of women (Börsch-Supan et al., 2021, p. 6) used this regular retirement pathway.

In this paper, we focus on the introduction of a partial retirement (PR) reform by the German government in 1996. The aim of this reform was to increase the average retirement age and to improve the low labor market attachment of older workers (Brussig et al., 2009; Huber et al., 2016; Wanger, 2009). Amidst a high and persistent unemployment (including high long-term unemployment) in Germany in that period, another aim of the PR reform was to encourage the recruitment of (young) unemployed workers as successors to workers in partial retirement (Huber et al., 2016, p. 1217). The PR reform was part of a larger pension reform, initiated in the year 1992, which aimed at limiting the exploding costs of the then very generous pension system. The pension reform also gradually increased the normal retirement age to the then 65 years and introduced a penalty for early retirement of 0.3% of pension claims per month. The reform was scheduled to be implemented from 2001 onwards, but due to the financial pressures on the public insurance system, the German government decided in 1996 to speed up implementation and start the phase-in of the reform from 1997 onwards (Lorenz et al., 2022).

Before the PR reform, the two main options used for early retirement were the *pension for the long-term insured* and the *pension after unemployment*.[7] To claim the former, a person needed to have at least 35 contribution years before a retirement at the age of 63 without any deductions was possible. For the latter, a person needed to have at least 15 qualifying periods[8] with at least 8 of them in the last 10 years before retirement. Then, people were able to retire without deductions at age 60 if they had at least 52 weeks of unemployment in the 18

[6] Most of those workers not covered are either civil servants or self-employed workers. See Börsch-Supan and Wilke (2004) and Börsch-Supan et al. (2021) for excellent overviews of the German pension system and its history.

[7] There were several reforms of the retirement system prior to 1996 (see footnote 6). The first reform was implemented in 1972 in reaction to mass unemployment. By enabling employees to effectively retire at the age of 59 instead of 65 without any deductions (Gatter and Hartmann, 1995, p. 413), the reform lead to the (to date) most radical shortening in retirement age in the developed world (Börsch-Supan, 2015) and a massive increase in the number of early retirees (Börsch-Supan and Schnabel, 1998).

[8] A qualifying period includes years of mandatory insurance contributions from working as well as unemployment spells and (to some degree) times of parental leave. Approximately 85% of all workers insured in the public pension system fulfilled these eligibility criteria (Lorenz et al., 2022).

months before retiring. Because unemployment benefits for older employees were paid for up to 32 months, qualifying employees effectively could stop working with 57 years and 4 months (Schmähl, 2003, p. 579). Notably, this early retirement pathway had the same entry conditions as those for entering partial retirement (Lorenz et al., 2022), but it appealed to those who were unemployed while the partial retirement pathway was set for currently employed workers.

The PR reform was implemented by collective bargaining agreements, which outlined the terms for PR contracts on a sectoral basis.[9] Employers and employees could enter into a PR contract if the employee was at least 55 years of age, i.e., ten years before the NRA. In principle, the employer and the employee were free to negotiate a flexible duration of the contract. However, few contracts actually lasted longer than six years (Wanger, 2010, p. 196) because the employer had the option to receive subsidies for topping up the part-time salary for some contracts with a duration of a minimum of two and a maximum of six years from the Federal Employment Agency (FEA). Specifically, the FEA would take over the supplemental payments if an unemployed person or a young job-seeker was hired to replace the worker with a PR contract after retirement.[10] Moreover, the supplements were exempt from taxes and social security contributions if the employer paid them herself. After the contract expired, the employee had to be granted the option to fully retire (prematurely) if he was at least 60 years of age (Berg et al., 2020; Brussig et al., 2009; Wanger, 2010). In general, PR contracts were highly attractive for many firms because they enabled the firms to release older employees in a socially acceptable manner, while avoiding expensive settlements and saving taxes on the portion of the remaining salary they paid (Brussig et al., 2009; Wanger, 2009).

The supplemental payments also made the offer attractive for many employees, and even more attractive than the alternative retirement after unemployment. First, employees received approximately 70% of their prior net salary, which was higher than unemployment assistance.[11] Second, the pension contributions in PR were set to 90% of the employee's former contributions. This was also considerably more than the contributions acquired during unemployment, which increased the value of the pension payments in retirement (Huber et al., 2016, p. 1222). Third, PR contracts covered a longer period than unemployment insurance. Lastly, as Hetschko et al. (2014) point out, being unemployed comes also with non-monetary costs. Unemployed persons do not correspond to the social norm that able-bodied persons of working age should be employed. This lowers the life satisfaction of unemployed persons substantially. Choosing a PR contract instead of the unemployment retirement pathway solved

[9] Even before the PR act was passed, a number of collective bargaining agreements, e.g., in the insurance and banking sector or the chemical industry, already included early retirement options similar to PR (Schmähl, 2003). However, they were hardly used because their conditions were less attractive (Lorenz et al., 2022).

[10] For smaller companies with a maximum of 50 employees training an apprentice instead ensured the employer's exemption from the supplemental payments. Wanger (2009) reports that subsidized PR contracts constituted approximately 35% of all PR contracts and that the subsidies of the FEA were substantial. The cumulative expenses from 1996 to 2007 amounted to 7.2 billion euros.

[11] The high net salary was facilitated by progressive income taxation. Berg et al. (2020, pp. 1228-9) show that the negotiated supplements even exceeded these numbers in many industries.

this problem and made retiring early more attractive for people who are sensitive to the norms of social roles.

To understand the empirical strategy used below, it is important to understand that two kinds of PR models were available: The first model consisted of part-time work during the entire period of the contract. In the second model – the so-called *block model* – people worked full-time for the first half of the contract and were granted a leave of absence in the second half.[12] In the first few years, prior to 2002, the part-time model was more widespread. This is also due to the fact that few collective bargaining agreements included the PR option from the 1996 reform before 1998 (Berg et al., 2020), which also explains the slow uptake. However, by 1999, 349 agreements covering approximately 13 million workers were in place.[13] In the large-scale negotiations preceding these agreements, employers and employees in many (male-dominated) industries agreed that they wanted to implement the block model (Wanger, 2009).[14] As a consequence, when the collective bargaining agreements were fully implemented after 2002, the block model gained popularity very quickly, and the overall number of PR contracts increased substantially (see Figure 2.1 as well as Berg et al., 2020, pp. 1233-1234). Consequently, PR contracts based on the block model constituted over 85% of all PR contracts in 2005 and almost 90% in 2008 (Federal Employment Agency, 2012). The average (and median) contract duration rose considerably from 2002 to 2007 (see Wanger, 2009). While approximately 50% of all contracts ran for less than three years in 2002, the share of these short-run contracts declined to less than 6% in 2007. By contrast, the share of contracts of at least five years grew from 22% to 61% in the same period.[15] Moreover, data from both the Federal Employment Agency (e.g., Wanger, 2010) and the German Pension Insurance Fund (DRV, 2020) show that the majority of PR workers, i.e., workers in partial retirement, were men (with the share of male workers in PR contracts ranging from a maximum of 85% in 1996 to a minimum 60% in 2008).

Figure 2.1 shows the roll-out of the PR reform over the years. We consider the situation of male workers in West Germany only because the adult education sector in West Germany was much more stable than that in East Germany, which experienced substantial restructuring after the fall of the Iron Curtain in 1989 (see Appendix A.1 for the history of VHS in Germany). The gray bars in Figure 2.1 show the development of the absolute number of male workers in PR (left scale). The number rises from zero in 1995 to 260,000 in 2006, where it stagnates

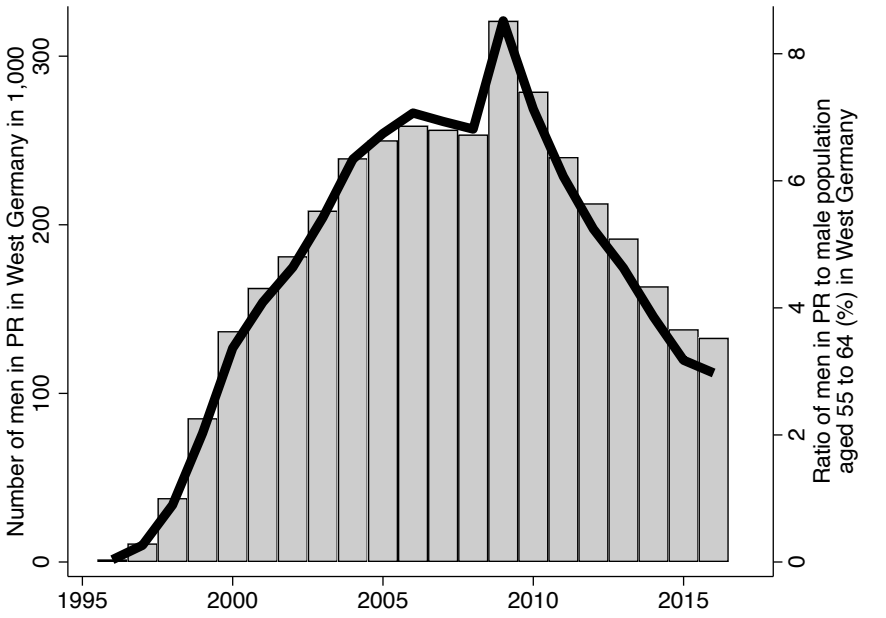
[12] From 1996 to 1999, individuals had to work at least 18 hours per week after reducing their working time by half in order to be eligible. In 2000, the program was extended to persons who worked part-time before entering PR.

[13] Berg et al. (2015, Appendix Table A2) show that a number of collective bargaining agreements limited the number of PR contracts to 5% of the workforce.

[14] Wanger (2010, figure 5) shows that in 2007 more than half of all workers in PR came from the public sector or the manufacturing sector. As a share of all workers aged 55 to 64 years within a given industry, energy and water companies had the highest share (44%), followed by the public administration and the banking and insurance sector (36% each). Wanger (2010, table 4) shows that there was no typical PR job, i.e., no single job dominated in PR contracts, although white-collar jobs were over-represented.

[15] Appendix Figure A-1 presents information on the distribution of the durations of PR contracts that were subsidized by the FEA between 2002 and 2007 based on Wanger (2009, p. 5).

Figure 2.1: Male Workers in PR



Notes: The figure shows the utilization of PR over time. Left scale: gray bars refer to the absolute number of male workers in PR. Right scale: black solid line reports the share of male workers in PR as a fraction of the 55 to 64 year old male population. All numbers refer to West Germany. Due to a time series break data are only available until 2016. Sources: destatis, Statistics of the German Pension Insurance Fund (DRV), authors' own calculations.

for two years, and then jumps to over 320,000 in 2009 (the last year of program entry) before falling to just above 130,000 in 2017. The corresponding share of male PR workers in the 55 to 64-year old male population is marked by the black line (right scale).[16] It rises from zero to approximately 7.1% in 2006 before stagnating for three years and then reaching its peak of approximately 8.5% in 2009. Finally, it falls to approximately 3.0% in 2016.

Fewer persons were entering the workforce and life expectancy was increasing, both of which reinforced a growing shortage of workers and an increasing deficit in pension insurance funds. As a consequence, the government decided to reduce the generosity of the FEA-sponsored components (see Federal Employment Agency, 2008, and Huber et al., 2016, for details) until the FEA stopped granting new supplemental payments for PR contracts starting after 2009. Because this change greatly reduced the attractiveness of the program, the stock of workers in PR dropped steeply to slightly over 130,000 in 2017, indicating that far fewer new contracts were made. Today, the PR legislation remains in force. Thus, employers and employees can still enter into a PR agreement. However, the employer can no longer claim direct subsidies or tax cuts, which strongly limits the attractiveness of offering PR contracts for the employer.

[16] Note that we use the *population* share and not the share in *employees* because of endogeneity issues. Wanger (2009, pp. 3-4) and Brussig et al. (2009, p. 5) use the share of PR workers in employees and arrive at numbers that are more than twice as large as ours.

2.3 Theoretical Considerations

In this section, we derive a theoretical prediction about the relationship between the PR reform and its expected effect on voluntary adult education activities of older workers. In general, the passive phase of the block model granted more available time to early retirees, which could have been spent in different ways. On the one hand, the early retiree may have spent the available time on activities such as part-time work to earn additional income,[17] childcare for grandchildren, volunteering in social service activities, and adult education activities. On the other hand, early retirees may have chosen more leisure-oriented activities such as traveling, recreation, socializing, sports, and the like. The mixture of these activities is arguably primarily a matter of individual preferences because employer and financial demands should matter much less at this point in life. Thus, we may observe that the PR reform increased the share of older people active in adult education activities if the reform attracted workers with a relatively low preference for leisure and a relatively high preference for staying productive and completing meaningful tasks.[18]

Because PR was very attractive for firms and the retirement option was written in most collective bargaining agreements, the decision to go into partial retirement was mainly due to the individual worker. To show that the reform may have pushed workers into early retirement that would have been stayed on in the labor market in the absence of the reform, we provide a simple illustration for choosing the optimal retirement age in Figure 2.2. The decision is based on the discounted future labor and retirement income and the preferences regarding household time (leisure) and consumption possibilities that are increasing in income (see, e.g., Ehrenberg and Smith, 2005, pp. 225-229, for a standard textbook treatment of optimal retirement decisions). Because PR was only accessible for employed workers, we abstract from retirement out of unemployment and illustrate the retirement decision of two hypothetical workers who are both 59 years old at the time when they decide the age at which to retire. The chosen age cutoff corresponds to the most demanded PR block model plan. This plan spans a total of six years, with full-time work continuing at the ages of 59 to 62 years (active phase) and early retirement beginning at age 63 (passive phase). The solid black line illustrates the discounted lifetime income. It is increasing in the retirement age because the workers receive their fulltime wages

[17] Note that this option was limited because employees in subsidized contracts were not allowed to earn more than the marginal earnings threshold (*Geringfügigkeitsgrenze*) defined by Chapter 4 of Social Code Book XII (see §5 AltTZG). This corresponded to 400 Euro until 2013 and 450 Euro afterward. Employees in non-subsidized contracts had to follow the rules lined out in the contract, often the sectoral agreement. Second jobs were usually possible but had to be negotiated with the employer.

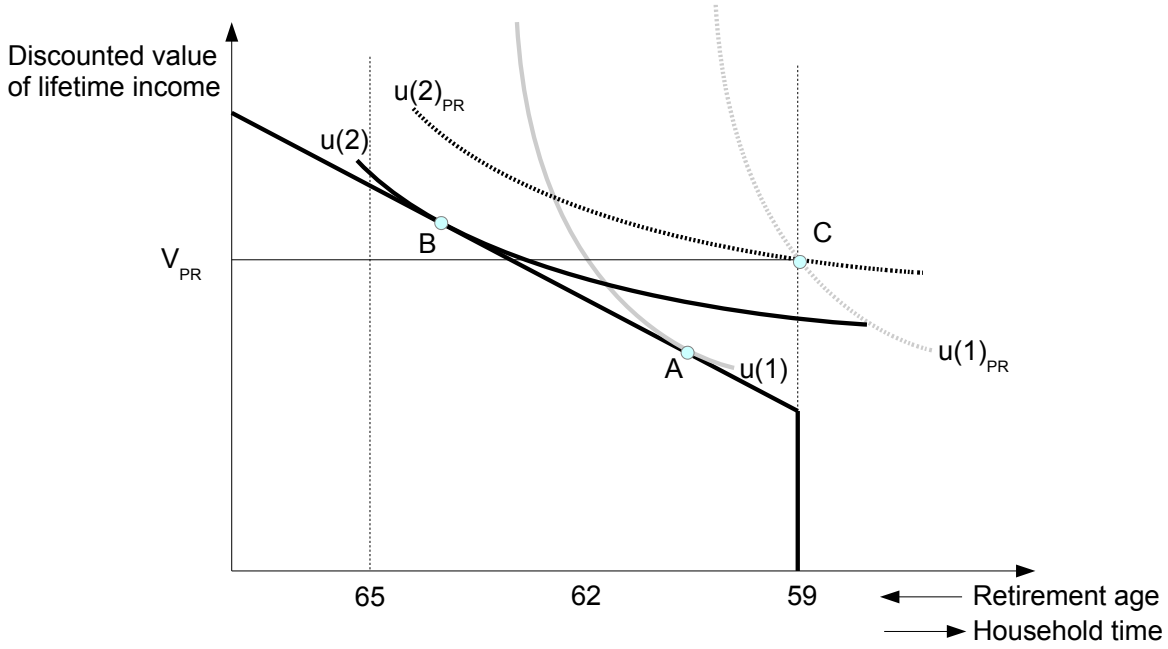
[18] Consistent with this prediction, Burkhardt and Schupp (2019) document, based on the German Socio-Economic Panel (SOEP), that the "generation of 1968", which they define as born between 1941 and 1954 and which largely overlaps with the generation analyzed in this paper, has so far been the most active retired generation around and after retirement. Similar observations have been made for the United States, where Ameriks et al. (2020) show that many retirees express a strong willingness to work and that this willingness increases significantly if working hours can be chosen flexibly. This argument is strenghtened by the observation that those sectors with high PR rates (see footnote 14) also have above-average participation rates in non-formal continued education (see, e.g., Dummert, 2018, table 23a).

for more years and deductions from the pension payments are smaller if retirement is delayed. For simplicity, we assume that both workers face the same budget constraints.

However, we also assume that both workers differ in their preferences regarding leisure and income. Worker 1 has a relatively high preference for leisure time and would therefore choose to retire rather early (point A). By contrast, worker 2 has a relatively high preference for consumption and would therefore choose to retire rather late (point B). Those differences in preferences may be explained by a variety of reasons. For example, research shows that economic preferences depend on the cognitive abilities and (to some extent) on the personality of the individual (Almlund et al., 2011; Thiel and Thomsen, 2013; John and Thomsen, 2015). We also suspect that some workers derive a strong sense of meaning or identity from their work or, at least, from some aspects of it. Other workers may experience strong enjoyment from their work or any kind of productive activity (Sharif et al., 2021). There is also suggestive evidence that work involvement and job satisfaction on the employee side (Topa et al., 2009) and high-involvement work practices on the employer side (Jiang et al., 2021) diminish retirement intentions of older workers. In addition, Hetschko et al. (2014) point out that conforming to the social norms of working while of working age has a high utility for many persons as well. These reasons, together with the possibility of socializing with coworkers, are important for approximately 90% of all working retirees in Germany (Anger et al., 2018). In each of these cases, some workers attach a non-monetary consumption value to doing their work. While increasing lifetime income is certainly an important driving factor for why worker 2 chooses a later retirement age than worker 1, we can expect that the non-monetary consumption value from working, i.e., performing productive tasks or conforming to social norms, is also important for understanding differences in the desired retirement age.

As described above, the PR reform offered workers the option to retire early with almost no deductions on pension payments, while working only 50% of the time on average and receiving approximately 70% of their net wages. Thus, the discounted lifetime income associated with a PR contract is somewhere between the lifetime income the worker would have received by retiring very early (and experiencing high deductions on pension payments) and the lifetime income of working until the legal retirement age. The present value of the PR contract is depicted in the figure by V_{PR}. At this present value, workers 1 and 2 both find it optimal to use the early retirement option (indicated by higher indifference curves going through point C). Because of the high leisure (low consumption) preference, we can expect that worker 1 would prefer to enjoy (unproductive) leisure time as soon as possible. By contrast, worker 2 would otherwise have worked for more years voluntarily because of a relatively lower preference for leisure (higher preference for consumption). Hence, the prediction of this very simple illustration is that some PR workers also remain engaged in productive activities such as adult education in the passive phase of retirement.

Figure 2.2: Illustration of Optimal Retirement Age



Notes: The figure shows an illustration of the optimum retirement age if agents are free to choose their retirement age. Present values are expressed for a hypothetical worker as of age 59. $u(1)$ and $u(2)$ represent indifference curves for household time (leisure) and income (consumption) for two workers with heterogeneous leisure-consumption preferences. Source: Authors' own illustration.

2.4 Related Literature

There are a few studies investigating the relationship between the retirement system and adult education. Early overview articles on European countries by Bassanini et al. (2007) and Fouarge and Schils (2009) found that the participation of older employees in training is lower when the pension system is more generous, although these studies do not claim to identify causality.[19] Montizaan et al. (2010) examine a pension reform in the Dutch public sector and show that a later (expected) retirement age leads to higher training participation rates for affected workers in large organizations. Brunello and Comi (2015) study how an increase in the *early retirement age* (ERA) from 50 to 57 years in Italy has influenced the participation of the affected age group in training. They find a 9% increase in training rates following a one-year increase in the ERA. At the same time, they note that the observed population is only in their mid-fifties and it is not clear whether this effect persists at higher ages. Gohl et al. (2020) examine a shift in the ERA from 60 to 63 years for German women born after 1951, which affected women retiring after 2011. They estimate that the incidence of training for the affected cohort increased by approximately 2.5 to 5 percentage points (depending on the specification), which corresponds to an increase of 20% to 30%. Bauer and Eichenberger (2017) study a Swiss reform of the *normal*

[19] Looking from the other direction, Stenberg et al. (2012) detect no effect of adult education on the timing of retirement, whereas Picchio and van Ours (2013) find that older workers who receive training are more likely to remain employed.

retirement age for women from 63 to 64 years and find a positive effect on training participation. However, these studies look at participation in training and adult education activities when the individual is still part of the workforce. Thus, the (intrinsic) willingness of the worker to learn cannot be disentangled from economic benefits and employer demands. In our paper, we study participation behavior in adult education *after* retirement, i.e., when the benefits of training can no longer be realized in the workplace.

Looking at the labor market effects of our PR reform, two studies find supporting evidence for PR increasing the lifetime employment duration. Berg et al. (2020) investigate how the program influenced part-time employment and retirement between 1999 and 2004. They use linked employer employee data from the Institute for Employment Research and find that the policy increased men's working life by 0.6 years and women's by 1.1 years on average.[20] Using the same data source, Huber et al. (2016) examine the effects of PR on labor market participation, employment, and tenure. Looking at the firms that started to offer PR contracts between the years 2000 and 2002, they find that workers aged between 51 and 60 years spent an average of 6 to 9 months more in part-time employment if their firm offered PR contracts. This, however, did not affect the length of working life in West Germany. Instead, Huber et al. (2016) find that elderly employees who likely would have opted for unemployment before retirement in the absence of PR chose to exit the labor market via the PR block model when it became available. For East Germany, PR showed some positive effects on the labor market attachment of older employees.

In general, Haan and Tolan (2019) show that the effects of partial retirement on labor market outcomes depend on the institutional setting. Thus, it is interesting to look at the effect of early and partial retirement on labor market outcomes in other countries. In descriptive studies across various European countries, Aranki and Macchiarelli (2013) and Been and van Vliet (2017) find a mostly increasing labor supply of older workers if the country's retirement and pension legislation allows for more flexible arrangements. Wadensjö (2006) and Sunden (1994) confirm this finding for Sweden. However, a large number of studies document negative effects (or, at best, no effects) on the labor market attachment and/or working hours of older workers in the presence of partial retirement options. This indicates that most workers substitute part-time work for full-time work. Among these studies are those by Graf et al. (2011) for Austria, Albanese et al. (2020) for Belgium, and Elsayed et al. (2018) for the Netherlands. Ilmakunnas and Ilmakunnas (2006) find no effects for Finland, and Kyyrä (2015) adds evidence that restricting (rather than extending) early retirement routes increases total working life. Hermansen (2015) finds no effect of the availability of partial retirement options on the retirement age in Norwegian firms and Røed and Haugen (2003), Bratberg et al. (2004), and Vestad (2013) estimate that two out of three Norwegian pensioners would have worked longer

[20] Berg et al. (2020) exclude all years after 2004 because during this time, PR was reformed in the course of the Hartz III legislation. The Hartz reforms dramatically changed the retirement behavior in Germany. (However, our event studies show that this does not affect our results.) As a consequence, there is only a small overlap with the period analyzed in this paper.

in the absence of national early retirement legislation. Since Portugal offers no distinct early retirement program, Machado and Portela (2014) look at voluntary reductions in working hours among Portuguese employees in 2006 and find they are associated with early exits from the labor force.

Finally, our paper is also related to studies that examine reforms of the ERA and the NRA. Existing studies mostly agree that a higher ERA, i.e., an increase in the lowest age at which a person can enter retirement, leads to longer working lives. Among them are Geyer and Welteke (2021) for Germany, Staubli and Zweimüller (2013) and Manoli and Weber (2016) for Austria, Cribb et al. (2016) for the United Kingdom, and Atalay and Barrett (2015) for Australia. An exception is the Norwegian pension reform of 2011, which disentangles the claiming of pensions from the decision to exit the workforce. Examining this reform, Brinch et al. (2015) and Hernæs et al. (2016) find that a sizable fraction of the affected employees keep working after claiming their pensions at the earliest possible claiming age once the earnings test is removed. This was confirmed by Andersen et al. (2021), who show that this leads to a 42% increase in hours worked at the early retirement age.

Studies analyzing reforms in the NRA mostly support these findings. These studies, among them Mastrobuoni (2009), Behaghel and Blau (2012), Hanel and Riphahn (2012), and Lalive and Staubli (2015), mostly find strongly positive labor market effects, i.e., raising the average retirement age induces many people to work longer. However, there are also a few studies indicating no effects for some groups. For example, Puhani and Tabbert (2016) found no effects for repatriated ethnic German workers, a relatively low-skilled group with low labor market attachment. Another exception is the study by Lorenz et al. (2022). It argues that raising the NRA in the course of the 1996 retirement reform in Germany did not lead to longer working lives because employers pushed employees into bridge options. The increasing length of the average work life in response to increases in the ERA and the NRA may also be explained by a strong signaling effect regarding the question of which retirement age is deemed socially acceptable (Seibold, 2021). If it would be impossible for workers to work longer, e.g., due to poor health, they would quit their jobs and pursue disability pensions (see, e.g., Börsch-Supan et al., 2018 or Andersen et al., 2021). Hence, it seems that health limitations are, on average, no major obstacle for longer working lives.

Given that many workers still retire before the normal retirement age, there has been surprisingly little research on how early retirees use the additional leisure time when they would otherwise be working. There are only a few studies looking at the time-use patterns of retirees in general, without making a distinction between early and regular retirees. The results by Insler (2014) suggest that retirees in the United States may invest more time in practicing healthier habits. This finding is supported by Grøtting and Lillebø (2020) who document positive health effects of retirement in Norway, at least for people with a low socioeconomic status. Picchio and van Ours (2020) add potential positive mental health effects for married men, which they link to more time available for socializing and thus less loneliness. However, the effect reverses

for single men. Moreover, even at higher ages, retirees might still invest in learning. Hsu (2016) shows that women in the United States acquire financial literacy skills as they approach widowhood, which can be explained by the expected collapse of the intermarital division of work.

In summary, even though retirement programs and legislation differ across countries, a key insight from all studies is the importance of incentive effects: If older workers receive a financial benefit from investing in their human capital, they invest. This is the case even at older ages. If employees are given a financially attractive option to leave the workforce early, many of them will take that option. However, there is no study that identifies a willingness to learn new skills that is not potentially driven by financial restraints and employer demands.

2.5 Adult Education in Germany

2.5.1 Adult Education Centers

After WWII, most German states included a guaranteed provision of adult education at the local level (city or county) in their constitutions.[21] To meet this legal duty, almost every local authority runs at least one public adult education center (VHS, *Volkshochschulen*). This is why VHS are the most important nonprofit supplier of public adult education in Germany (Wittenbrink and Frick, 2018; Deutscher Volkshochschul-Verband e. V. (DVV), 2019).

For our study, we use administrative data from the *Statistics of the German Adult Education Centers* (VHS statistics, *VHS-Statistik*; DIE, 2020) on adult activities coming from the full sample of VHS and their yearly survey, which is provided by the German Institute for Adult Education (DIE, 2020).[22] The VHS statistics offer harmonized data from 1987 onwards for West Germany (and from 1991 onwards for East Germany) and cover aspects such as the number of courses, hours taught, course topics, gender and age of learners,[23] budget and budget structure, staff, and freelance teachers for each VHS in each year. The VHS have offered an average of approximately 7 courses per 1,000 inhabitants for years (see Figure A-2). This corresponds to over 590,000 courses in total per year and is almost five times as many courses as the next largest supplier (labor unions and churches), which offered 1.4 courses per 1,000 inhabitants (Wittenbrink and Frick, 2018).[24] On average, there are 11 participants per VHS course, and this number has been highly persistent across the years (Huntemann and Reichart, 2018, p. 13). At an average of 7 courses per 1,000 inhabitants, this implies that 7.7% of inhabitants (can) participate in VHS courses. Because we cannot identify individuals in the

[21] Appendix A.1 provides details on the long history and legal basis of VHS.

[22] See https://www.die-bonn.de/weiterbildung/statistik/vhs-statistik/default.aspx?lang=en&. The latest developments are summarized in yearly reports; see, e.g., Huntemann et al. (2020).

[23] The VHS statistics list age group and gender separately before 2008.

[24] While these numbers refer to nonformal activities, i.e., organized that does not necessarily lead to a certificate, we do not cover informal learning activities (e.g., reading newspapers and magazines, having discussions), which are not formally organized in any way.

data and the same individual may participate more than once (e.g., in different courses during one semester or in the same course in consecutive semesters), we refer to "participations" rather than "participants".

VHS exist in almost all 401 German counties.[25] Many counties, especially those covering a large geographic area, are home to more than one VHS, leading to a total number of almost 900 independent VHS. Using community identification numbers (*Amtlicher Gemeindeschlüssel*), we map each VHS to its respective county. We consider the foundation of new VHS and the merger or division of existing VHS. Even though VHS are mostly directly or indirectly controlled and administered at the local level, their curricula are comparable across VHS and over time since they coordinate their activities at the state and federal level. Because VHS are highly subsidized (on average, over 35% of their revenue consists of public subsidies; Huntemann and Reichart, 2017), tuition fees for VHS courses are very low. In 2017, regular tuition fees averaged €75 for a course lasting ten to twelve weeks or approximately €25 per month for 90 minutes a week (authors' own calculations). On a monthly basis, tuition fees thus constituted just above 1% of the monthly median income of a German employee.[26] Further subsidies are offered for unemployed persons and those with a very low family income.

The available courses cover a wide variety of topics in the areas of work-related training, languages, health, arts & culture, politics & society, and basic education. Table 2.1 lists examples of courses that are offered in the different course areas and their relative shares in the respective subfields. *Work-related* courses consist mostly of courses on information and communications technology (ICT) for different purposes (e.g., basics, advanced, commercial, technical). The second most important subarea are other office-related skills such as accounting or organization and management. The rest are either industry-specific trainings or classified as "other" courses. *Language* courses are a variety of language training courses at different proficiency levels. *Health* courses cover mainly topics such as autogenic training, mobility training, and yoga and, to a lesser extent, lectures or workshops on diseases and cures. Courses on *arts & culture* are rather diverse and cover areas such as literature, crafts, and music. The area of *politics & society* includes courses not only in the social sciences and humanities but also in the natural sciences and geography. Finally, a small number of VHS activities are devoted to basic education. Figure 2.3 shows the proportion of course areas over time. The figure shows that the distribution remained relatively stable; only health courses grew in popularity, mostly at the expense of arts & culture courses.

The unique position of VHS in Germany helps us to overcome two challenges in evaluating the effect of the PR reform described above on adult learning. First, retirees may have a variety of opportunities to engage in learning activities. However, the choice of activities actually pursued and the associated intensity strongly depend on the available options, i.e., the supply

[25] This number includes free cities that do not belong to a county. For simplicity, we refer to both as counties.

[26] The estimated median net income of a German employee was equal to €20,053 per year or €1,671 per month in 2014 (Krause et al., 2017).

side of adult education. For example, not everyone lives close to a university and is thus able to enroll as a guest student.[27] In addition, the adult education options offered by private training institutions may be limited, especially in smaller towns and rural areas, are more costly than those offered by VHS, and may only be open to individuals who are still working. Second, relying on survey and administrative data for this research question is problematic because of the low observation numbers of retirees in many surveys and missing details on adult learning activities in administrative data.

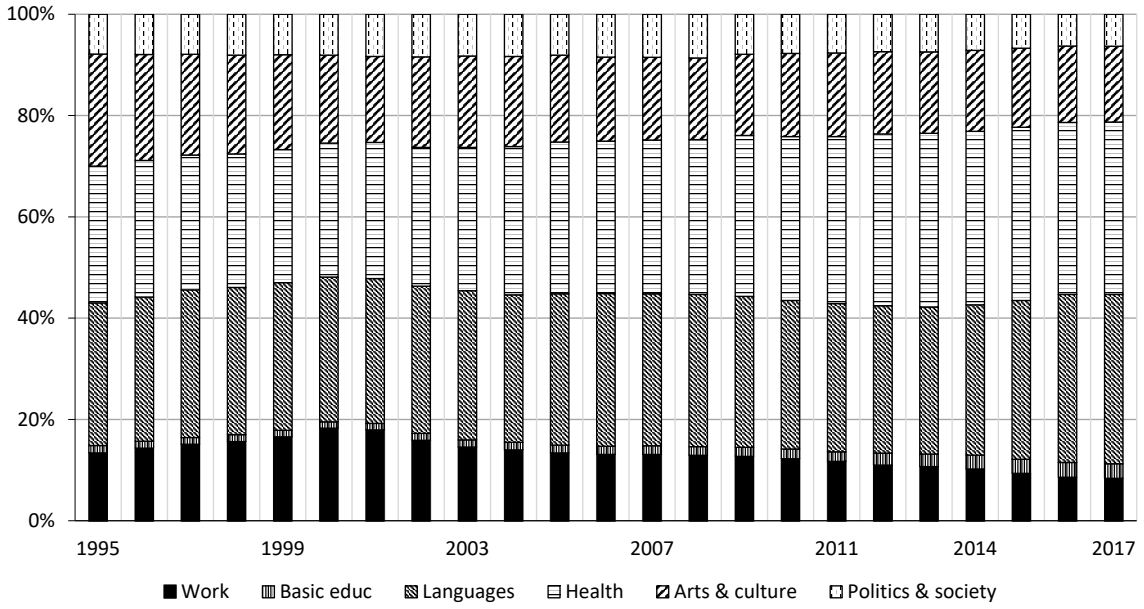
Table 2.1: Courses in Different Course Areas

Course area	Examples of courses offered	Share
Work	a) ICT skills	63%
	b) Other office-related skills (accounting, organization & management)	18%
	c) Industry-specific trainings (commercial, technical, other)	7%
	d) Other	13%
Languages	a) English	32%
	b) Other European languages	39%
	c) Other languages	6%
	d) German as a foreign language	23%
Health	a) Relaxation (autogenic training, mobility training, yoga)	71%
	b) Diseases & cures (addictions, diet, (alternative) medicine, first aid, nursing, psychosomatics)	19%
	c) Other	10%
Arts & culture	a) Arts & crafts (theater, drawing & printing, visual arts)	51%
	b) Music (music, dance)	29%
	c) Literature & media (literature, media, art history)	14%
	d) Other	6%
Politics & society	a) Social sciences (consumer issues, economics, history, law, political science, sociology)	52%
	b) Humanities (pedagogy, philosophy, theology)	16%
	c) Natural sciences & geography (biology, chemistry, physics)	4%
	d) Other	28%
Basic education	a) Preparation for school-leaving examinations	50%
	b) Literacy courses	38%
	c) Other	12%

Notes: The table shows the main categories and examples of courses offered in the different course areas in the VHS. *Share* refers to the share of each topic in the respective course area and is averaged over the period 1995-2017. Source: VHS statistics, authors' own calculations.

[27] The number of guest students aged between 55 and 64 is not available for all states as a time series. In states that published numbers, these are negligible. This probably reflects the higher effort and commitment that comes with enrolling.

Figure 2.3: Share of Different Course Areas over Time



Notes: The figure shows the (relative) development of the different course areas in West Germany between 1995 and 2017. Source: VHS statistics, authors' own calculations.

2.5.2 Data and Descriptions

The VHS statistics provide data on course participation for different age groups: below 18 years, 18 to 24 years, 25 to 34 years, 35 to 49 years, 50 to 64 years, and over 64 years. Since the partial retirement reform targets older workers close to retirement, we focus on participations in the age group of 50 to 64 years. Moreover, we concentrate on adult education activities in work-related courses for three reasons. First, these courses are similar to the courses employers require to update the skills of (older) employees (e.g., ICT training to become familiar with modern communication and computer equipment). In fact, the VHS often offer these courses on behalf of external clients such as local companies or the local branch of the federal employment agency (Huntemann and Reichart, 2018, p. 19). Second, compared to other courses, these courses are cognitively demanding. Thus, it is more likely that individuals who choose courses in this area do so because they want to learn new skills and techniques that they can apply in their daily lives. By contrast, courses in other areas have a much higher leisure aspect (such as language training for their next holiday abroad). This may explain why health-related and language courses are much more popular than work-related courses (see Figure 2.3). Third, if an individual is still participating in the labor market, investing in these skills would potentially yield an economic payoff.

Panel A of Table 2.2 shows the summary statistics of the VHS data. Due to data availability of regional control variables (see below), we cover the period from 1995 to 2017 and have valid observations for 318 West German counties. Our baseline analytical sample consists of 6,811

county-year observations (6.9% missing county-year observations).[28] The table shows that on average 2,797 VHS participations of 50 to 64 year olds (SD: 2,680) took place over all course areas, and that 238 participations of 50 to 64 year olds (SD: 239) took place on average in work-related courses.[29] In relative terms, the participations of 50 to 64-year-olds account for 23% of all VHS participations over the entire sample period. In the area of work-related courses this share is very similar at 21%.

Panel B of Table 2.2 provides summary statistics of all regional variables used in the main analysis at the county level.[30] Information on the age composition of the population in each county comes from the Federal Statistical Office (destatis) from 1995 onwards and is available in 5-year intervals. The age composition of each county is an important determinant of the participation share engaged in adult education. Thus, the data availability on this variable defined the earliest starting point for the analysis. Moreover, we include other information, which likely influences both the propensity to engage in adult education and the provision of adult education, namely, GDP per capita, the percentage of unemployed persons in the general population (provided by the FEA), the share of foreigners, and the population density (both BBSR).

In Figure 2.4, we use a box plot to illustrate the variation in the work-related participation share in the 50 to 64-year age group across counties for each year. The median share starts out at approximately 8.3% in 1995 and grows steadily to over 29% in 2017. Although there is considerable variation across counties, the upward trend is clearly discernible. The development of VHS participation shares is different for the neighboring age groups (see Appendix Figure A-3). The participation share of 35 to 49-year-old persons follows an inverted u-shape over time, fluctuating between median shares of 30% and 39%. The participation of persons over 64 years of age grows over time from a median of approximately 1% to almost 17%, although the variance across counties is large. However, the growing participation share of 50 to 64-year-old persons cannot be explained by a growing population share (see top panel of Appendix Figure A-4). In contrast, the fluctuations in population shares are quite similar to the VHS participation shares of the neighboring age groups (see center and bottom panels of Appendix Figure A-4).

[28] Missing information is mainly due to VHS that do not report data for every course and every year. However, the missing values are evenly distributed across years and states without any clear pattern.

[29] The average county in our sample registers approximately 1,610 VHS courses with a standard deviation (SD) of 1,382 courses. On average, there are 210 work-related courses per VHS, with a SD of 195. As for the county population, we observe that the VHS offer 8.4 total courses and 1.1 work-related courses per 1,000 inhabitants on average.

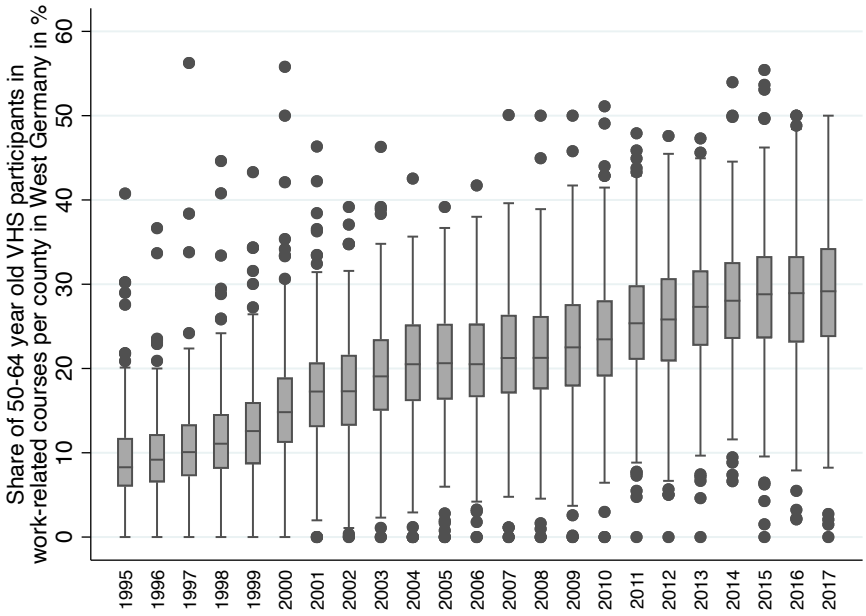
[30] During the time of our analysis, there were a few redivisions of county borders. We take this into account by using conversion keys for county population and area that were provided by the Federal Institute for Building, Urban Affairs and Spatial Research (BBSR). As a result, every county observation is available within its 2017 borders for the whole observation period.

Table 2.2: Summary Statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
Panel A: VHS statistics					
VHS participations of 50-64 year olds					
All courses	6,811	2,797	2,680	0	25,799
Work-related courses	6,811	238	239	0	2,764
Language courses	6,806	833	890	0	7,921
Health courses	6,807	1,100	1,064	0	10,565
Arts & culture courses	6,807	434	501	0	5,940
Politics & society courses	6,772	183	285	0	5,533
Basic education courses	5,776	14	31	0	561
VHS participation share of 50-64 year olds					
All courses	6,811	22.54	6.81	0	100
Work-related courses	6,811	20.59	9.83	0	100
Language courses	6,806	22.37	7.18	0	57.1
Health courses	6,807	25.42	8.24	0	95.98
Arts & culture courses	6,807	23.83	9.18	0	100
Politics & society courses	6,772	20.39	10.50	0	100
Basic education courses	5,776	6.49	9.25	0	100
Panel B: Regional control variables					
Population share of men 55 to 64 years old	6,811	6.21	0.67	4.35	8.91
Population share of 18 to 24 year olds	6,811	8.01	.92	6.04	14.18
Population share of 25 to 34 year olds	6,811	12.86	2.49	8.06	23.43
Population share of 35 to 49 year olds	6,811	22.39	1.93	15.76	27.42
Population share of 50 to 64 year olds	6,811	19.56	2.18	14.48	26.64
Population share of persons above 64	6,811	18.59	2.62	11.22	26.98
GDP per capita	6,811	20,909	12,539	10,423	137,616
Umemployed in population	6,811	3.546	1.31	0.68	10.78
Share of foreigners	6,811	8.85	4.27	2.05	32.29
Population density (per square km)	6,811	561.66	692.66	52.49	4,713

Notes: The table shows summary statistics of our main variables used in the analysis at the county level (boundaries as of 2017) for West Germany. The sample covers the time period between the years 1995 and 2017 . The regional control variables are shown only for work-related courses. Varying observation numbers in the participation share are due to non-existing courses for some years and counties. For the years 1995 to 1999, GDP per capita is not available for Lower Saxony and Saarland at the county level. These numbers are imputed based on the states' GDP that is distributed across counties using the counties' shares of the states' GDP in 2000. Sources: BBSR, VHS statistics, destatis, FEA, authors' own calculations.

Figure 2.4: Share of 50 to 64 Year Old Persons in Work-Related VHS Courses



Notes: The boxplot illustrates the development of the share of participations of persons between 50 and 64 years old in work-related courses in West Germany. The box demarcates the 25th and the 75th percentile, and the whiskers represent up to 1.5 times the interquartile range. A small number of county-year observations (14 out of 6,811 or 0.2%) with participation shares of over 60% are not displayed for expositional purposes, but are included in the analysis. Source: VHS statistics, authors' own calculations.

2.6 Empirical Strategy

2.6.1 Estimation Model

Our aim is to identify the causal effect of the PR reform on the VHS participation share of 50 to 64-year-old persons in work-related courses, i.e., the number of VHS participations of 50 to 64-year-old persons in work-related courses relative to the number of all VHS participations in work-related courses.[31] To elicit this effect, we exploit the fact that mainly older male workers took advantage of the reform and retired early. Thus, the basic idea of the identification strategy is to estimate the effects of the reform, which was uniform across the country, by exploiting preexisting county differences in the share of male workers at the age of 55 to 64 years, i.e., individuals who can take up partial retirement. The prediction is that counties with a relatively higher share of older men will (c.p.) show a stronger increase in VHS participations in the 50 to 64-year-old age group than other counties with a lower share of older men. We implement

[31] Ideally, we would have used the share of 55 to 64-year-old men because PR could not be started before the age of 55 years. However, the VHS statistics do not offer more detailed age groups or sample splits along the age-gender dimension for the sample period.

the estimation in the form of a generalized difference-in-differences (DiD) approach according to equation 2.1.[32]

$$\begin{aligned} \text{VHSworkpartshare50to64}_{ct} = \beta_1 + \beta_2 \text{55to64malepopshare}_{ct} \times \text{reform}_t \\ + \beta_3 \text{55to64malepopshare}_{ct} + \mathbf{P}'_{ct}\omega + \mathbf{X}'_{ct}\gamma + \mu_t + \mu_c + \varepsilon_{ct} \end{aligned} \tag{2.1}$$

The equation relates the VHS participation share of 50 to 64-year-old persons in work-related courses ($\text{VHSworkpartshare50to64}_{ct}$) in county c in year t to the (demeaned) population share of 50 to 64-year-old men ($\text{55to64malepopshare}_{ct}$), a dummy variable ($\text{reform}_t$) indicating the duration during which the PR reform may have had an effect on adult education participation, and the interaction of the variables.[33] The reform dummy is equal to one for the years 2000 to 2013, and zero for the years 1995 to 1999 and 2014 to 2017. This classification takes into account that, as Figure 2.1 illustrates, the number of PR contracts grew steeply only after 1999 when the different collective bargaining agreements containing provisions on PR had been started to be implemented. It also shows that anticipation effects did not play a role and make it unlikely that we would find any effect before. Moreover, the first cohort choosing the duration of the block model of six years only reached the passive part in late 1999. We end after 2013 because afterwards the number of persons in PR is as low as it was in 1999. While the choice of the duration is necessarily somewhat arbitrary, we show that the results do not strongly depend on coding of the treatment years by showing yearly effects in an event study.

For our main specification, we interact the reform dummy by the *contemporary* (demeaned) population share of 55 to 64-year-old men. While this accounts for the fact that the gender distribution among the older population changes over time (and therefore the size of the eligible population also changes), it complicates the interpretation of the results. Therefore, in further analysis, we show results that are based on a fixed population share in Section 2.7.2. Also note that we are not using the counties' shares of older *workers* in the workforce to explain the VHS participation share because the share of older workers becomes endogenous to the reform over time as an increasing number of older workers retire.

Importantly, we control for the overall population shares in vector $\mathbf{P}_{ct}$ (categories: 18 to 24 years, 25 to 34 years, 35 to 49 years, 50 to 64 years and above 64 years, with below 18 years being the baseline category).[34] This allows us to capture the effect of having *relatively more men in the relevant age group* at the time than other counties have.[35] This specification also controls

[32] Similar approaches can be found in, e.g., Berlinski et al. (2009); Havnes and Mogstad (2011); Bauernschuster et al. (2016), and Sandner and Thomsen (2018) in the context child care reforms and Cantoni et al. (2017) in the context of evaluating school curricula reform regarding students' political attitudes in China.

[33] We also present the results from yearly interactions in Section 2.7.1, showing that the effect is not dependent on the exact specification of the reform dummy.

[34] The results do not change when we also control for gender-specific population groups (results not shown).

[35] Appendix Figure A-6 shows considerable variation in the counties' population share of 55 to 64-year-old men, even after conditioning on year and county fixed effects.

for general shifts in the age distribution between and within countries over time. We additionally control for a vector of further time-varying covariates $\mathbf{X}_{ct}$ (shown in Panel B of Table 2.2). We control for GDP per capita and the unemployment rate in both periods t and $t-1$. We also control for the share of foreigners and population density. The latter is important because some counties are less densely settled than others, which usually leads to a more scattered catchment area of the VHS. The model is completed by year fixed effects μ_t to account for common shocks to all counties within a given year and by county fixed effects μ_c to account for persistent differences between counties over time. To check the robustness of the results, we replace μ_c by county-specific linear time trends, $\mu_c \times \text{year}_t$, in some specifications, which allow counties to follow different trends over time. The error term ε_{ct} captures all remaining determinants of the counties' participation share of 50 to 64-year-old persons in work-related VHS courses and is clustered at the county level to absorb shocks that are correlated within counties over time.

In the empirical model the coefficient of interest is β_2, which shows the reform-induced additional uptake of adult education in counties that have a relatively higher older male population. Thus, we expect that the coefficient β_2 is positive. The estimated coefficient can be interpreted as percentage point changes. For instance, the PR reform leads to a change in the VHS participation share in work-related courses of 50 to 64-year-old persons averaged over the period from 2000 to 2013 by β_2 percentage points in counties where the population share of men aged 55 to 64 years is one percentage point above the mean.

2.6.2 Identification

Since we use a continuous treatment indicator, there is no clear cut-off between the treatment and comparison groups. Instead, all counties are subject to different treatment *intensities*. To identify the causal effect of the PR reform on the VHS participation share of 50 to 64-year-old persons, we therefore exploit the temporal and spatial variation of the preexisting population that is most likely to take up partial retirement, i.e., men in the age group between 55 and 64 years. The effect can be considered causal if this variation is conditional on year and county fixed-effects (or county-specific linear trends) and time-variant controls independent of other determinants for VHS participation in this age-gender group. This translates into the well-known common trend assumption of the difference-in-differences estimator.

Threats to our identification arise if the common trend assumption does not hold or if compositional differences between counties with a high treatment intensity and those with a low treatment intensity drive the effect. One potential threat is that other policies, targeting older workers, would have been initiated and phase-out at the same time as the PR reform. We are not aware of any reform that fulfill these criteria. Note that the fixed-effect specification partials out

the effect of existing retirement legislation such as the retirement after unemployment, which had the same entry qualifications.[36]

The common trend assumption would also be violated if counties with a lower population share of 55 to 64-year-old men faced increasing supply restrictions in VHS participation opportunities over time or if counties with a higher population share of 55 to 64-year-old men faced increasing supply in VHS participation opportunities over time. Given the VHS' structure and mandate described above, this is very unlikely to be of first-order importance. Moreover, these restrictions would have to discriminate between counties with a higher and lower share of men in the age group of 55 to 64, which is also highly unlikely. In addition, in Section 2.7.2, we show that the VHS participations and the VHS courses per 1,000 inhabitants are not correlated with the average population age of the county or the share of individuals aged 50 and older.

However, as illustrated in Section 2.3, people have different preferences for learning, affecting the demand for and selection of candidates in adult education. These preferences depend on, among other things, skills and former (learning) experiences. This is especially true if the training is not subject to employer demands. For example, comparing worker 1 (strong preference for leisure) and worker 2 (strong preference for work and consumption) in the theory section, we expect that worker 2, rather than worker 1, will pursue learning in retirement because worker 2 values cognitively demanding activities more than worker 1 does. This means that the demand for learning opportunities is necessarily heterogeneous in the population. However, because the PR reform was very generous and triggered a high uptake among older workers, it is unlikely that the uptake was systematically correlated with future intentions to engage in adult education activities.

In the next section, we present several pieces of empirical evidence supporting the common trend assumption and the robustness of the results. All of these analyses show that it is very unlikely that there are omitted variables that influence both the population share of 55 to 64-year-old men and the VHS participation share of the 50 to 64-year-old age group. Thus, we are confident that our estimates allow for a causal interpretation of the PR reform on adult education.

Some other specification choices affect how we interpret the results in the next section. First, the fact that the VHS statistics only provide the participation share of the 50 to 64-year-old persons and the reform only affects individuals in the age group from 55 to 64 years introduces measurement error to the empirical model. This should result in a downward bias of the estimates because we include individuals in the dependent variable who are not directly affected by the reform. However, there could have been spillover effects to neighboring age groups and women if early retirees motivated other individuals in their peer group to join them in their adult education activities. We argue that these spillover effects are also part of the treatment

[36] Appendix Table A-3 shows the results of a triple difference-in-differences estimation, examining whether the treatment effect of the reform varies with the regional unemployment rate. This is not the case. This also implies that (the threat of) unemployment does not play a role for the individual decision to enroll in adult education.

effect. Second, because the VHS statistics measure "participations" rather than "participants", any effect identified in the analysis constitutes a mixture of the extensive and intensive margins. Third, as already mentioned above, due to potential endogeneity reasons, we use the older-age population share, not the older-age worker share, in our empirical setup. Moreover, since we know neither how many persons actually take up PR at the county level nor the share of VHS participants who are in PR, we interpret our effects as intention-to-treat effects (ITT).[37]

2.7 Results

2.7.1 Main Results

Table 2.3 shows the estimated ITT effects based on equation 2.1. The results show that the interaction term is positive and significant in all specifications. Using the specification without control variables in column (1), a one percentage point higher population share of 55 to 64-year-old men in a county leads to a reform-induced increase of 1.76 percentage points in the VHS participation share of 50 to 64-year-old persons in work-related courses. The coefficient increases to 2.14 when time-varying control variables are considered in column (2).[38] Compared to the mean (median) VHS participation share of 50 to 64-year-olds in work-related courses, which was equal to 12.8% (12.6%) in 1999, this corresponds to an increase of 16.7 % in the VHS participation share of 50 to 64-year-olds in work-related courses for each additional percentage point in a county's population share of 55 to 64-year-old men. In column (3), we allow for county-specific linear time trends, which do not affect the results.

An alternative formulation of the dependent variable would be to take the number of VHS participations of 55 to 64-year-old persons in work-related courses relative to the county population (instead of the number of all VHS participations in work-related courses). However, since we do not measure participation at the individual level, this may introduce severe and potentially endogenous measurement error if the change in multiple participations in VHS courses over time is not constant. Nevertheless, the results of this alternative specification, reported in Appendix Table A-1 and in Appendix Figure A-5, confirm our baseline results. We find an increase in work-related courses of 12.2% when evaluated for the average county, which is of similar magnitude as the 16.7% reported in Table 2.3. Moreover, in comparing Appendix Figure A-5 to Figure 2.5, the time pattern of the yearly effects is very similar.

[37] To estimate a treatment-on-the-treated effect (ATT), we would have to know how many persons opted (had to opt) into PR and how their adult learning behavior developed relative to those persons in earlier or later years who could not retire early.

[38] Since GDP per capita at the county level had to be imputed for counties in Lower Saxony and Saarland (see Table 2.2), we added a dummy indicating the imputation in the subsequent analysis. The results are unaffected. To ensure that the results were not driven by a few outlier counties, we also dropped county observations at or below the 1st and above the 99th percentile of the population share of 55 to 64-year-old men in each year. Appendix Table A-2 shows that the results were hardly affected.

Table 2.3: Average Reform Effect on VHS Participation Share in Work-Related Courses

	(1)	(2)	(3)
Dependent variable: VHS participation share 50 to 64_{ct} in work-related courses			
Male population share 55 to $64_{ct} \times$ reform$_t$	1.759***	2.140***	2.113***
	(0.400)	(0.425)	(0.442)
Male population share 55 to 64_{ct}	2.295***	-2.135*	-1.821
	(0.457)	(1.243)	(1.232)
Year fixed effects	x	x	x
County fixed effects	x	x	
Control variables		x	x
County-specific linear trends			x
Adj. R-squared	0.528	0.533	0.611
Observations	6,811	6,811	6,811

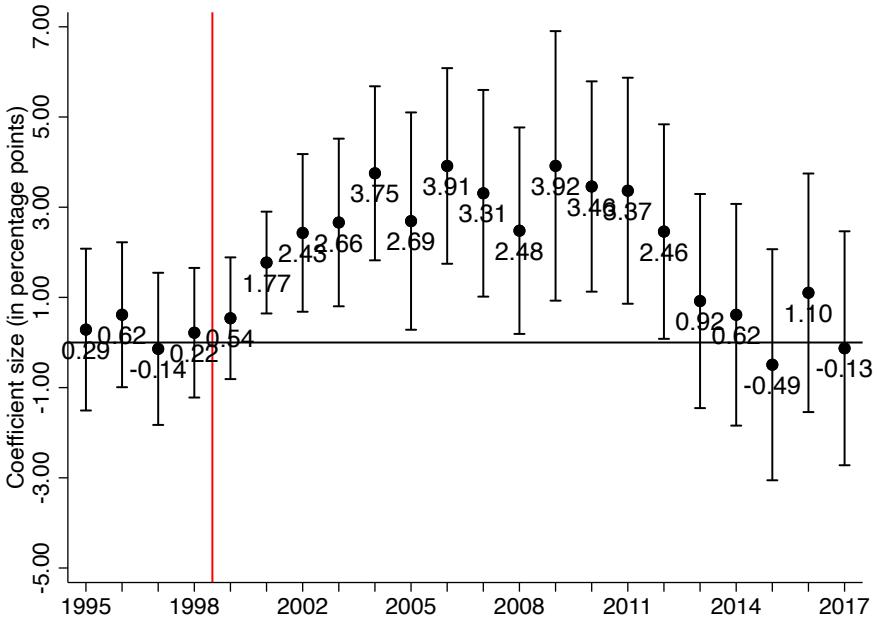
Notes: Table shows baseline results. The mean VHS participation share in work-related courses grows from 12.8 percent (median: 12.6) in 1999 to 28.8 percent (median: 29.2) in 2017. The mean (median) participation share in this time period was 23.2 (23.0) percent. *Male population share 55 to 64* is demeaned. *Control variables:* population shares 18 to 24, 25 to 34, 35 to 49, 50 to 64, and 64 and older, GDP per capita in period t and $t-1$, unemployment rate in period t and $t-1$, share of foreigners, and population density. Robust standard errors, clustered at the county level, in parentheses. Full results are available from the authors upon request. *Data sources:* BBSR, VHS statistics, destatis, FEA, authors' own calculations. Significance level: *** p<0.01, ** p<0.05, * p<0.1.

The average results from Table 2.3 conceal a large heterogeneity in the effects over time. To show this heterogeneity, we estimate year-by-year treatment effects of the PR reform by interacting year dummies with the demeaned contemporary population share of 55 to 64-year-old men. The interaction terms and 95% confidence intervals are plotted in Figure 2.5.[39] The figure shows that the interaction coefficients roughly mimic the pattern from Figure 2.1 with an expected two- to three-year lag (since retirees had to enter the passive phase of their PR contract). The first significant effect appears in 2001, which was approximately two years after the program started to reach a noticeably larger number of workers. The reform effect is considerably larger than the average effect from when the PR reform was fully enacted. Supporting the common trend assumption, we find coefficients that are close to zero and are not statistically significant for the pretreatment periods from 1995 to 1999 (see Section 2.7.2 for further discussion of the common trend assumption).

The effect sizes vary over the years and are always highly significant until (and including) 2012. The interaction in the year 2012 likely captures the last persons who chose a PR contract of six years before leaving the workforce. It also fits with the observation that the average duration of PR contracts grew over the years (see Section 2.2). Finally, the coefficients after 2012 are much closer to zero and are statistically insignificant. This is expected since hardly any persons entered the passive phase of the block model in these years.

[39] Corresponding regression results can be found in column (2) of Appendix Table A-4.

Figure 2.5: Yearly Reform Effect on VHS Participation Share in Work-Related Courses



Notes: The figure plots the interaction coefficients from a DiD estimation, which correspond to the estimated ITT effects from the generalized DiD regression. It shows the point estimates as well as the 95% confidence intervals. 1999, which represents the baseline year, is indicated by the vertical line. The corresponding regression results can be found in column (2) of Table A-4. The figure was created using Stata's *coefplot* command by Jann (2014). Sources: BBSR, VHS statistics, destatis, authors' own calculations.

2.7.2 Robustness Checks

The results presented so far strongly suggest that a higher population share of men potentially eligible for PR led to a higher participation share in work-related VHS courses of the corresponding age group. However, a causal interpretation is only possible if the common trend assumption holds, implying that there are no systematic unobserved influences that affect both the population share of 55 to 64-year-old men and the participation share of 50 to 64-year-old persons. To support our causal argumentation of this finding, we now present a variety of robustness checks.

Fixed population share. Using the contemporary share of 55 to 64-year-old men in a county as an explanatory variable could bias the estimates if, for example, both the population age structure and the VHS participation share correlate with time. Both could, e.g., rise due to the secular trend of the overall population aging. Although the descriptions in Section 2.5 suggest that these developments do not closely match each other in the aggregate, this kind of correlation could potentially lead to biased estimation results. We thus examine the issue further by fixing the (demeaned) population share in 1995 – the year before the reform started – and use this measure instead of the contemporary population share.

This robustness check exploits the fact that the share of 55 to 64-year-old men in 1995 is only a good predictor for the first cohort of early retirees. The 1995-cohort of 55 to 64-year-olds completely progressed to 69 years and older in 2009, i.e., any effect of PR is expected

to have occured before 2009 in this case. The results are plotted in Figure 2.6a (based on column (2) of Appendix Table A-5). Reassuringly, positive and significant effects emerge only for the years 2001 to 2008. The effects remain relatively large but statistically insignificant thereafter, potentially reflecting correlation over time in the share of 55 to 64-year-old men within counties. An alternative interpretation relates to spillover effects on other groups. For example, in Section 2.7.4 below, we show that the reform effects on adult learning seem to have extended beyond retirement at least for some persons. Thus, it could be that the reform triggered spillovers on family members (e.g., wives and younger siblings) and former (younger) colleagues.

Cohort at risk. As a second check, we fix the share of 40 to 49-year-old men in 1995. These persons can be considered a "cohort at risk" because they were between 54 and 63 years old in 2009 and therefore constituted the last cohorts who were able to conclude a PR contract before the subsidies for the program were suspended at the end of 2009. Given a two- to three-year lag to reach the passive phase of the block model, we do not expect reform effects earlier than 2011. The ITT coefficients are plotted in Figure 2.6b (based on column (4) of Appendix Table A-5). As expected, the interaction effects in 2011 and 2012 are highly significant and are comparable in effect size to the year-by-year specification in Figure 2.5. At the same time, there are no statistically significant effects observed in the mid-2000s. This further supports our conclusions because the vast majority of the cohort was not eligible for PR during this time.

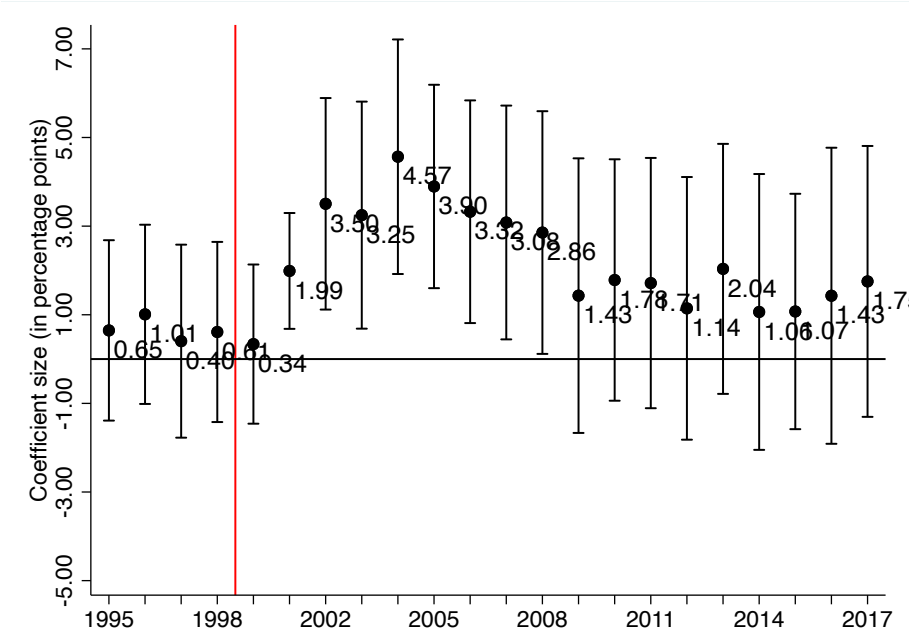
Age structure and VHS activity. As stated in Section 2.6.2, the common trend assumption would be violated if particular changes in the supply of VHS courses were related to the age structure of the county. We use two proxies for the age structure, first, the share of persons aged 50 or above and, second, the average age of the county; the data for both of these proxies were provided by the State Statistical Offices. VHS activity is proxied by VHS participation and VHS course supply, both per 1,000 inhabitants.

Appendix Table A-6 shows the results when the VHS participations and courses are regressed on the population share of persons above 50 years of age and the average age, respectively (also including year fixed effects, county fixed effects, and control variables). The coefficients are insignificant in all but one specification. Moreover, the R-squared in all these regressions is well below 10%, suggesting that the age structure does a poor job of explaining VHS activities, even after adding further covariates and filtering out year fixed effects and time-invariant county heterogeneity. The low explanatory power should make it less likely to find a positive effect. The common trend assumption seems to hold reasonably in our design, and we are confident in presenting causal effects in the estimations.[40]

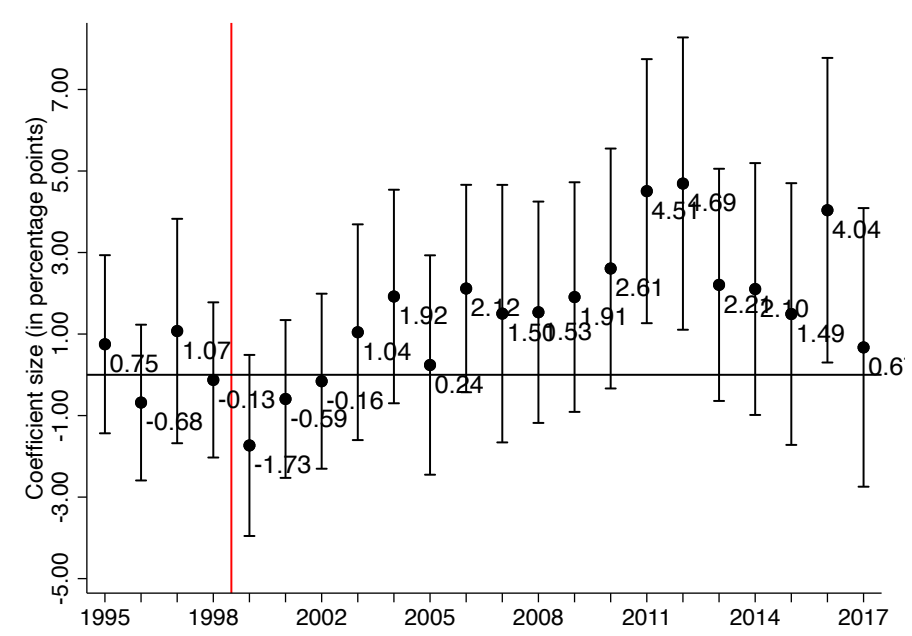
Female population share. We also check the explanatory power of the female population share of 55 to 64-year-olds vis-a-vis the explanatory power of the male population share of

[40] The notion that VHS activities are independent of the PR reform is also strengthened by the fact that we did not find any correlation between the PR reform on the one hand and the number of VHS employees, the number of participants per course, or the expenses on advertisements on the other hand (not shown).

Figure 2.6: Yearly Reform Effect on VHS Participation Share in Work-Related Courses: Fixed Population Share



(a) Interaction effects of male population share 55 to 64 years in 1995



(b) Interaction effects of male population share 40 to 49 years in 1995

Notes: This figure plots the interaction terms of the demeaned population share of 55 to 64 year old men (upper panel) and 40 to 49 year old men (lower panel), respectively, both of which are fixed in 1995. The coefficients correspond to the estimated ITT effects from the generalized DiD regression. The figure shows the point estimates as well as the 95% confidence intervals. The corresponding regressions can be found in columns (2) and (4) of Table A-5. The figure was created using Stata's *coefplot* command by Jann (2014). Sources: BBSR, VHS statistics, destatis, authors' own calculations.

the same age group. We do not expect any significant effect from the female share because the uptake of PR contracts among female workers was much lower than that among the male workers. Appendix Table A-7 repeats the specifications from Table 2.3 but also includes the female population share of 55 to 64-year-olds and the interaction with the reform dummy. The correlation between the population shares is high ($r = 0.9$), which drives up standard errors considerably due to collinearity. Nevertheless, the results indicate that the female share has no additional explanatory power over and above the male share.

2.7.3 Effect Heterogeneity

Our theoretical model in Section 2.3 implies that persons like worker 2, i.e., individuals with a low preference for leisure, are most likely to attend cognitively demanding courses such as work-related courses. However, it might be that, for example, early retirees are not only interested in productive and/or cognitively demanding skills that are also useful in the labor market but also (or even more) interested in other courses. In this section, we therefore examine whether the PR reform also triggered adult education activities in courses other than work-related courses.

The empirical specification remains identical to the main analysis, but instead of the VHS participation share of 50 to 64-year-old persons in work-related courses, we now use the participation share of this group in all VHS courses as well as in each of the other course areas. The participation categories refer to (1) all VHS courses, (2) languages, (3) health, (4) arts & culture, and (5) politics & society (see Table 2.1 for examples from the different course areas). Table 2.4 presents the corresponding estimates on effect heterogeneity. Panel A shows the regressions with year and county fixed effects, and panel B includes county-specific linear trends instead of county fixed effects.

The reform effect is statistically and economically significant for (1) all courses and (2) language courses in Panel A. The magnitude of the effects is smaller than for work-related courses (2.140 in column (2) of Table 2.3), but nevertheless: If a county's population share of men between 55 and 64 years rises by one percentage point, the overall VHS participation share of persons aged between 50 and 64 years rises by almost one percentage point (column (1)). Given that work-related courses and language courses constitute well above 40% of all VHS courses (see Figure 2.3), this is not surprising. Including county-specific linear trends in Panel B increases the magnitude of the estimates for all courses and for language courses. By contrast, the other course areas are not as strongly affected by the PR reform (columns (3) to (5)), even though the coefficient on health courses is statistically significant, and Appendix Figure A-7 shows significant positive effects for some years in the area of arts & culture. In general, we can conclude from this analysis that early retirees seem to prefer cognitively demanding courses over more leisure-oriented courses.

Table 2.4: Average Reform Effect on VHS Participation Share in Other Course Areas

	(1)	(2)	(3)	(4)	(5)
	All VHS courses	Languages	Health	Arts & culture	Politics & society
Panel A: Year and county fixed effects					
Male population share 55 to $64_{ct} \times$ reform$_t$	0.993***	1.161***	0.703**	0.427	0.512
	(0.286)	(0.369)	(0.334)	(0.381)	(0.559)
Mean (median) participation share in 1999	19.2 (19.9)	21.7 (22.2)	21.4 (21.4)	19.8 (19.9)	16.6 (15.8)
Year fixed effects	x	x	x	x	x
County fixed effects	x	x	x	x	x
Control variables	x	x	x	x	x
Adj. R-squared	0.451	0.199	0.511	0.424	0.182
Observations	6,855	6,831	6,839	6,838	6,796
Panel B: Year fixed effects and county-specific linear trends					
Male population share 55 to $64_{ct} \times$ reform$_t$	1.154***	1.412***	0.667*	0.290	0.465
	(0.297)	(0.358)	(0.350)	(0.397)	(0.593)
Mean (median) participation share in 1999	19.2 (19.9)	21.7 (22.2)	21.4 (21.4)	19.8 (19.9)	16.6 (15.8)
Year fixed effects	x	x	x	x	x
County-specific linear trends	x	x	x	x	x
Control variables	x	x	x	x	x
Adj. R-squared	0.590	0.460	0.643	0.580	0.328
Observations	6,855	6,831	6,839	6,838	6,796

Notes: Table shows results for the different course areas. Dependent variable is the VHS participation share 50 to 64_{ct} in the course area indicated in the column header. Varying observation numbers in the participation share are due to non-existing course areas for the age group for some years and counties. *Male population share 55 to 64* is demeaned. *Control variables:* population shares 18 to 24, 25 to 34, 35 to 49, 50 to 64, and 64 and older, GDP per capita in period t and $t-1$, unemployment rate in period t and $t-1$, share of foreigners, and population density. Robust standard errors, clustered at the county level, in parentheses. Full results are available from the authors upon request. *Data sources:* BBSR, VHS statistics, destatis, FEA, authors' own calculations. Significance level: *** p<0.01, ** p<0.05, * p<0.1.

2.7.4 Long-Term Effects

We also examine potential long-term effects by studying the VHS participation share of persons who are 65 years and older in work-related courses. For this analysis, we focus on the first PR cohort, i.e., men who were between 55 and 64 years old in 1995 and had completely reached the NRA in 2005. Section 2.7.2 shows that this cohort was very active in VHS participation. The question is whether this high degree of activity still shows up when they reached the NRA. To study this question, we fix the population share of 55 to 64-year-old men in 1995 and use it as the main explanatory variable (analogous to the analysis in Figure 2.6a). However, we use this share to explain the VHS participation share of persons aged 65 and over in work-related courses. Otherwise, the specification remains identical to the main analysis, i.e., with control variables as well as year and county fixed effects. Equation 2.2 gives the empirical model for the analysis.

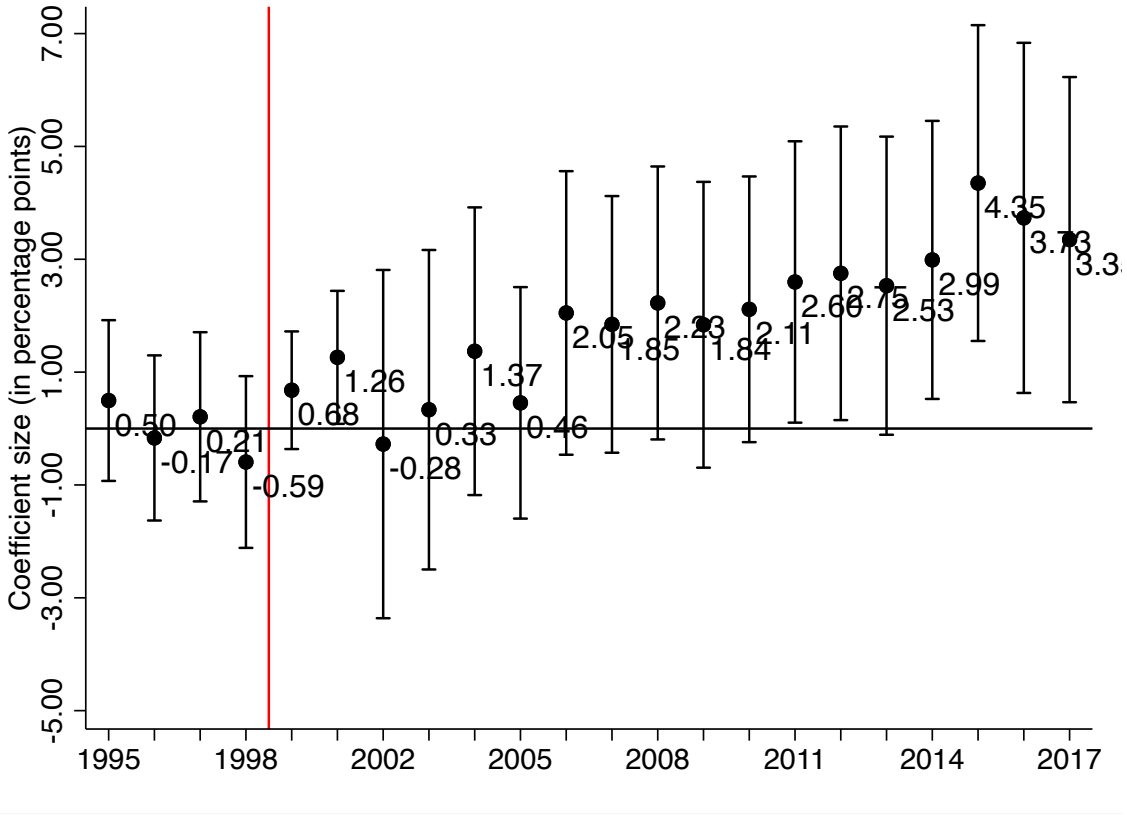
$$\begin{aligned} \text{VHSworkpartshare65+}_{ct} = \beta_1 + \sum_t \beta_t (\text{55to64malepopshare}_{c,t=1995} \times \mu_t) \\ + \mathbf{P}'_{ct}\omega + \mathbf{X}'_{ct}\gamma + \mu_t + \mu_c + \varepsilon_{ct} \end{aligned} \tag{2.2}$$

The coefficients are small and insignificant until 2005, when the cohort had completely reached the NRA of 65. While sizeable and stable from 2006 to 2017, the estimates are rather imprecisely estimated. As a consequence, only the coefficients for the last few years (after 2011) are statistically significant at conventional levels. Nevertheless, we interpret this pattern as supportive evidence for the existence of long-term effects of the PR reform on VHS participation.

2.8 Conclusions

Keeping older employees in the workforce longer can be an important measure to combat the growing skills shortage and balance social insurance funds in many developed economies, especially in Europe. One argument against a longer working life has been that productivity decreases with age. Moreover, older employees are said to be unable or unwilling to increase their productivity through learning and acquiring new techniques and skills. The results of this paper challenge this narrative by analyzing the adult learning activities of individuals in Germany who retired early due to a specific partial retirement policy (PR) that was in place between 1996 and 2009. Using statistics from German adult education centres (VHS), which provide comparable data on adult learning activities across counties and over time, we use the preexisting regional variation in the share of eligible individuals at the county level to assess the uptake of adult learning activities in VHS in a generalized difference-in-differences (DiD) framework. Our empirical results show that these persons continue to learn and do so mostly in work-related courses. This indicates that a sizeable fraction of older persons remain willing to

Figure 2.7: Yearly Reform Effect on VHS Participation Share in Work-Related Courses: Long-Term Effects



Notes: The figure plots the interaction terms of the demeaned population share of men aged 55 to 64 in 1995 with the respective years from the regression of the VHS participation share of persons aged 65 and older in work-related courses, which correspond to the estimated ITT effects from the generalized DiD regression. It shows the point estimates as well as the 95% confidence intervals. 1999, which represents the baseline year, is indicated by the vertical line. The corresponding regression is available from the authors upon request. The figure was created using Stata's *coefplot* command by Jann (2014). Sources: BBSR, VHS statistics, destatis, authors' own calculations.

learn in cognitively demanding skills and that these persons still have the capacity and interest to acquire new skills and master new situations.

Given that skills shortages are likely to increase in many sectors of the economy in a number of developed countries, this study contributes to at least two important discussions. First, even though the PR reform was initially designed to retain workers longer in the workforce, the popularity of the block model led to an increase in the early retirement of workers who were likely still productive and, according to our study, of workers who would have been willing to update their skills. Therefore, the reform likely resulted in a loss of human capital for society, aggravating the skills shortage in the German workforce. Since PR was designed as an agreement between employer and employee, it was not easy for policy makers to influence the number of early retirees. Thus, if the government aims to retain workers in the workforce for longer and does not want to force workers and firms to stay in employment relationships for longer, it has to design a retirement policy that provides appropriate incentives for all stakeholders.

Second, the success of retirement reforms depends not only on retaining older workers in the workforce but also on whether it is possible to mitigate the skill depreciation of older workers through adult education and training. While the government and firms can affect the skills formation of older workers by providing adult learning opportunities and may even force older workers to participate in adult learning activities, it is much harder for them to encourage older workers to actually learn new skills while participating. Since this study provides some evidence that older workers are willing to continue learning, we can have some confidence in the potential success of adult education initiatives that aim to counteract skill depreciation among older workers.

Chapter 3

Scaling Up and Crowding Out: How German Adult Education Centers Adapted Course Offers to Refugee Integration *

with:
Stephan L. Thomsen

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Chapter 4

The Benefits of Adult Learning: Work-Related Training, Social Capital, and Earnings *

with:
Jens Ruhose
Stephan L. Thomsen

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Chapter 5

Work-Related Training and Subjective Well-Being: Estimating the Effect of Training Participation on Satisfaction, Worries, and Health in Germany*

with:
Jens Ruhose
Stephan L. Thomsen

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Appendix A

Appendix for Chapter 2

A.1 Background Information on VHS in Germany

Adult education centers (VHS) have a long tradition in Germany. The first VHS were founded in the late 18th and early 19th century, motivated by two competing interests (Olbrich and Siebert, 2001; Hufer, 2009). On the one hand, the Enlightenment movement inspired the ideal that every citizen should be educated and empowered to participate in (national) societal and political discourse. On the other hand, industrialization induced a change away from agrarian jobs and towards manufacturing-oriented jobs, which required further training for adults to adjust their skills. VHS became more widespread over time and found their legal basis in the constitution of the Weimar Republic in 1919, leading to country-wide availability (Olbrich and Siebert, 2001). However, after the Nazi Party came to power in 1933, VHS were closed or brought into line politically.

After World War II, the Allied Forces emphasized the fast rebuilding of the adult education sector in West Germany and thus supported the swift reopening of the VHS. One main motivation for this was the so-called "re-education program", which was intended to teach and spread "democratic values" and to debunk the falsehoods and dangers of the Nazi doctrine (Hufer, 2009). It was also after the war that most states included a guaranteed provision of adult education on the commune or county level in their constitutions. In addition to abiding by the requirement of general provision, VHS in West Germany have been autonomous in their administration and content creation since that time. Most of them are directly or indirectly controlled and administered on the community or county level, but they coordinate voluntarily on the state level as well as on the federal level and have undergone several programmatic changes over the last several decades.

In contrast, VHS in the German Democratic Republic (1949-1989, GDR; East Germany before unification) were centralized and mostly repurposed as evening schools for adults obtaining school-leaving degrees (Knoll and Sommer, 1992). After reunification, East German VHS could develop freely again and became increasingly similar to their West German counterparts. However, significant structural differences between East and West German VHS remain today. The most notable is the number of courses offered per 1,000 inhabitants, which is only half as high in East Germany as it is in West Germany.*

Since VHS are independent, there are no prescribed curricula, and VHS are able to adapt both the quantity and content of their courses in response to local demands. This degree of decentralization also means that there is no uniform quality management. However, a number of VHS have repeatedly acquired quality certificates from independent auditors, e.g., the European Foundation for Quality Management (EFQM) or *Lernerorientierte Qualiätstestierung in der Weiterbildung* (LQW2). In addition, even though there are no formal prerequisites for becoming a VHS lecturer, most of the lecturers are highly qualified, with almost 65% having graduated from university (Koscheck and Ohly, 2016).

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* See Olbrich and Siebert (2001) for a detailed history (only available in German). Knoll and Sommer (1992) and Opelt (2004) (also in German) describe the developments of VHS in the GDR under communism and the developments in East Germany during the first years after the German reunification in 1990.

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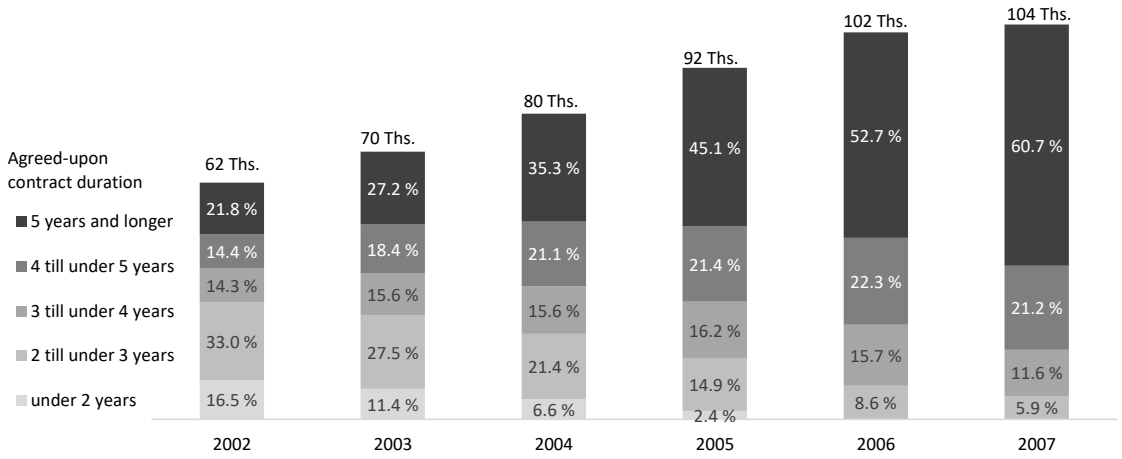
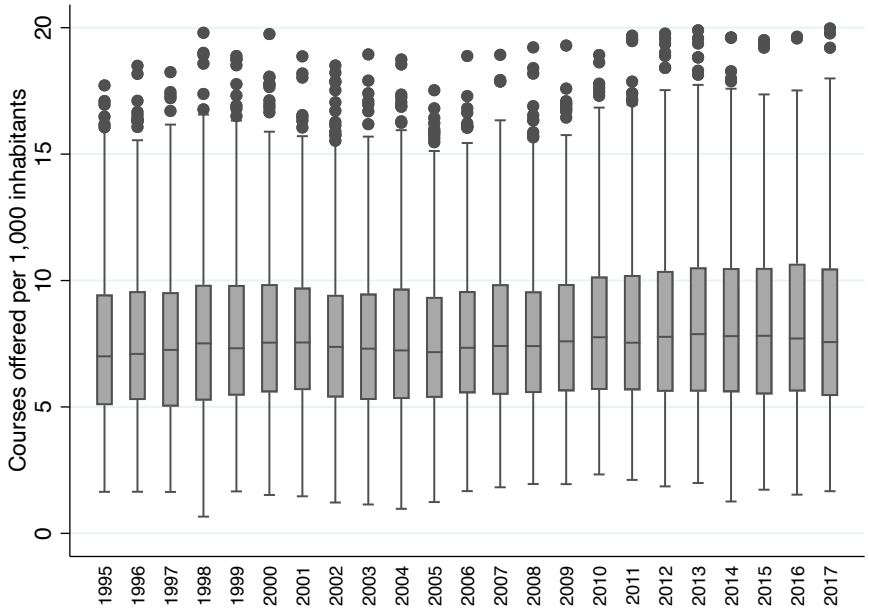
A.2 Appendix Figures and Tables

Figure A-1: Average Number of Subsidized PR Contracts by Contract Duration



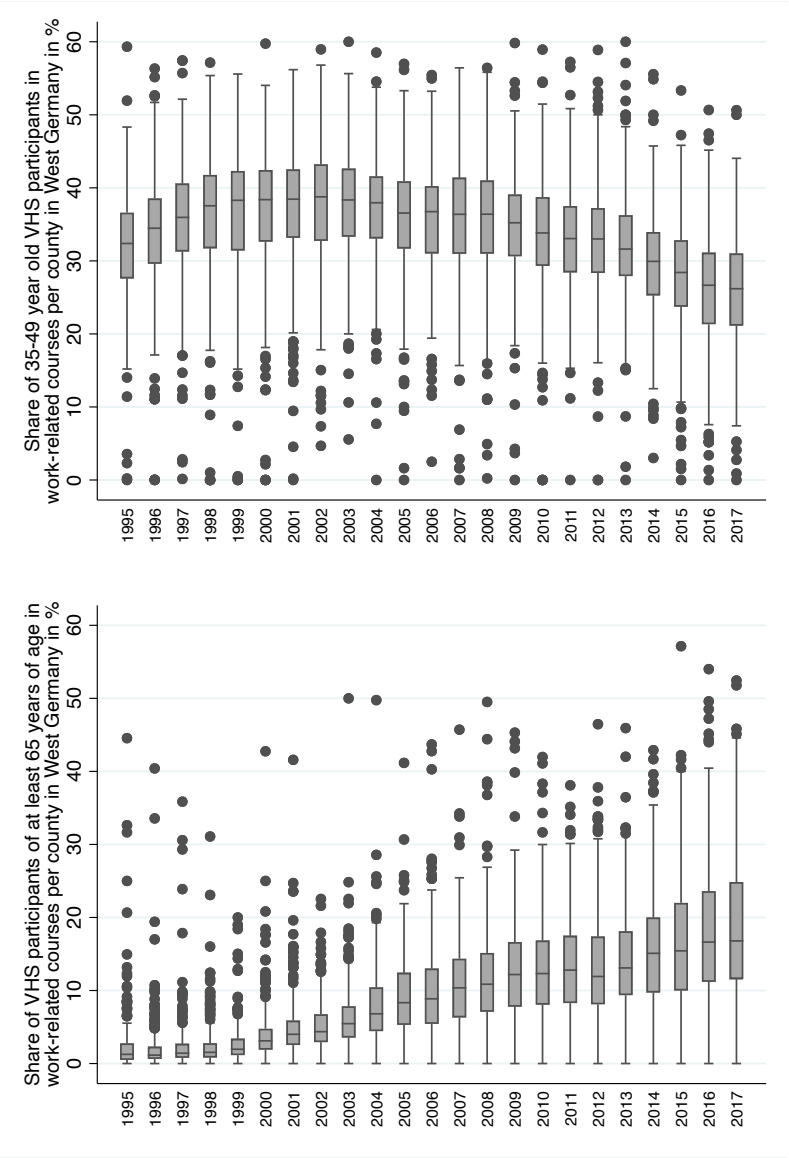
Notes: This figure is taken from Wanger (2009, p. 5), slightly modified, and translated to English. Values above bars show the absolute numbers of PR contracts. Values within bars show the distribution of PR contracts by contract duration.

Figure A-2: Courses per 1,000 Inhabitants in Each County over Time



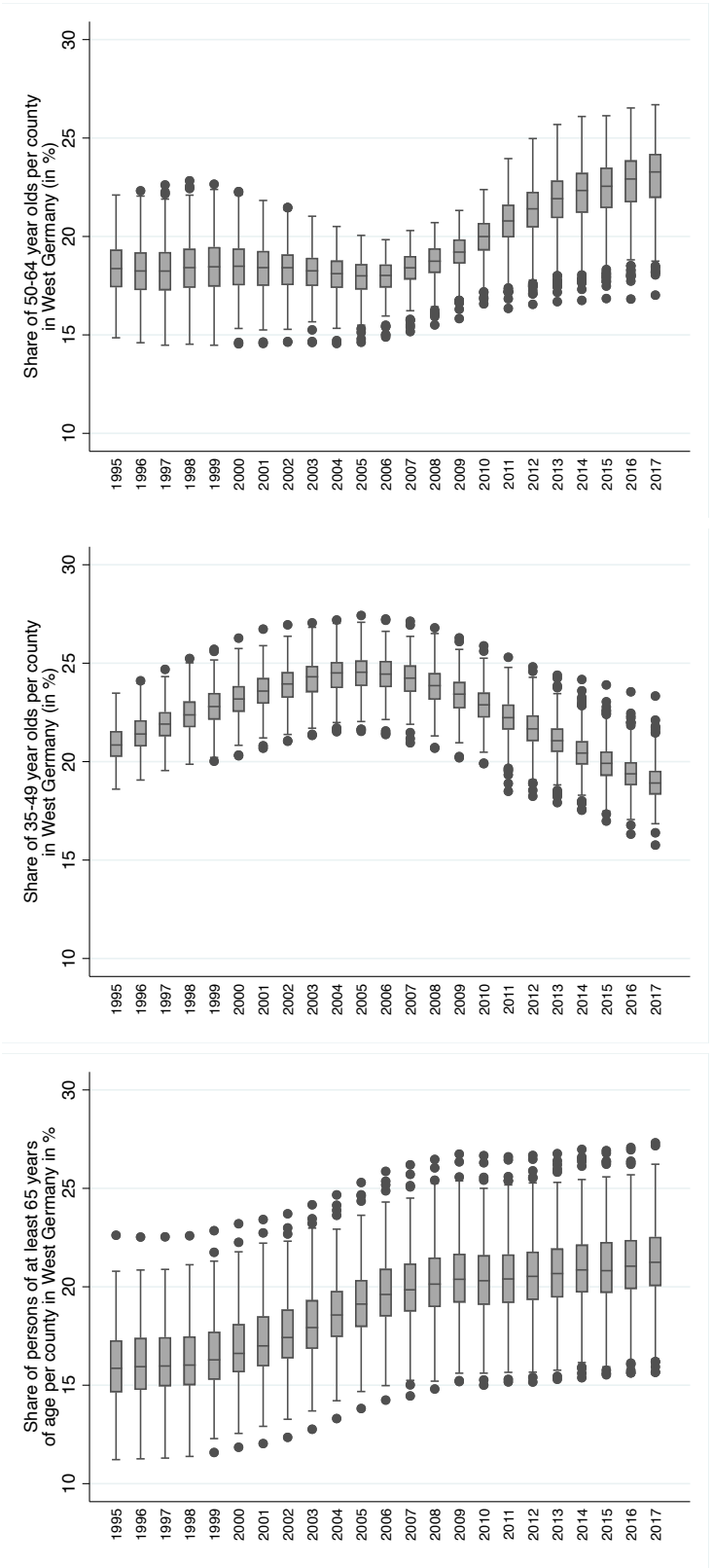
Notes: The boxplot illustrates the development of the number of courses offered per 1,000 inhabitants on a county basis (West Germany only). The box demarcates the 25th and the 75th percentile, and the whiskers represent up to 1.5 times the interquartile range. A small number of county-year-observations (127 out of 6,811 or 1.9%) with more than 20 courses per 1,000 inhabitants is not displayed here for readability purposes but they are included in the analysis. Source: VHS statistics, authors' own calculations.

Figure A-3: Share of Persons Aged 35 to 49 and 65 Years Old and Above in Work-Related Courses



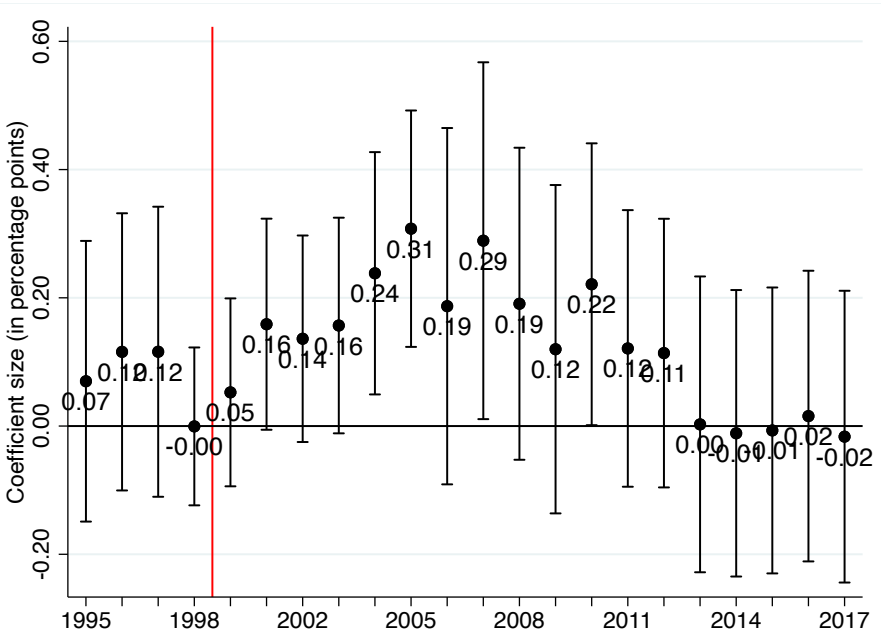
Notes: The boxplot illustrates the development of the share of VHS participations in work-related courses of persons between 35 and 49 years old in the upper figure and of persons of 65 years and above in the lower figure (West Germany only). The box demarcates the 25th and the 75th percentile, and the whiskers represent up to 1.5 times the interquartile range. A small number of county-year-observations (35 and 5 out of 6,811 or 0.5% and 0.07%, respectively) with participation shares of over 60% are not displayed here for readability purposes. Source: VHS statistics, authors' own calculations.

Figure A-4: Share of Persons 50 to 64 Years Old, 35 to 49 Years Old, and 65 Years Old and Older in the Population



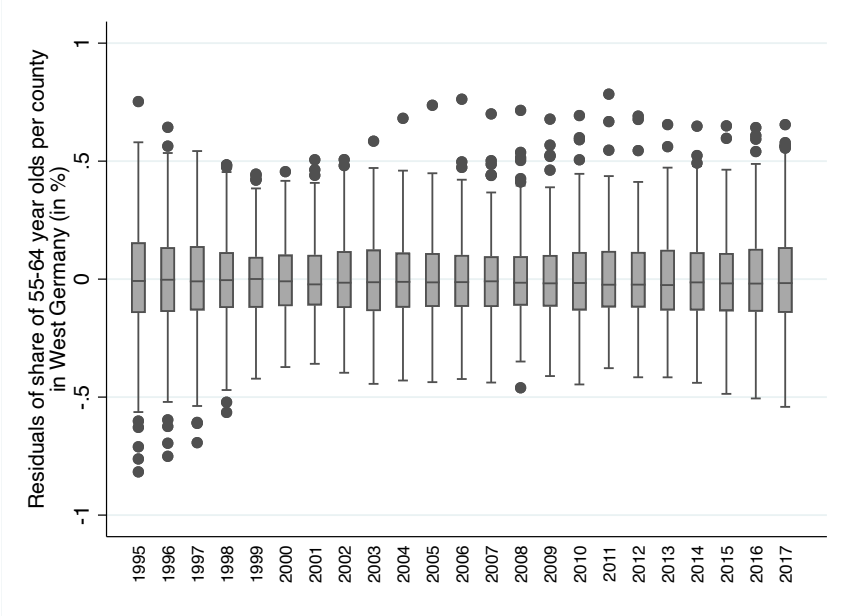
Notes: The boxplot illustrates the development of the share of persons in the general population between 55 and 64 years old in the top figure, 35 and 49 years old in the middle and of persons of 65 years and above in the bottom figure (West Germany only). The box demarcates the 25th and the 75th percentile, and the whiskers represent up to 1.5 times the interquartile range. Source: destatis, authors' own calculations.

Figure A-5: Yearly Reform Effect on VHS Participation per 1,000 Inhabitants in Work-Related Courses



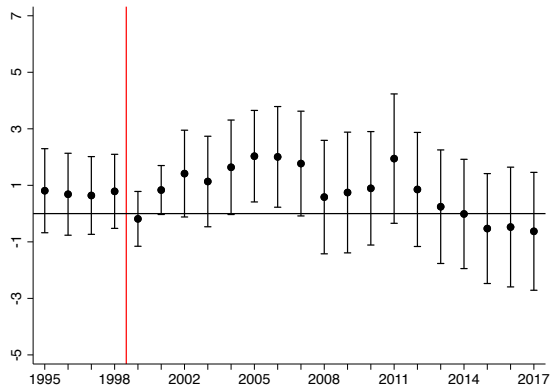
Notes: The figure plots the interaction coefficients from a DiD estimation, which correspond to the estimated ITT effects from the generalized DiD regression. It shows the point estimates as well as the 95% confidence intervals. 1999, which represents the baseline year, is indicated by the vertical line. The figure was created using Stata's *coefplot* command by Jann (2014). Sources: BBSR, VHS statistics, destatis, authors' own calculations.

Figure A-6: Residual Share of 55 to 64 Olds in the Population

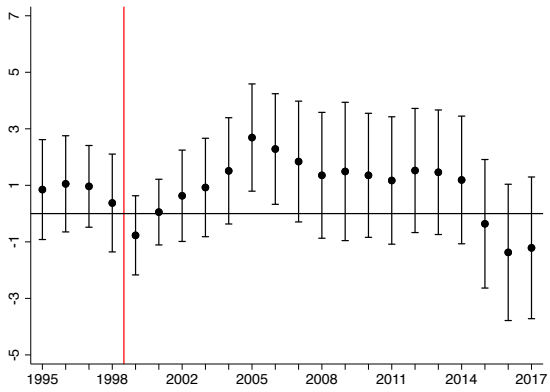


Notes: The boxplot shows the residuals from the regression of the male population share in the age group 55 to 64 years for county c at time t on all other population shares, county fixed effects, and time fixed effects. The sample is restricted to West Germany. The box demarcates the 25th and the 75th percentile, and the whiskers represent up to 1.5 times the interquartile range. Source: destatis, authors' own calculations.

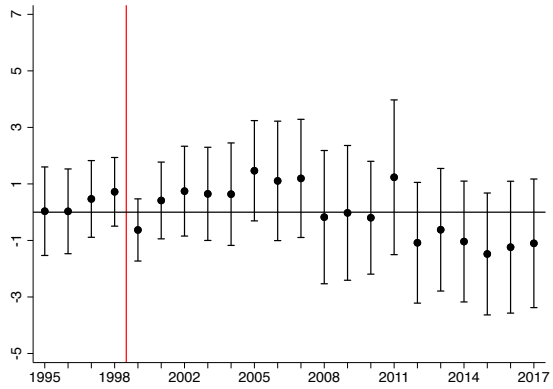
Figure A-7: Yearly Reform Effect on VHS Participation Share in Different Course Areas



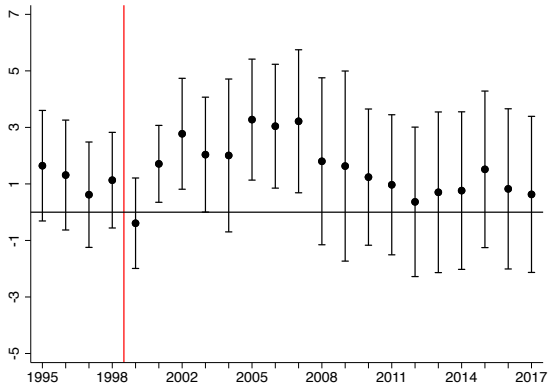
(a) All VHS courses



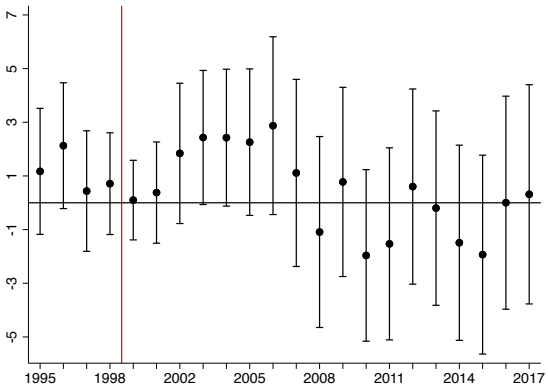
(b) Languages



(c) Health



(d) Arts & culture



(e) Politics & society

Notes: The figures plot the interaction terms of the demeaned population share of 50 to 64 year old persons with the respective years for the subgroup analysis, which correspond to the estimated ITT effects from the generalized DiD regression. It shows the point estimates as well as the 95% confidence intervals. 1999, which represents the baseline year, is indicated by the vertical line. *Control variables:* population shares 18 to 24 years, 25 to 34 years, 35 to 49 years, 50 to 64 years, and 64 years and older, GDP per capita in period t and $t-1$, unemployment rate in period t and $t-1$, share of foreigners, and population density. Robust standard errors, clustered at the county level, in parentheses. The figure was created using Stata's *coefplot* command by Jann (2014). Sources: BBSR, VHS statistics, destatis, authors' own calculations.

Table A-1: Average Reform Effect on VHS Participation per 1,000 Inhabitants in Work-Related Courses

	(1)	(2)	(3)
Dependent variable: VHS participations 50 to 64 year old persons per 1,000 inhabitants$_{ct}$ in work-related courses			
Male population share 55 to 64$_{ct}$ (%) $\times$ reform$_t$	0.155***	0.147***	0.153***
	(0.045)	(0.044)	(0.049)
Male population share 55 to 64$_{ct}$ (%)	0.134**	-0.083	-0.015
	(0.054)	(0.123)	(0.144)
Year fixed effects	x	x	x
County fixed effects	x	x	
Control variables		x	x
County-specific linear trends			x
Adj. R-squared	0.165	0.193	0.362
Observations	6,811	6,811	6,811

Notes: Table shows baseline specification with an alternative dependent variable, VHS participations of 50 to 64 year old persons per 1,000 inhabitants. The mean VHS participations in work-related courses are at 1.20 (median: 1.05) per 1,000 inhabitants in 1999 and 0.87 (median: 0.75) in 2017. The mean (median) participations in this time period were 1.28 (1.10). *Male population share 55 to 64* is demeaned. *Control variables:* population shares 18 to 24, 25 to 34, 35 to 49, 50 to 64, and 64 and older, GDP per capita in period t and $t-1$, unemployment rate in period t and $t-1$, share of foreigners, and population density. Robust standard errors, clustered at the county level, in parentheses. Full results are available from the authors upon request. *Data sources:* BBSR, VHS statistics, destatis, FEA, authors' own calculations. Significance level: *** p<0.01, ** p<0.05, * p<0.1.

Table A-2: Average and Yearly Reform Effect on VHS Participation Share in Work-Related Courses: Dropping Outliers (98% Sample)

	(1)	(2)	(3)	(4)
Dependent variable: Share of VHS participations by 50 to 64 year old persons in county c in year t (%)				
	55-64 in t	55-64 in t	55-64 in 1995	40-49 in 1995
Male population share 55 to $64_{ct} \times$ reform$_t$	2.446***			
	(0.461)			
Male population share$_{c,t}$ (%) $\times$ 1995		-0.354	0.084	0.585
		(0.951)	(1.071)	(1.136)
Male population share$_{c,t}$ (%) $\times$ 1996		0.240	0.734	-0.857
		(0.836)	(1.052)	(0.987)
Male population share$_{c,t}$ (%) $\times$ 1997		-0.679	0.005	0.920
		(0.852)	(1.115)	(1.420)
Male population share$_{c,t}$ (%) $\times$ 1998		0.093	0.617	-0.252
		(0.847)	(1.195)	(0.987)
Male population share$_{c,t}$ (%) $\times$ 2000		0.434	0.236	-1.918
		(0.772)	(1.023)	(1.167)
Male population share$_{c,t}$ (%) $\times$ 2001		1.774***	2.075***	-0.770
		(0.639)	(0.730)	(1.002)
Male population share$_{c,t}$ (%) $\times$ 2002		2.624***	3.755***	-0.314
		(0.989)	(1.333)	(1.106)
Male population share$_{c,t}$ (%) $\times$ 2003		2.646**	3.360**	0.784
		(1.076)	(1.443)	(1.378)
Male population share$_{c,t}$ (%) $\times$ 2004		3.778***	4.679***	1.612
		(1.117)	(1.492)	(1.367)
Male population share$_{c,t}$ (%) $\times$ 2005		2.766*	4.146***	0.008
		(1.414)	(1.283)	(1.398)
Male population share$_{c,t}$ (%) $\times$ 2006		4.102***	3.334**	1.994
		(1.238)	(1.389)	(1.328)
Male population share$_{c,t}$ (%) $\times$ 2007		3.122**	2.864**	1.290
		(1.256)	(1.452)	(1.663)
Male population share$_{c,t}$ (%) $\times$ 2008		2.074	2.687*	1.223
		(1.357)	(1.539)	(1.447)
Male population share$_{c,t}$ (%) $\times$ 2009		3.633**	1.078	1.458
		(1.702)	(1.729)	(1.491)
Male population share$_{c,t}$ (%) $\times$ 2010		3.512***	1.601	2.434
		(1.289)	(1.512)	(1.561)
Male population share$_{c,t}$ (%) $\times$ 2011		3.243**	1.521	4.561***
		(1.350)	(1.448)	(1.696)
Male population share$_{c,t}$ (%) $\times$ 2012		2.411*	0.785	4.541**
		(1.233)	(1.447)	(1.871)
Male population share$_{c,t}$ (%) $\times$ 2013		0.641	1.844	2.057
		(1.225)	(1.400)	(1.471)
Male population share$_{c,t}$ (%) $\times$ 2014		0.224	0.838	2.050
		(1.260)	(1.568)	(1.569)
Male population share$_{c,t}$ (%) $\times$ 2015		-0.853	1.233	1.444
		(1.422)	(1.556)	(1.692)
Male population share$_{c,t}$ (%) $\times$ 2016		0.709	1.156	3.671*
		(1.352)	(1.701)	(1.938)
Male population share$_{c,t}$ (%) $\times$ 2017		-0.796	1.545	0.279
		(1.377)	(1.665)	(1.784)
Year fixed effects	x	x	x	x
County fixed effects	x	x	x	x
Control variables	x	x	x	x
Adj. R-squared	0.533	0.534	0.532	0.531
Observations	6,676	6,676	6,676	6,676

Notes: Table shows regression on the trimmed 98% sample. *Male population share* ist demeaned. *Control variables:* population shares 18 to 24 years, 25 to 34 years, 35 to 49 years, 50 to 64 years, and 64 years and older, GDP per capita in period t and $t-1$, unemployment rate in period t and $t-1$, share of foreigners, and population density. Robust standard errors, clustered at the county level, in parentheses. Full results are available from the authors upon request. *Data sources:* BBSR, VHS statistics, destatis, FEA, authors' own calculations. Significance level: *** p<0.01, ** p<0.05, * p<0.1.

Table A-3: Average Reform Effect on VHS Participation Share in Work-Related Courses: Accounting for Unemployment

	(1)	(2)	(3)
Dependent variable: VHS participation share 50 to 64$_{ct}$ in work-related courses			
Male population share$_{ct}$ (%) $\times$ reform$_t$ $\times$ unemp$_{ct}$ (%)	-0.202	-0.182	-0.585
	(0.376)	(0.364)	(0.450)
Male population share$_{ct}$ (%) $\times$ reform$_t$	1.841***	2.194***	2.136***
	(0.396)	(0.425)	(0.452)
Male population share$_{ct}$ (%) $\times$ unemp$_{ct}$ (%)	0.305	0.306	0.194
	(0.412)	(0.415)	(0.669)
reform$_t$ $\times$ unemp$_{ct}$ (%)	-0.510***	-0.440**	-0.358*
	(0.190)	(0.205)	(0.213)
Male population share$_{ct}$ (%)	2.325***	-2.137*	-1.921
	(0.447)	(1.243)	(1.215)
unemp$_{ct}$ (%)	0.497	17.153***	17.413**
	(0.431)	(3.331)	(8.549)
reform$_t$	17.790***	6.688***	8.339***
	(0.451)	(1.087)	(1.880)
Year fixed effects	x	x	x
County fixed effects	x	x	
Control variables		x	x
County-specific linear trends			x
Adj. R-squared	0.529	0.534	0.612
Observations	6,811	6,811	6,811

Notes: Table shows a triple difference estimator that interacts the baseline estimation with the (demeaned) unemployment share in the population. *Male population share* and *unemp* are demeaned. *Control variables:* population shares 18 to 24, 25 to 34, 35 to 49, 50 to 64, and 64 and older, GDP per capita in period t and $t-1$, unemployment rate in period t and $t-1$, share of foreigners, and population density. Robust standard errors, clustered at the county level, in parentheses. Full results are available from the authors upon request. *Data sources:* BBSR, VHS statistics, destatis, FEA, authors' own calculations. Significance level: *** p<0.01, ** p<0.05, * p<0.1.

Table A-4: Yearly Reform Effect on VHS Participation Share in Work-Related Courses

	(1)	(2)	(3)
Dependent variable: Share of VHS participations by 50 to 64 year old persons in county c in year t (%)			
	FE/DiD	FE/DiD	CLT/DiD
Male population share 55 to 64_{ct} (%)	2.489***	-2.703*	-1.388
	(0.835)	(1.430)	(1.506)
Male population share 55 to 64_{ct} (%) × 1995	0.334	0.286	0.311
	(0.868)	(0.912)	(1.208)
Male population share 55 to 64_{ct} (%) × 1996	0.765	0.615	0.746
	(0.808)	(0.817)	(1.036)
Male population share 55 to 64_{ct} (%) × 1997	0.046	-0.141	-0.098
	(0.845)	(0.857)	(1.004)
Male population share 55 to 64_{ct} (%) × 1998	0.309	0.217	0.174
	(0.731)	(0.730)	(0.785)
Male population share 55 to 64_{ct} (%) × 2000	0.189	0.538	0.223
	(0.675)	(0.686)	(0.700)
Male population share 55 to 64_{ct} (%) × 2001	1.259**	1.772***	1.417**
	(0.554)	(0.574)	(0.585)
Male population share 55 to 64_{ct} (%) × 2002	1.640*	2.430***	2.078**
	(0.874)	(0.888)	(0.812)
Male population share 55 to 64_{ct} (%) × 2003	1.586*	2.661***	2.323***
	(0.946)	(0.945)	(0.881)
Male population share 55 to 64_{ct} (%) × 2004	2.559***	3.752***	3.261***
	(0.967)	(0.981)	(0.874)
Male population share 55 to 64_{ct} (%) × 2005	1.280	2.692**	2.293**
	(1.235)	(1.225)	(1.163)
Male population share 55 to 64_{ct} (%) × 2006	2.676**	3.915***	3.167***
	(1.060)	(1.102)	(0.990)
Male population share 55 to 64_{ct} (%) × 2007	2.223*	3.309***	2.330**
	(1.155)	(1.165)	(1.056)
Male population share 55 to 64_{ct} (%) × 2008	1.522	2.479**	1.323
	(1.138)	(1.163)	(1.191)
Male population share 55 to 64_{ct} (%) × 2009	3.053**	3.916**	2.859*
	(1.446)	(1.519)	(1.566)
Male population share 55 to 64_{ct} (%) × 2010	2.580**	3.459***	2.318*
	(1.205)	(1.185)	(1.204)
Male population share 55 to 64_{ct} (%) × 2011	2.729**	3.366***	2.766**
	(1.249)	(1.274)	(1.327)
Male population share 55 to 64_{ct} (%) × 2012	1.994*	2.460**	1.671
	(1.202)	(1.209)	(1.244)
Male population share 55 to 64_{ct} (%) × 2013	0.479	0.919	0.088
	(1.135)	(1.206)	(1.444)
Male population share 55 to 64_{ct} (%) × 2014	0.142	0.616	-0.260
	(1.149)	(1.249)	(1.360)
Male population share 55 to 64_{ct} (%) × 2015	-1.055	-0.493	-1.491
	(1.103)	(1.302)	(1.689)
Male population share 55 to 64_{ct} (%) × 2016	0.433	1.103	-0.038
	(1.201)	(1.344)	(1.452)
Male population share 55 to 64_{ct} (%) × 2017	-0.855	-0.127	-1.408
	(1.106)	(1.318)	(1.692)
Year fixed effects	x	x	x
County fixed effects	x	x	
County linear trends			x
Control variables		x	x
Adj. R-squared	0.529	0.533	0.613
Observations	6,811	6,811	6,811

Notes: Male population share 55 to 64 is demeaned. *Control variables:* population shares 18 to 24 years, 25 to 34 years, 35 to 49 years, 50 to 64 years, and 64 years and older, GDP per capita in period t and $t-1$, unemployment rate in period t and $t-1$, share of foreigners, and population density. Robust standard errors, clustered at the county level, in parentheses. Full results are available from the authors upon request. *Data sources:* BBSR, VHS statistics, destatis, FEA, authors' own calculations. Significance level: *** p<0.01, ** p<0.05, * p<0.1

Table A-6: Participation in VHS and the Counties' Age Structure

	(1)	(2)	(3)	(4)
Dependent variable:	participations/pop$_{ct}$	participations/pop$_{ct}$	courses/pop$_{ct}$	courses/pop$_{ct}$
Population over 50$_{ct}$ (%)	2.159**		0.069	
	(1.060)		(0.075)	
Average age$_{ct}$		-4.126		-0.505
		(6.393)		(0.327)
Year fixed effects	x	x	x	x
County fixed effects	x	x	x	x
Control variables	x	x	x	x
Adj. R-squared	0.021	0.027	0.081	0.056
Observations	6,811	4,505	6,811	4,505

Notes: Control variables: GDP per capita in period t and $t-1$, unemployment rate in period t and $t-1$, share of foreigners, and population density. Robust standard errors, clustered at the county level, in parentheses. Age share controls are 18 to 24 years, 25 to 34 years and 35 to 49 years in columns (1) and (3) and 18 to 24 years, 25 to 34 years, 35 to 49 years, 50 to 64 years, and 64 years and above in columns (2) and (4), respectively. Full results are available from the authors upon request. Robust standard errors, clustered at the county level, in parentheses. *Data sources:* BBSR, VHS statistics, destatis, FEA, authors' own calculations. Significance level: *** p<0.01, ** p<0.05, * p<0.1.

Table A-7: Average Reform Effect on VHS Participation Share in Work-Related Courses: Female Population Share

	(1)	(2)	(3)
Dependent variable: VHS participation share 50 to 64$_{ct}$ in work-related courses			
Male population share 55 to 64$_{ct}$ (%) $\times$ reform$_t$	2.028***		2.439**
	(0.424)		(1.042)
Male population share 55 to 64$_{ct}$ (%)	-2.164**		-3.391*
	(1.332)		(1.829)
Female population share 55 to 64$_{ct}$ (%) $\times$ reform$_t$		1.693***	-0.487
		(0.409)	(1.041))
Female population share 55 to 64$_{ct}$ (%)		-1.137	1.426
		(0.899)	(1.360)
Year fixed effects	x	x	x
County fixed effects	x	x	x
Control variables	x	x	x
Adj. R-squared	0.532	0.531	0.532
Observations	6,811	6,811	6,811

Notes: The mean VHS participation share in work-related courses grows from 12.8 percent (median: 12.6) in 1999 to 28.8 percent (median: 29.2) in 2017. The mean (median) participation share in this time period was 23.2 (23.0) percent. *Male/Female population shares* are demeaned. *Control variables:* population shares 18 to 24 years, 25 to 34 years, 35 to 49 years, 50 to 64 years, and 64 years and older, GDP per capita in period t and $t-1$, unemployment rate in period t and $t-1$, share of foreigners, and population density. Robust standard errors, clustered at the county level, in parentheses. Full results are available from the authors upon request. *Data sources:* BBSR, VHS statistics, destatis, FEA, authors' own calculations. Significance level: *** p<0.01, ** p<0.05, * p<0.1.

Table A-5: Yearly Reform Effect on VHS Participation Share in Work-Related Courses: Fixed Population Share

	(1)	(2)	(3)	(4)
Dependent variable: Share of VHS participations by 50 to 64 year old persons in county c in year t (%)				
	55-64 in 1995	55-64 in 1995	40-49 in 1995	40-49 in 1995
Male population share$_{c,t=1995}$ (%) × 1995	1.004	0.647	0.613	0.750
	(1.066)	(1.035)	(1.093)	(1.110)
Male population share$_{c,t=1995}$ (%) × 1996	1.254	1.009	-0.751	-0.681
	(1.051)	(1.028)	(0.948)	(0.971)
Male population share$_{c,t=1995}$ (%) × 1997	0.600	0.404	1.011	1.074
	(1.123)	(1.107)	(1.371)	(1.399)
Male population share$_{c,t=1995}$ (%) × 1998	0.780	0.611	-0.226	-0.125
	(1.035)	(1.033)	(0.948)	(0.968)
Male population share$_{c,t=1995}$ (%) × 2000	-0.081	0.338	-1.786	-1.733
	(0.905)	(0.913)	(1.127)	(1.129)
Male population share$_{c,t=1995}$ (%) × 2001	1.342**	1.989***	-0.401	-0.593
	(0.647)	(0.664)	(0.937)	(0.984)
Male population share$_{c,t=1995}$ (%) × 2002	2.590**	3.504***	0.078	-0.157
	(1.176)	(1.213)	(1.041)	(1.091)
Male population share$_{c,t=1995}$ (%) × 2003	2.064	3.248**	1.332	1.045
	(1.265)	(1.302)	(1.290)	(1.345)
Male population share$_{c,t=1995}$ (%) × 2004	3.039**	4.566***	2.162*	1.921
	(1.292)	(1.345)	(1.303)	(1.331)
Male population share$_{c,t=1995}$ (%) × 2005	1.935*	3.895***	0.777	0.240
	(1.082)	(1.166)	(1.287)	(1.368)
Male population share$_{c,t=1995}$ (%) × 2006	1.210	3.325***	2.396**	2.117
	(1.177)	(1.277)	(1.207)	(1.293)
Male population share$_{c,t=1995}$ (%) × 2007	0.794	3.082**	1.966	1.500
	(1.260)	(1.341)	(1.543)	(1.605)
Male population share$_{c,t=1995}$ (%) × 2008	0.335	2.856**	2.272*	1.534
	(1.321)	(1.392)	(1.287)	(1.380)
Male population share$_{c,t=1995}$ (%) × 2009	-1.270	1.432	2.849**	1.907
	(1.512)	(1.575)	(1.376)	(1.431)
Male population share$_{c,t=1995}$ (%) × 2010	-1.099	1.784	3.474**	2.608*
	(1.310)	(1.385)	(1.475)	(1.496)
Male population share$_{c,t=1995}$ (%) × 2011	-1.017	1.715	5.374***	4.505***
	(1.396)	(1.435)	(1.643)	(1.646)
Male population share$_{c,t=1995}$ (%) × 2012	-1.495	1.145	5.770***	4.691**
	(1.487)	(1.506)	(1.816)	(1.822)
Male population share$_{c,t=1995}$ (%) × 2013	-0.562	2.036	3.344**	2.206
	(1.372)	(1.434)	(1.351)	(1.448)
Male population share$_{c,t=1995}$ (%) × 2014	-1.464	1.064	3.257**	2.104
	(1.497)	(1.582)	(1.512)	(1.570)
Male population share$_{c,t=1995}$ (%) × 2015	-1.381	1.075	2.655*	1.490
	(1.179)	(1.350)	(1.514)	(1.632)
Male population share$_{c,t=1995}$ (%) × 2016	-1.007	1.430	5.102***	4.037**
	(1.561)	(1.698)	(1.843)	(1.899)
Male population share$_{c,t=1995}$ (%) × 2017	-0.568	1.753	1.733	0.671
	(1.398)	(1.554)	(1.628)	(1.737)
Year fixed effects	x	x	x	x
County fixed effects	x	x	x	x
Control variables		x		x
Adj. R-squared	0.513	0.532	0.511	0.531
Observations	6,811	6,811	6,811	6,811

Notes: Male population shares are demeaned. *Control variables:* population shares 18 to 24 years, 25 to 34 years, 35 to 49 years, 50 to 64 years, and 64 years and older, GDP per capita in period t and $t-1$, unemployment rate in period t and $t-1$, share of foreigners, and population density. Robust standard errors, clustered at the county level, in parentheses. Full results are available from the authors upon request. *Data sources:* BBSR, VHS statistics, destatis, FEA, authors' own calculations. Significance level: *** p<0.01, ** p<0.05, * p<0.1.