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ABSTRACT

Are Older Workers Willing to Learn?*

Adult education can mitigate the productivity decline in aging societies if older workers are willing to learn. We examine a generous partial retirement reform in Germany that led to a massive increase in early retirement. Using county-level administrative data on voluntary education activities, we employ a difference-in-differences approach for identification. The estimates show a strong increase in participation in adult education, specifically in cognitively demanding courses, for early retirees who would have continued working in the absence of the reform. This supports the notion of an intrinsic willingness of older individuals to acquire skills and abilities independent of financial incentives.

JEL Classification: J14, J24, J26

Keywords: partial retirement, early retirement, older workers, adult education, generalized difference-in-differences

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1 Introduction

The OECD (2006, 2019) estimates that the working-age population will decrease substantially in many industrialized countries in the next decades. This demographic shift may result in skill shortages, which pose a serious threat to each country's welfare and prosperity (Brunello and Wruuck, 2019; Jones, 2020; OECD, 2017a). Thus, policies that are being 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, 2017b), 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). 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 (Casey, 1998; 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). While these initiatives may increase adult education and training opportunities (and firms may force workers to participate in them), it is much harder to encourage older workers to actively learn while participating. Thus, any education initiative can only be successful if older workers are *willing to learn* new approaches and techniques.

In this paper, we show that older (male) workers who are close to retirement or in early retirement are still willing to learn new approaches and techniques. To identify this group's willingness to learn, we analyze adult education activities in a population that is effectively eligible to retire early due to a generous reform of the partial retirement (henceforth PR) legislation in Germany 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 85% in 1996 to 64%

[1] See, e.g., Kotlikoff and Gokhale (1992); Spirduso et al. (1995); Skirbekk (2004); Belbase et al. (2016); and Hudomiet et al. (2018). The number of days absent from work due to illness rise monotonously with age (BKK, 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., 2019). 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).

[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 (Eichhorst et al., 2014; Böheim and Nice, 2019).

[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

in 2014 (see below). Our results show that a large fraction of the affected cohorts, who would most likely still be employed in the absence of the reform, voluntarily participated in adult education when they retired early. This supports the notion of a strong willingness of older individuals to acquire new skills and abilities because demand-side effects such as monetary incentives, employment prospects, and employer requirements, all of which usually confound the analysis of the adult learning activities of older individuals, should no longer matter for this group.

Adult education is highly heterogeneous because its activities differ in content, quality, and availability. Moreover, people have different perceptions of what constitutes an adult learning activity. Thus, individual survey data on adult education activities are very likely affected by (nonclassical) measurement errors and the regional availability of adult education opportunities. To avoid these issues, we use unique administrative data on adult education activities among all German community learning centers (*Volkshochschulen* in German, henceforth CLCs) and their yearly reports (DIE (2018); see Reichart et al. (2020) for the 2016 report). CLCs 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, CLCs 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 CLCs 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. CLCs 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 (which teach mostly ICT skills) because these courses are cognitively demanding and teach skills that are 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 CLCs in particular) underwent substantial reconstruction efforts after the German reunification in 1990 (see Appendix A for the history of CLCs in Germany).[4]

We use these data to evaluate the effect of a comprehensive partial retirement reform on adult learning activities. In 1996, the German government enacted legislation on partial retirement to permit retirement schemes that are more flexible than the early retirement schemes in the 1970s and 1980s. However, instead of promoting a gradual withdrawal from the labor market and

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.

[4]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 communism and reunification.

extended working lives, the so-called "block model" of the partial retirement reform effectively enabled workers to retire up to five years earlier than before (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.[5] The legislation also was attractive for employers 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 (Gatter and Hartmann, 1995; Casey, 1996; Schmähl, 2003). Due to the popularity of the block model, which aggravated skill shortages in the late 2000s, the federal government effectively retracted the reform in 2009 by stopping supplemental payments to employers. 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 very likely that many of them would have worked until the statutory retirement age 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 CLC 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 CLC 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 learning activities that is due to retirement reform. Using a generalized difference-in-differences approach, we estimate the effect of the reform on adult learning 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.[6] Thus, our identification strategy mainly exploits the fact that the reform was biased towards older male workers instead of female workers. Conditioning on county- and time-fixed effects as well as on the time-varying age distribution of the county, the approach allows us to estimate an intent-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 more after the reform in relatively old counties, i.e., counties with a higher share of older persons, than in relatively young counties, i.e., counties with a higher share of younger persons. This increase in participation is observed almost exclusively in work-related courses with, no effects (or, at best, much lower effects) on adult learning activities in other course areas. Furthermore, event studies on the adult education activities of two separate affected cohorts show increasing participation only during the early retirement phase. This indicates clearly that the results are not driven

[5]Employees would earn on average approximately 70% of their prior net salary and 90% of their former social security contributions for working 50% of their former full-time job during their partial retirement contract (Huber et al., 2016).

[6]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.

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. We interpret these results as evidence that the effect comes from individuals who would very likely have been employed until the normal retirement age in the absence of the financially very attractive partial retirement reform. Thus, we conclude that specifically those workers who would likely stay in the workforce for longer are also those who are still willing to learn and acquire new skills and abilities.

Our study complements a growing literature on the behavior of older workers, which has emerged in light of drastic demographic shifts. While some studies show that older workers are in fact 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),[7] we are not aware of any causal evidence showing that older workers are actually willing to learn new approaches and techniques. 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 the topic so far comes from participation behavior in the continuous training activities of older workers in response to increases in the retirement age (Brunello and Comi, 2015; Montizaan et al., 2010). However, these studies are not able to disentangle the willingness of the worker to learn from other factors such as the requirement of the employer or the financial restraints of the worker.

The paper proceeds as follows. Section 2 offers background information on the 1996 partial retirement (PR) reform in Germany. Section 3 presents some theoretical considerations, and section 4 summarizes the related literature. Section 5 describes the system of the German community learning centers (CLCs) and introduces the statistics of the centers before offering some descriptions and introducing the dependent variable. Our empirical strategy is laid out in section 6. Estimation results are presented in section 7, which also contains a number of robustness checks and a heterogeneity analysis with respect to the course topics. Section 7 also briefly highlights a potential long-term effect, and section 8 concludes the paper.

2 The Partial Retirement Reform in Germany

In 1996, the German government introduced a legislation on partial retirement (PR) that was in force until 2009. The aim was to increase the average retirement age and improve the low labor

[7] 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).

market attachment of older workers (Brussig et al., 2009; Huber et al., 2016; Wanger, 2009).[8] The reform intended to enable a smoother transition from working life to retirement and thus to facilitate a longer working life due to the enhanced flexibility of work arrangements. Against the background of high and persistent unemployment (including high long-term unemployment) in Germany in that period, another aim of the PR reform was also to encourage the recruitment of (young) unemployed workers as successors to workers in partial retirement (Berg et al., 2015).

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 normal retirement age[9] of 65 years. In principle, the employer and the employee were free to negotiate a flexible duration of the contract of up to ten years. 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. 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 very attractive for many employees because they received approximately 70% of their prior net salary and 90% of their former pension contributions.[11] Berg et al. (2015, p. 7) show that the negotiated supplements even exceeded these numbers in many industries. Because of the attractiveness of the PR offer, PR arrangements were included in many collective bargaining agreements. 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., 2015; Brussig et al., 2009; Wanger, 2010). Overall, the PR reform demonstrated an attractive option for employees because they became able to effectively retire before the age of 65 with only small deductions (if any) in their pension claims, while at the

[8]There were several reforms of the retirement system prior to 1996 (see Börsch-Supan and Wilke (2004) for an excellent overview of the German pension system and its history).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). Because this reform became a serious financial burden for the German PAYGO retirement insurance system (Gatter and Hartmann, 1995, p. 415), a reform in the year 1992 set, among other things, the earliest regular retirement age at 63 years and introduced a penalty for early retirement of 0.3% of pension claims per month. However, the actual retirement age only rose slowly and the modal retirement age was at a low 58 years in 1996 (Berg et al., 2015, p. 6).

[9]See footnote 19 for the definition of normal and early retirement ages.

[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 Germany's progressive income taxation.

same time earning an average of approximately 70% of their prior net salary for working 50% of their former full-time job during their PR contract.

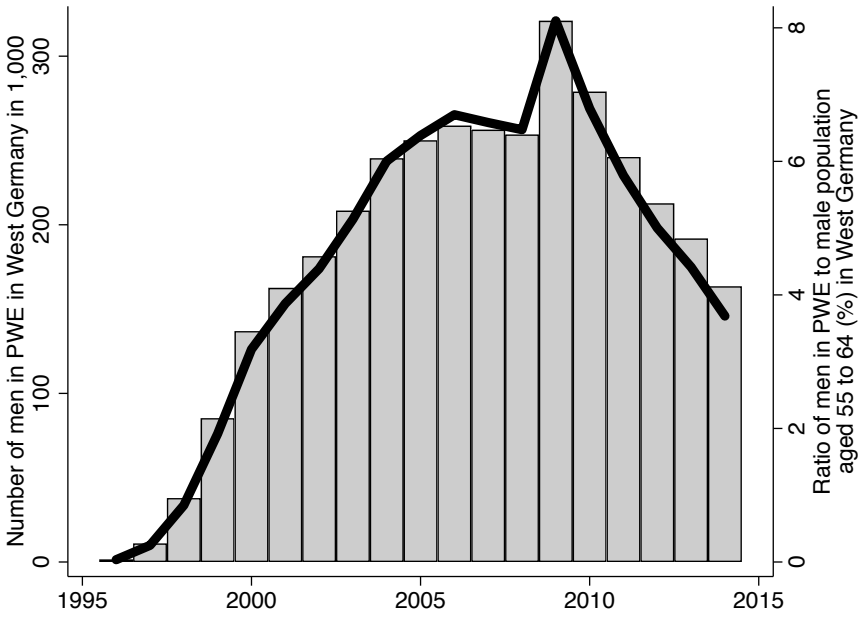
To understand the empirical strategy used below, it is important to understand that two kinds of PR models were available: The first model consisted of part-time work during the entire period of the contract. In the second model – the so-called *block model* – people worked full-time for the first half 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 (Berg et al., 2015, pp. 12-13 and Figure 2). However, PR legislation became an important topic in collective bargaining rounds in many (male-dominated) industries from 1998 to 2000 (Berg et al., 2015, pp. 12-13 and Appendix A2). In these negotiations, employers and employees agreed that they wanted to implement the block model (Wanger, 2009). 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 1 as well as Berg et al., 2015, pp. 12-13). 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.[13] 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 male (with the share of male workers in PR contracts ranging from 85% in 1996 to 64% in 2014). Thus, the typical worker who entered a PR contract was a male worker who signed up for a block model at the age of 59 with a total duration of six years, worked fulltime for three years until age 62 (active phase), and retired early at age 63 (passive phase).

Figure 1 shows the large success of the PR reform in attracting a substantial portion of older workers. In this paper, we focus on male workers in West Germany 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 for the history of CLCs in Germany). The gray bars in Figure 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 for two years, and then jumps to over 320,000 in 2009 (the last year of program entry) before falling to just below 165,000 in 2014. The corresponding share of male PR workers in the 55- to 64-year old male population is marked by the black line

[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] Appendix Figure B-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 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. Sources: destatis, Statistics of the German Pension Insurance Fund (DRV), authors' own calculations.

(right scale). It rises from zero to approximately 6.7% in 2006 before stagnating for three years and then reaching its peak of approximately 8.1% in 2009. Finally, it falls to approximately 3.7% in 2014.

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.[14] Because this change greatly reduced the attractiveness of the program, the stock

[14]Reductions in the generosity of the pension system started with the *Hartz III* reform in 2003, which restructured the organization and services of the Federal Employment Agency. In general, the *Hartz* reforms (I to IV), which came into effect between 2003 and 2005, were a reaction to worsening labor market conditions paired with growing social insurance costs. Since the 1970s, unemployment in Germany had risen from 4% to over 10% in 2005. In addition to high levels of regulation and employment protection, one of the main factors contributing to this was the structure of the unemployment insurance system (Ebbinghaus and Eichhorst, 2006). One of its components, called *unemployment assistance*, paid benefits based on previous net earnings for an essentially indefinite duration. This was especially attractive for workers who had enjoyed relatively high earnings before unemployment, but whose marketable skills were strongly depreciated by leaving their former job. Many of these workers would go on to enter retirement without ever working again (Krause and Uhlig, 2012). Therefore, the Hartz reforms, among other things, worked at removing incentives for retiring early.

of workers in PR dropped steeply to slightly over 250,000 in 2014, indicating that far fewer new contracts were made.[15]

3 Theoretical Considerations

Due to the generosity of the PR reform, retiring early became the dominant option for many workers, even if their optimal retirement age (in the absence of the reform) would have been at a later age. Moreover, we argue that the reform has likely forced some workers out of the workforce who would have been otherwise willing to learn new skills to meet new task requirements.

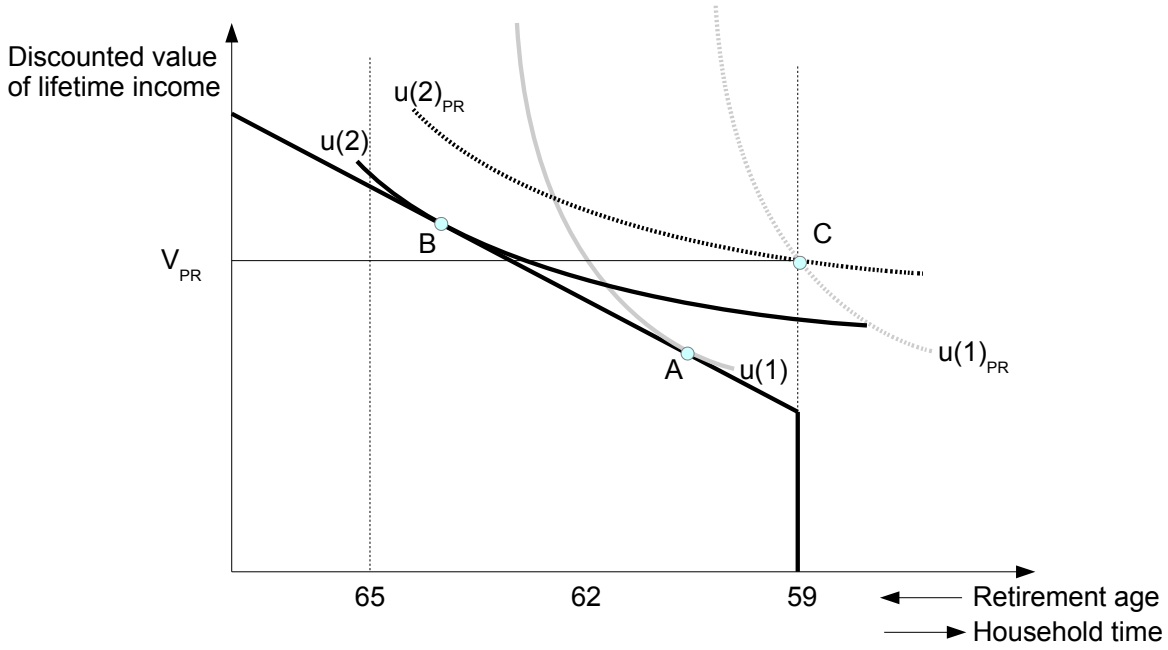
To aid in understanding, Figure 2 provides a simple illustration for choosing the optimal retirement age. The decision is based on the discounted future labor and retirement income and the preferences regarding household time (leisure) and consumption possibilities that are increasing in income (see, e.g., Ehrenberg and Smith, 2005, pp. 225-229, for a standard textbook treatment of optimal retirement decisions). We 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 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. 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 nonmonetary 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

[15] Currently, employers and employees can still enter into a PR agreement as long as the PR Act itself remains in force. However, the employer can no longer claim direct subsidies or tax cuts.

can expect that the nonmonetary consumption value from working or performing productive tasks are also important for understanding differences in the desired retirement age.

Figure 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: Own illustration.

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 remain engaged in productive activities in the passive phase of retirement. While we certainly expect that some early retirees, i.e., those with a relatively low preference for leisure and a relatively high preference for staying productive and completing meaningful tasks, stay on in (part-time) employment in the passive phase of the PR contract to earn additional income, there are also

multiple possible other productive activities through which early retirees can stay active.[16] Thus, we may observe that some of the PR workers engage in adult education activities to learn new skills or improve existing ones even without receiving economic returns from doing so and without having to meet employer requirements.[17] This would be consistent with the idea that older workers are willing to learn.

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.[18] 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)[19] 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 retirement age* (NRA) 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.

[16] These other activities may include childcare for grandchildren and volunteering in social service activities.

[17] 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.

[18] 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.

[19] The ERA constitutes the lowest age at which a person can enter retirement and claim benefits, even though he or she has to accept reductions if he or she retires before the *normal retirement age* (NRA) is reached. The NRA is the lowest age at which a person can claim retirement benefits without any deductions.

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. (2015) 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 1.8 years and women's by 0.2 years on average. These numbers drop to 1.2 years and -0.2 years, respectively, if the passive part of the block model is counted as retired.[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. (2019) for Belgium, and Elsayed et al. (2018) for the Netherlands. Ilmakunnas and Ilmakunnas (2006) find no effects for Finland, and Kyyrä (2010) 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 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.

[20] Berg et al. (2015) 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.

Finally, our paper is also related to studies that examine reforms of the early retirement age (ERA) and the normal retirement age (NRA) (see footnote 19). Existing studies 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 (2019) 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.[21] Studies analyzing reforms in the NRA support these findings. These studies, among them Mastrobuoni (2009); Behaghel and Blau (2012); Hanel and Riphahn (2012); and Lalive and Staubli (2014), mostly find considerably positive labor market effects, i.e., raising the average retirement age induces many people to actually work longer.[22] 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. 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); Andersen et al. (2020)). 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 some 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 (2019) 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 labor force early, many of them will take that option. However, the literature review shows that there is no study that identifies a

[21] Somewhat special in this regard is the Norwegian pension reform of 2011, which disentangles the claiming of pensions from the decision to exit the labor force. 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. (2020), who show that this leads to a 42% increase in hours worked at the early retirement age.

[22] However, there are also a few studies indicating no effects for some groups, e.g., Puhani and Tabbert (2016) found this for repatriated ethnic German workers, a relatively low-skilled group with low labor market attachment.

willingness to learn new skills that is not potentially driven by financial restraints and employer demands.

5 Adult Education in Germany

5.1 Community Learning Centers

After WWII, most German states included a guaranteed provision of adult education at the local level (city or county) in their constitutions.[23] To meet this legal duty, almost every local authority runs at least one community learning center (CLC, *Volkshochschulen (VHS)*). This is why CLCs are the most important nonprofit supplier of public adult education in Germany (Wittenbrink and Frick, 2018; DVV, 2019).

For our study, we use unique administrative data from the *Statistics of the German Community Learning Centers* (CLC statistics, *VHS-Statistik*; DIE, 2018) on adult learning activities coming from the full sample of CLCs and their yearly survey, which is provided by the German Institute for Adult Education (DIE, 2018).[24] The CLC 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,[25] budget and budget structure, staff, and freelance teachers for each CLC in each year. In 2015, the CLCs offered an average of 6.9 courses per 1,000 inhabitants and have held this level consistently (see Figure 3). This corresponds to over 590,000 courses in total 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.[26] On average, there are 11 participants per CLC course, and this number has been highly persistent across the years (Huntemann and Reichart, 2018, p. 13). At an average of 6.9 courses per 1,000 inhabitants, this implies that 7.6% of inhabitants (can) participate in CLC courses. Because we cannot identify individuals in the 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 always refer in the following to "participations" rather than "participants".

CLCs exist in almost all 401 German counties.[27] Many counties, especially those covering a large geographic area, are home to more than one CLC, leading to a total number of almost 900 independent CLCs. Using community identification numbers (*Amtlicher Gemeindeschlüssel*), we map each CLC to its respective county. We consider the foundation of new CLCs and

[23] Appendix A provides details on the long history and legal basis of CLCs.

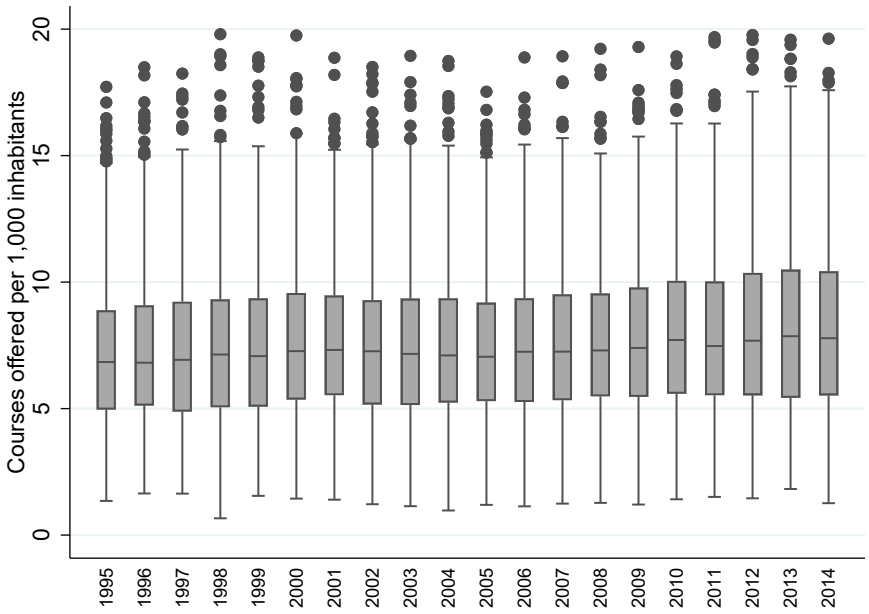
[24] See https://www.die-bonn.de/weiterbildung/statistik/vhs-statistik/default.aspx?lang=en&. The latest developments are summarized in yearly reports; see, e.g., Reichart et al. (2020).

[25] The CLC statistics list age group and gender separately before 2008.

[26] While these numbers refer to nonformal learning activities, i.e., organized learning 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.

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

Figure 3: 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 (111 out of 6,319 or 1.8%) with more than 20 courses per 1,000 inhabitants is not displayed here for readability purposes but they are included in the analysis. Source: CLC statistics, authors' own calculations.

the merger or division of existing CLCs. Even though CLCs are mostly directly or indirectly controlled and administered at the local level, their curricula are comparable across CLCs and over time since they coordinate their activities at the state and federal level. Because CLCs are highly subsidized (on average, over 35% of their revenue consists of public subsidies; Huntemann and Reichart, 2017), tuition fees for CLC courses are very low. In 2014, regular tuition fees averaged €61 for a course lasting ten to twelve weeks or approximately €20 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 in 2014.[28] 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 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

[28]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, p. 552).

,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 CLC activities are devoted to basic education. Figure 4 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.

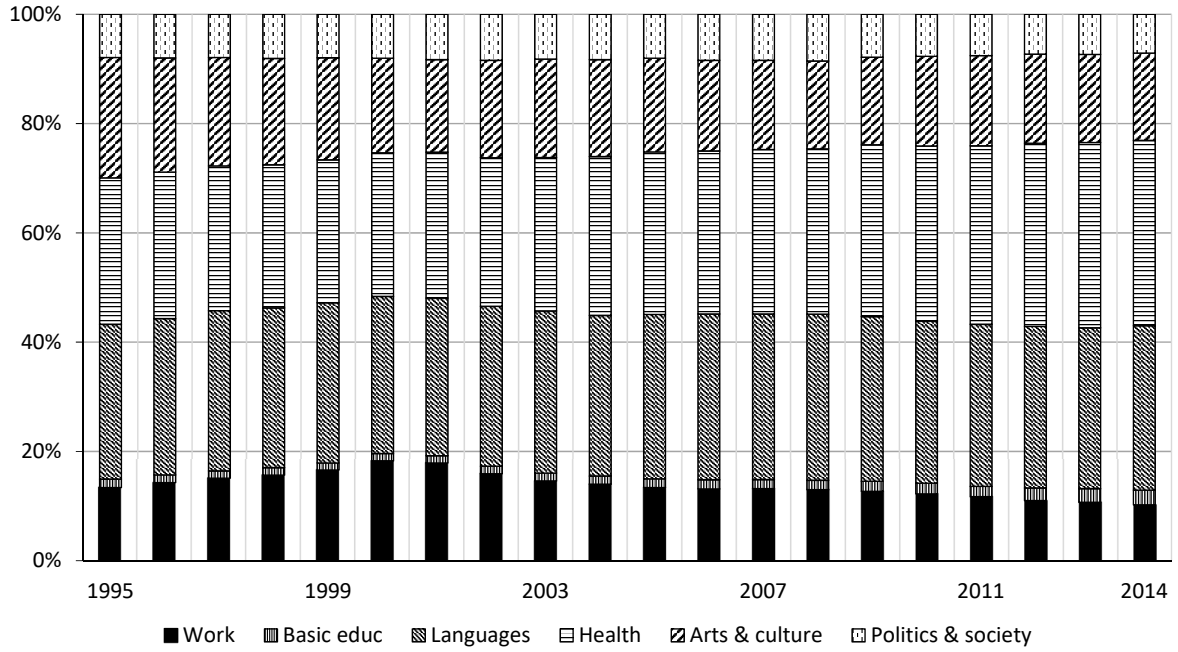
The unique position of CLCs in Germany helps us to overcome two challenges in evaluating the effect of the PR reform described above on adult learning. First, retirees may have a variety of opportunities to engage in learning activities. However, the choice of activities actually pursued and the associated intensity strongly depend on the available options, i.e., the supply side of adult education. For example, not everyone lives close to a university and is thus able to enroll as a guest student. 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 CLCs, 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 1: Courses in different course areas

Course area	Examples of courses offered	Share
Work	a) ICT skills	64%
	b) Other office-related skills (accounting, organization & management)	18%
	c) Industry-specific trainings (commercial, technical, other)	6%
	d) Other	12%
Languages	a) English	33%
	b) Other European languages	41%
	c) Other languages	6%
	d) German as a foreign language	20%
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)	28%
	c) Literature & media (literature, media, art history)	15%
	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	52%
	b) Literacy courses	37%
	c) Other	11%

Notes: The table shows the main categories and examples of courses offered in the different course areas in the CLCs. *Share* refers to the share of each topic in the respective course area and is averaged over the period 1995-2014. Source: CLC statistics, authors' own calculations.

Figure 4: 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 2014. Source: CLC statistics, authors' own calculations.

5.2 Data and Descriptions

The CLC 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 primarily 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 CLCs 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 4). Third, if an individual is still participating in the labor market, investing in these skills would most likely yield an economic payoff.

Panel A of Table 2 shows the summary statistics of the CLC data. Due to data availability for regional control variables (see below), we cover the period from 1995 to 2014 and have valid observations for all 316 West German counties. Our baseline analytical sample consists

of 5,844 county-year observations (7.5% missing county-year observations).[29] The table shows that on average 2,758 CLC participations of 50 to 64 year olds (SD: 2,818) took place over all course areas, and that 254 participations of 50 to 64 year olds (SD: 263) took place on average in work-related courses.[30] In relative terms, the participations of 50- to 64-year-olds account for 22% of all CLC participations over the entire sample period. In the area of work-related courses, this share is very similar at 19%.

Panel B of Table 2 provides summary statistics of all regional variables used in the main analysis at the county level.[31] 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 5, 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 8.4% in 1995 and grows steadily to over 28% in 2014. Although there is considerable variation across counties, the upward trend is clearly discernible. The development of CLC participation shares is different for the neighboring age groups. 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%, while the participation of persons over 64 years of age grows over time from a median of approximately 1% to almost 15%, although the variance across counties is large (see Appendix Figure B-2). However, the growing participation share of 50- to 64-year-old persons cannot be explained by a growing population share, as the top panel of Appendix Figure B-3 shows. In contrast, the center and bottom panels illustrate that the fluctuations in population shares are quite similar to the CLC participation shares of the neighboring age groups.

[29] In particular, missing information is mainly due to CLCs 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.

[30] The average county in our sample registers approximately 1,651 CLC courses with a standard deviation (SD) of 1,522 courses. On average, there are 227 work-related courses per CLC, with a SD of 217. As for the county population, we observe that the CLCs offer 8.3 total courses and 1.1 work-related courses per 1,000 inhabitants on average.

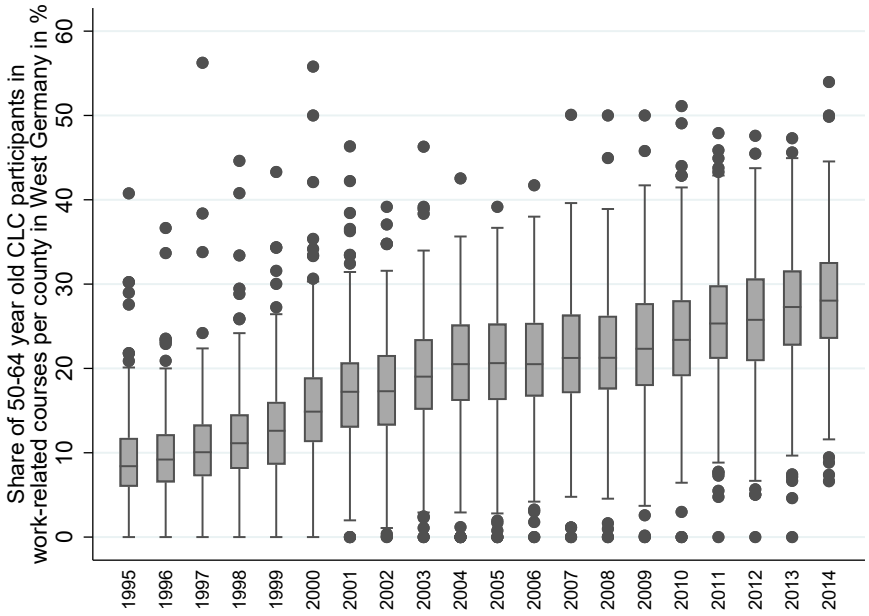
[31] During the time of our analysis, there were a few redivisions of county borders. We take this into account by using conversion keys for county population and area that were provided by the Federal Institute for Building, Urban Affairs and Spatial Research (BBSR). As a result, every county observation is available within its 2016 borders for the whole observation period.

Table 2: Summary statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
Panel A: CLC statistics					
CLC participations of 50-64 year olds					
All courses	5,887	2757.92	2817.66	0	25799
Work-related courses	5,844	253.76	263.13	0	2764
Language courses	5,863	838.15	946.79	0	8215
Health courses	5,871	1041.80	1046.82	0	9161
Arts & culture courses	5,870	436.42	530.04	0	5940
Politics & society courses	5,838	187.61	295.73	0	5533
Basic education courses	4,940	13.24	28.26	0	534
CLC participation share of 50-64 year olds					
All courses	5,887	21.74	6.90	0	100
Work-related courses	5,844	19.31	9.39	0	100
Language courses	5,863	22.35	7.18	0	60
Health courses	5,871	24.01	7.87	0	100
Arts & culture courses	5,870	22.47	8.77	0	100
Politics & society courses	5,838	19.52	10.22	0	100
Basic education courses	4,940	6.29	8.74	0	100
Panel B: Regional control variables					
Population share of 18 to 24 year olds	5,844	7.98	0.87	6.04	14.18
Population share of 25 to 34 year olds	5,844	12.97	2.52	8.06	23.43
Population share of 35 to 49 year olds	5,844	22.86	1.59	17.53	27.42
Population share of 50 to 64 year olds	5,844	19.08	1.81	14.48	26.09
Population share of persons above 64	5,844	18.61	2.62	11.22	26.98
GDP per capita	5,844	28,642	12,539	10,423	137,616
Umemployed in population	5,844	3.59	1.31	0.68	10.78
Share of foreigners	5,844	8.53	4.27	2.05	32.29
Population density (per square km)	5,844	567	712	52	4,601

Notes: The table shows summary statistics of our main variables used in the analysis at the county level (boundaries as of 2016) for West Germany. The sample covers the time period between the years 1995 to 2014 . 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, CLC statistics, destatis, FEA, authors' own calculations.

Figure 5: Share of 50 to 64 year old persons in work-related CLC 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 (11 out of 5,844 or 1.9%) with participation shares of over 60% are not displayed for expositional purposes, but are included in the analysis. Source: CLC statistics, authors' own calculations.

6 Empirical Strategy

6.1 Estimation Model

Our aim is to identify the causal effect of the PR reform on the CLC participation share of 50- to 64-year-old persons in work-related courses, i.e., the number of CLC participations of 50- to 64-year-old persons in work-related courses relative to the number of all CLC participations in work-related courses.[32] To elicit this effect, we exploit the fact that mainly older male workers took advantage of the reform and retired early (see above). 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 are most likely to 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 CLC participations in the 50- to 64-year-old age group than other counties with a lower share of older men. We implement the estimation in the form of a generalized difference-in-differences (DiD) approach according to equation 1.[33]

[32] 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 CLC statistics do not offer more detailed age groups or sample splits along the age-gender dimension for the sample period.

[33] 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.

$$\begin{aligned}\text{CLCworkpartshare50to64}_{ct} = \beta_1 + \beta_2 \text{55to64malepopshare}_{ct} \times \text{post1999}_t \\ + \beta_3 \text{55to64malepopshare}_{ct} + \mathbf{P}'_{ct}\omega + \mathbf{X}'_{ct}\gamma + \mu_t + \mu_c + \varepsilon_{ct}\end{aligned} \tag{1}$$

The equation relates the CLC participation share of 50- to 64-year-old persons in work-related courses ($\text{CLCworkpartshare50to64}_{ct}$) in county c in year t to the (demeaned) population share of 50- to 64-year-old men ($\text{55to64malepopshare}_{ct}$), a dummy variable ($\text{post1999}_t$) indicating the earliest date, i.e., the year 1999, after which the PR reform may have had an effect on adult education participation and the interaction of the variables. Note that we are not using the counties' shares of older *workers* in the workforce to explain the CLC 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 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). 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 CLC. 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 CLC 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 CLC participation share in work-related courses of 50- to 64-year-old persons averaged over the period from 2000 to 2014 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.

Two specification choices require more explanation. First, the years 1995 to 1999 constitute the *pre* period, and the *post* period is defined as the years after 1999, i.e., the years 2000 to

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

[35] Appendix Figure B-5 shows considerable variation in the counties' population share of 55- to 64-year-old men, even after conditioning on year- and county-fixed effects.

2014. This classification takes into account that, as Figure 1 illustrates, the number of PR contracts grew steeply only after 1999, showing that anticipation effects did not play a role and making 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, i.e., had completely retired in 2000 at the earliest. Second, 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 7.2 below.

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 *intensities* of the treatment. To identify the causal effect of the PR reform on the CLC participation share of 55- 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 CLC participation in this age-gender group. This translates into the well-known common trend assumption of the difference-in-differences estimator. Because it is very unlikely that there are omitted variables that influence both the population share of 55- to 64-year-old men and the CLC participation share of the 50- to 64-year-old age group, we are confident that our estimates allow for a causal interpretation of the PR reform on adult education.

Nevertheless, 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. In the next section, we present several pieces of empirical evidence supporting the common trend assumption and the robustness of the results.

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 CLC participation opportunities over time or if counties with a higher population share of 55- to 64-year-old men faced increasing supply in CLC participation opportunities over time. Given the CLCs' 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 7.2, we show that the CLC participations and the CLC 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 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.

Some other specification choices affect how we interpret the results in the next section. First, the fact that the CLC 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 effect. Second, because the CLC 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 CLC participants who are in PR, we interpret our effects as intention-to-treat effects (ITT).[36]

7 Results

7.1 Main Results

Table 3 shows the estimated ITT effects when estimating equation 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 1.26 percentage points in the CLC participation share of 50- to 64-year-old persons in work-related courses. The coefficient increases to 1.98 when time-varying control variables are considered in column (2).[37]

[36] 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.

[37] Since GDP per capita at the county level had to be imputed for counties in Lower Saxony and Saarland (see Table 2), we added a dummy indicating the imputation in the subsequent analysis. The results were unaffected,

Compared to the mean (median) CLC participation share of 50- to 64-year-olds in work-related courses, which was previously equal to 21.5% (21.1%), this corresponds to an increase of 9.2% (9.4%) in the CLC 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 CLC participations of 55- to 64-year-old persons in work-related courses relative to the county population (instead of the number of all CLC participations in work-related courses). However, since we do not measure participation at the individual level, this may introduce severe and potentially endogenous measurement errors if the change in multiple participations in CLC courses over time is not constant. Nevertheless, the results of this alternative specification, reported in Appendix Table B-1 and in Appendix Figure B-4, confirm our baseline results. As expected, coefficients are imprecisely estimated for the average and are significant only at the 12% level. However, we find an increase in work-related courses of 12% when evaluated for the average county, which is very similar to the effect reported in Table 3. Moreover, in comparing Appendix Figure B-4 to Figure 6, the time pattern of the yearly effects (see below) is very similar (and highly significant for the alternative specification).

Table 3: Average reform effect on CLC participation share in work-related courses

	(1)	(2)	(3)
Dependent variable: CLC participation share 50 to 64_{ct} in work-related courses			
Male population share 55 to $64_{ct} \times$ post1999$_t$	1.264**	1.984***	1.787***
	(0.547)	(0.565)	(0.635)
Male population share 55 to 64_{ct}	2.647***	-2.262*	-1.417
	(0.620)	(1.332)	(1.528)
Year fixed effects	x	x	x
County fixed effects	x	x	
Control variables		x	x
County-specific linear trends			x
R-squared	0.517	0.523	0.636
Observations	5,844	5,844	5,844

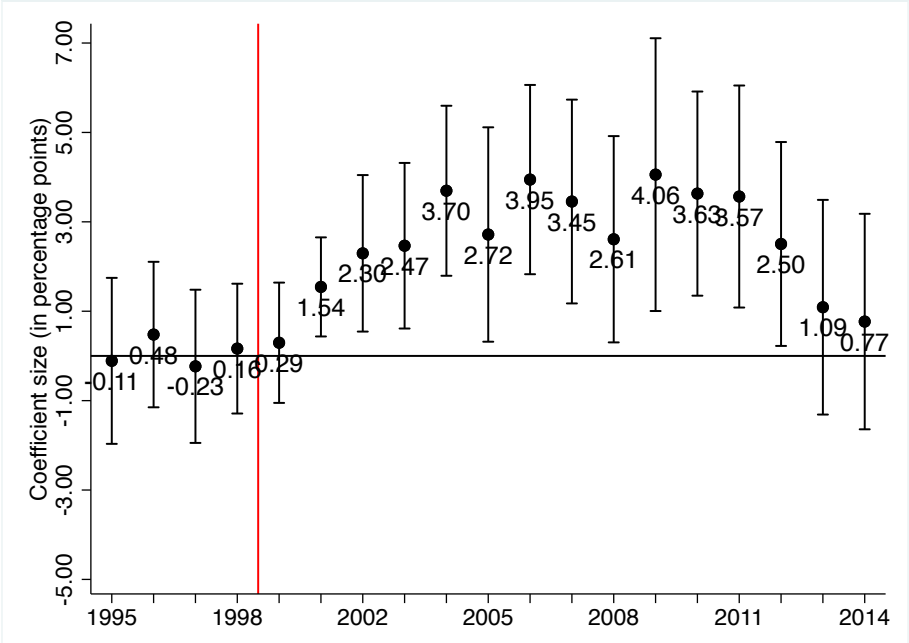
Notes: Table shows baseline results. The mean CLC participation share in work-related courses grows from 9.3 percent (median: 8.4) in 1999 to 28.3 percent (median: 28.2) in 2014. The mean (median) participation share in this time period was 21.5 (21.1) percent. *Male population share 55 to 64* is demeaned. *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, CLC statistics, destatis, FEA, authors' own calculations. Significance level: *** p<0.01, ** p<0.05, * p<0.1.

The average results from Table 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

and the imputation dummy was not significant. 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 B-2 shows that the results were hardly affected.

64-year-old men. The interaction terms and 95% confidence intervals are plotted in Figure 6.[38] The figure shows that the interaction coefficients roughly mimic the pattern from Figure 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. From 2004 to 2011, the effect size is equal to an annual increase of approximately 3.5 percentage points in the CLC participation share of 55- to 64-year-old men in work-related courses (relative to 1999). 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 7.2 for further discussion of the common trend assumption).

Figure 6: Yearly reform effect on CLC 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 B-3. The figure was created using Stata's *coefplot* command by Jann (2014). Sources: BBSR, CLC statistics, destatis, authors' own calculations.

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 above). Finally, the coefficients for 2013 and 2014 are much closer to zero and are statistically insignificant. This is expected since no more persons entered the passive phase of the block model in these years.

[38] Corresponding regression results can be found in column (2) of Appendix Table B-3.

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 CLC 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

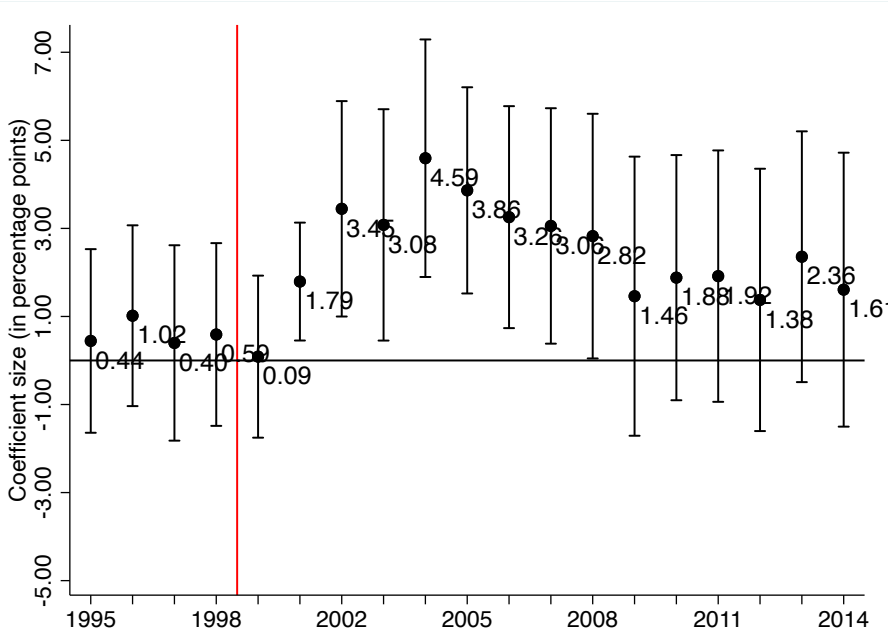
Using the contemporary share of 55- to 64-year-old in a county as an explanatory variable could bias the estimates if, for example, both the population age structure and the CLC participation share correlate with time. Both could, e.g., rise due to the secular trend of the overall population aging. Although the descriptions in section 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 it instead of the contemporary population share.

This robustness check takes advantage of 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 7a (see column (2) of Appendix Table B-4). 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 7.4 below, we show that the reform effects on adult learning seem to have extended beyond retirement. Thus, it could well be that the reform triggered spillovers on family members (e.g., wives and siblings who are younger) and former (younger) colleagues.

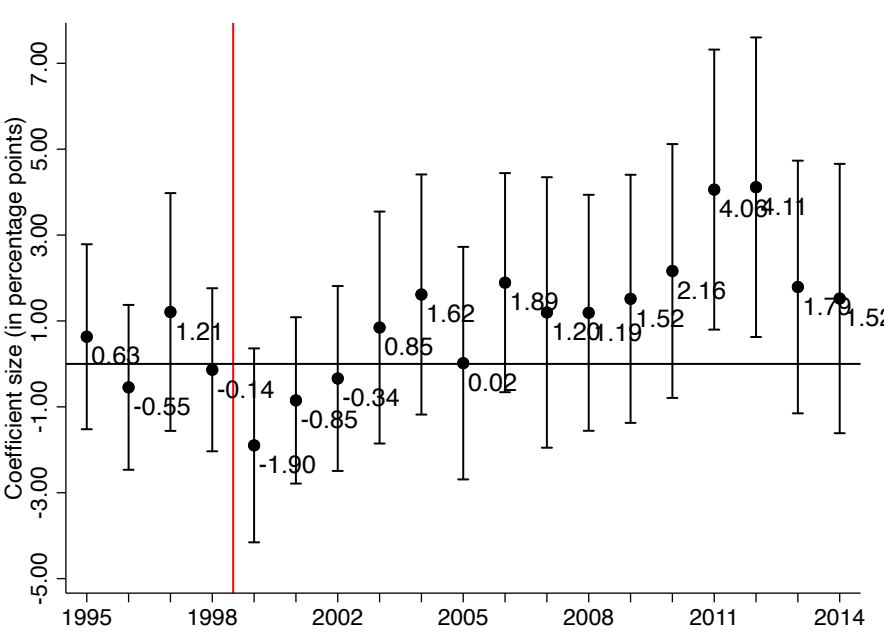
Cohort at risk

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 program was effectively suspended in 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

Figure 7: Yearly reform effect on CLC 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 B-4. The figure was created using Stata's *coefplot* command by Jann (2014). Sources: BBSR, CLC statistics, destatis, authors' own calculations.

coefficients are plotted in Figure 7b (see column (4) of Appendix Table B-4). 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 6. 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 CLC activity

As stated in section 6.2, the common trend assumption would be violated if particular changes in the supply of CLC 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. CLC activity is proxied by CLC participation and CLC course supply, both per 1,000 inhabitants.

Appendix Table B-5 shows the results when the CLC 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). All coefficients on the age structure variables in these regressions have a negative sign, although most of them are statistically insignificant. This indicates that course supply was – if changing at all – *decreasing* in counties with an older population. Moreover, the R-squared in all these regressions is well below 10%, suggesting that the age structure does a poor job of explaining CLC activities, even after adding further covariates and filtering out year-fixed effects and time-invariant county heterogeneity. The low explanatory power and the negative correlation of age structure and CLC course supply 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.[39]

Female population share

Finally, 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 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 B-6 repeats the specifications from Table 3 but also includes the female population share of 55- to 64-year-olds and the interaction with the reform dummy. While the correlation between the shares is high ($r = 0.9$), which drives up standard errors considerably due to

[39]The notion that CLC 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 CLC employees, the number of participants per course, or the expenses on advertisements on the other hand (not shown).

collinearity, the results indicate that the female share has no additional explanatory power over and above the male share.

7.3 Effect Heterogeneity

Our theoretical model in section 3 implies that persons like worker 2, i.e., individuals with a low preference for leisure, are most likely to attend work-related courses, i.e., cognitively demanding courses, if they retire early. These persons derive a nonmonetary consumption value from working (or performing productive tasks), and we thus expect them to prefer 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 so) 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 CLC participation share of 50- to 64-year-old persons in work-related courses, we use the participation share of this group in all CLC courses as well as in each of the other course areas. The dependent variables are (1) all CLC courses, (2) languages, (3) health, (4) arts & culture, and (5) politics & society (see Table 1 for examples from the different course areas). Table 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. All postinteraction terms are insignificant. It is notable, however, that most coefficients (except for health and politics courses) are positive and that they all grow in magnitude if county-specific linear trends are accounted for. This shows that the effect on work-related courses is not strong enough to show up in the average for all courses (column (1)). Given that work-related courses constitute well below one-fifth of all CLC courses (see Figure 4), this is not surprising. The other course areas were basically unaffected by the PR reform (columns (2) to (5)), even though Appendix Figure B-6 shows some positive overall effects for some years and some positive effects in the areas of languages and arts & culture, which may be more associated with the idea of taking adult education classes for leisure purposes. These results strongly suggest that early retirees seem to prefer work-related courses that teach skills and techniques that would likely also be valuable in the labor market over other courses.

Table 4: Average reform effect on CLC participation share in other course areas

	(1)	(2)	(3)	(4)	(5)
	All CLC courses	Languages	Health	Arts & culture	Politics & society
Panel A: Year- and county-fixed effects					
Male population share 55 to $64_{ct} \times$ post1999$_t$	0.390	0.310	-0.078	0.607	-0.236
	(0.433)	(0.562)	(0.565)	(0.556)	(0.734)
Mean (median) participation share in 1999	19.1 (18.7)	21.5 (22.2)	21.4 (21.4)	19.8 (19.9)	16.7 (15.1)
Year fixed effects	x	x	x	x	x
County fixed effects	x	x	x	x	x
Control variables	x	x	x	x	x
R-squared	0.416	0.235	0.376	0.322	0.153
Observations	5,887	5,863	5,871	5,870	5,838
Panel B: Year-fixed effects and County-specific linear trends					
Male population share 55 to $64_{ct} \times$ post1999$_t$	0.640	0.379	-0.102	0.940	0.798
	(0.441)	(0.602)	(0.589)	(0.670)	(0.827)
Mean (median) participation share in 1999	19.1 (18.7)	21.5 (22.2)	21.4 (21.4)	19.8 (19.9)	16.7 (15.1)
Year FE	x	x	x	x	x
County-specific linear trends	x	x	x	x	x
Control variables	x	x	x	x	x
R-squared	0.586	0.506	0.565	0.516	0.330
Observations	5,887	5,863	5,871	5,870	5,838

Notes: Table shows results for the different course areas. Dependent variable is the CLC 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, CLC statistics, destatis, FEA, authors' own calculations. Significance level: *** p<0.01, ** p<0.05, * p<0.1.

7.4 Long-Term Effects

We also examine potential long-term effects by studying the CLC 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. In fact, section 7.2 shows that this cohort was very active in CLC participation. The question is whether this high degree of activity still shows up when each of them 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 7a). However, we use this share to explain the CLC 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 gives the empirical model for the analysis.

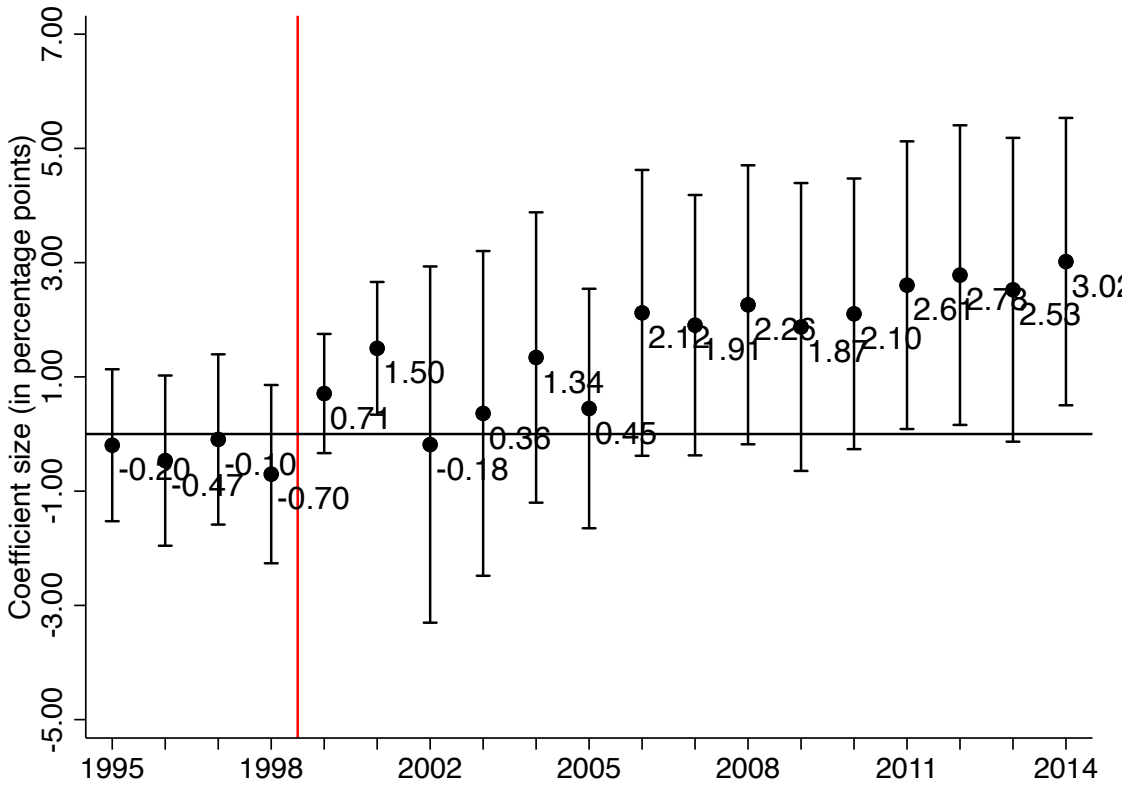
$$\begin{aligned} \text{CLCworkpartshare65+}_{ct} = \beta_1 + \sum_t \beta_t (\text{55to64malepopshare}_{c,t=1995} \times \mu_t) \\ + \mathbf{P}'_{ct}\omega + \mathbf{X}'_{ct}\gamma + \mu_t + \mu_c + \varepsilon_{ct} \end{aligned} \tag{2}$$

Figure 8 plots the resulting interaction coefficients. The coefficients are rather small and insignificant until 2005, when the cohort had completely reached the NRA of 65. While sizeable and stable from 2005 to 2014, the estimates are rather imprecisely estimated. As a consequence, only the coefficients for the last few years (2011, 2013, 2014) 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 CLC participation.

8 Conclusions

Keeping older employees in the workforce longer can be an important way 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 acquiring and learning 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 community learning centers (CLCs), 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 CLCs in a generalized difference-in-differences (DiD) framework. Our empirical results show that early retirees continue to learn and do so mostly in work-related courses that teach skills also useful in the labor market. This indicates that

Figure 8: Yearly reform effect on CLC 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 CLC 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, CLC statistics, destatis, authors' own calculations.

a sizeable fraction of older persons remain willing to learn/improve 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 exist and 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 an 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,[40] 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 around the world that aim to counteract skill depreciation among older workers.

[40] In more recent German retirements reform in 2014, the retirement age was set to 63 for workers who have paid social security contributions for at least 45 years and who can retire without deductions. This reform is predicted to increase skills shortages and burden the PAYGO retirement insurance system. Thus, at least in the German context, the extent to which retirement policies should be used to retain older workers for longer in the workforce is not clear.

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A Background Information on CLCs in Germany

Community learning centers (CLCs) have a long tradition in Germany. The first CLCs 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. CLCs 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, CLCs 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 CLCs. 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, CLCs 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, CLCs 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 CLCs could develop freely again and became increasingly similar to their West German counterparts. However, significant structural differences between East and West German CLCs 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.[41]

Since CLCs are independent, there are no prescribed curricula, and CLCs 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 CLCs 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

[41] 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 CLCs in the GDR under communism and the developments in East Germany during the first years after the German reunification in 1990.

becoming a CLC lecturer, most of the lecturers are highly qualified, with almost 65% having graduated from university (Koscheck and Ohly, 2016).

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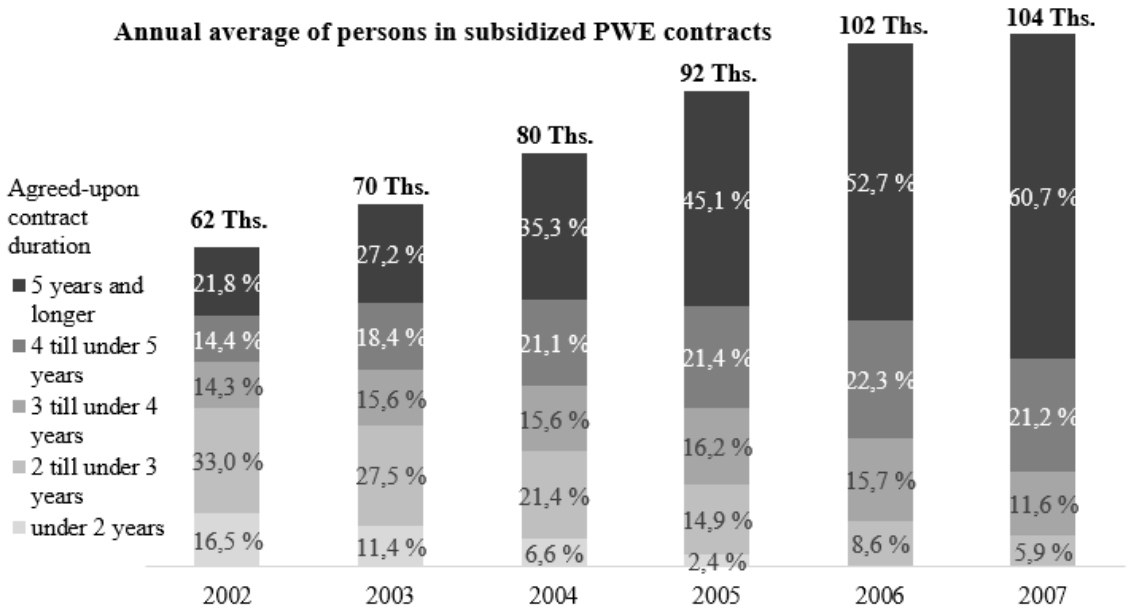
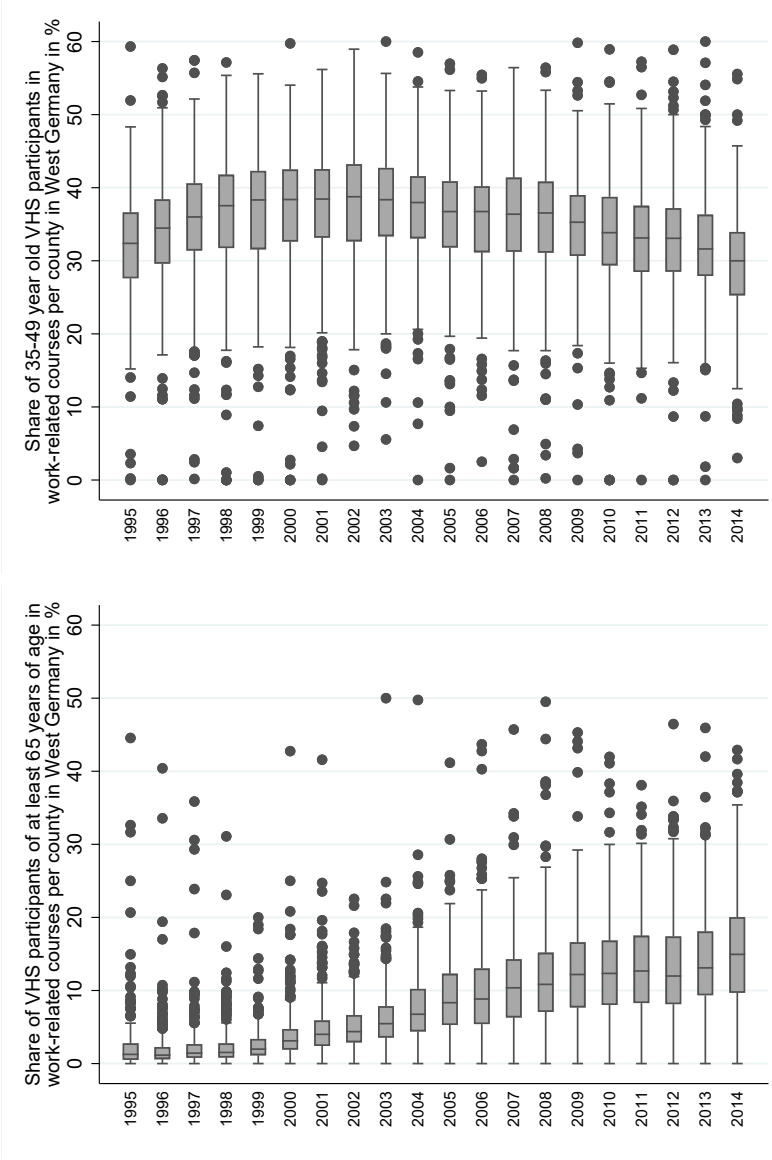
B Appendix Figures and Tables

Figure B-1: Number of subsidized PR contracts by contract duration



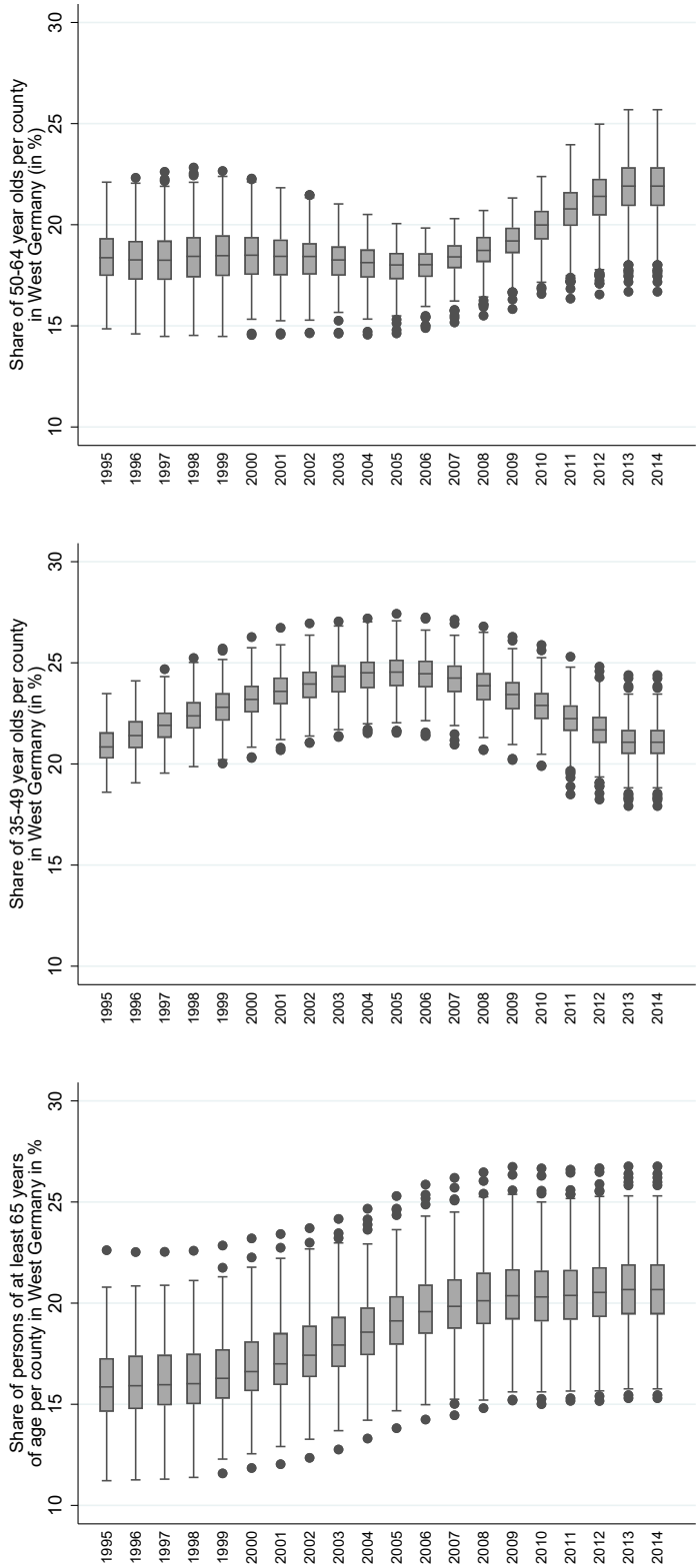
Notes: This figure is taken from Wanger (2009, p. 5), slightly modified, and translated to English.

Figure B-2: Share of persons aged 35 to 49 and 65 years old and above in work-related courses



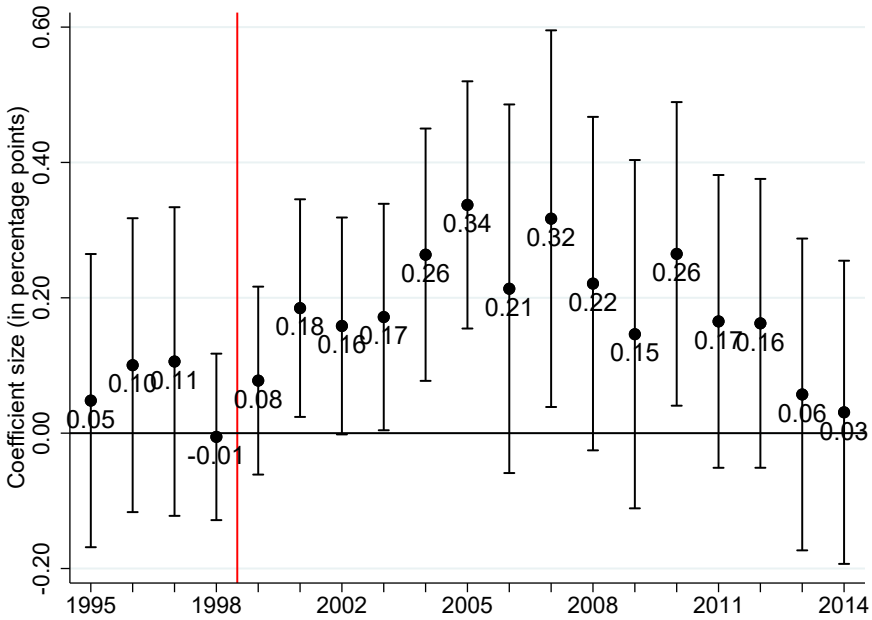
Notes: The boxplot illustrates the development of the share of CLC participations in work-related courses of persons between 35 and 49 years old in the upper figure and of persons of 65 years and above in the lower figure (West Germany only). The box demarcates the 25th and the 75th percentile, and the whiskers represent up to 1.5 times the interquartile range. A small number of county-year-observations (31 and 4 out of 5,844 or 0.5% and 0.01%, respectively) with participation shares of over 60% are not displayed here for readability purposes. Source: CLCs statistics, authors' own calculations.

Figure B-3: Share of persons 50 to 64 years old, 35 to 49 years old and 65 years old and older in the population



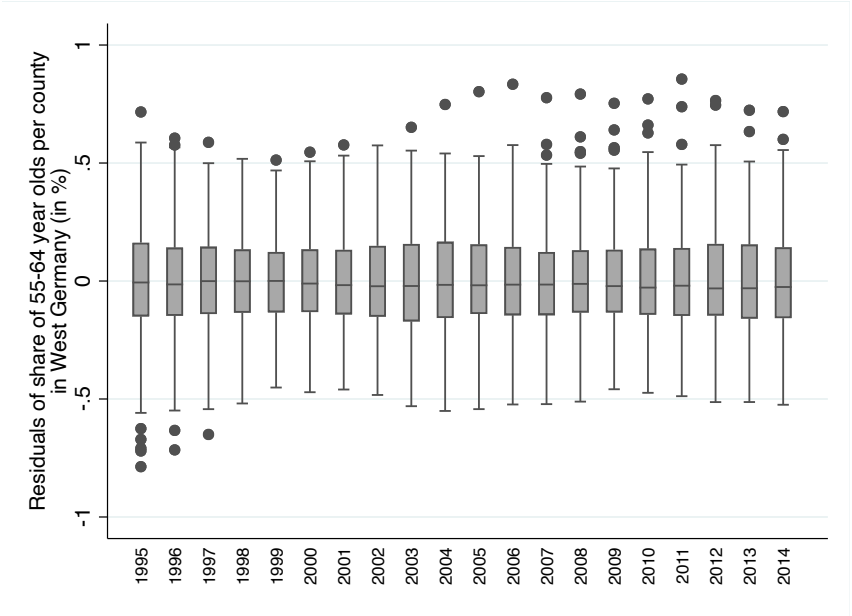
Notes: The boxplot illustrates the development of the share of persons in the general population between 55 and 64 years old in the top figure, 35 and 49 years old in the middle and of persons of 65 years and above in the bottom figure (West Germany only). The box demarcates the 25th and the 75th percentile,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

Figure B-4: Yearly reform effect on CLC participation per 1,000 inhabitants in work-related courses



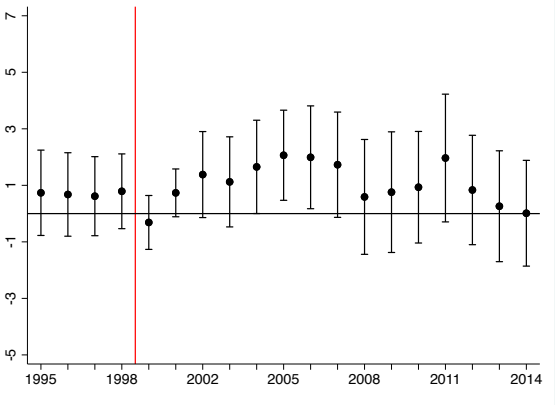
Notes: The figure plots the interaction coefficients from a DiD estimation, which correspond to the estimated ITT effects from the generalized DiD regression. It shows the point estimates as well as the 95% confidence intervals. 1999, which represents the baseline year, is indicated by the vertical line.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

Figure B-5: Residual share of 55 to 64 olds in the population

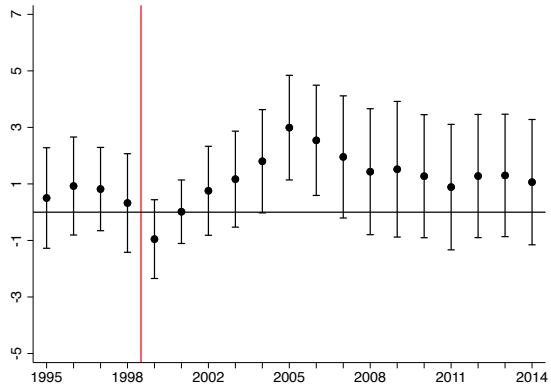


Notes: The boxplot shows the residuals from the regression of the male population share in the age group 55 to 64 years for county c at time t on all other population shares, county fixed effects, and time fixed effects. The sample is restricted to West Germany. The box demarcates the 25th and the 75th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

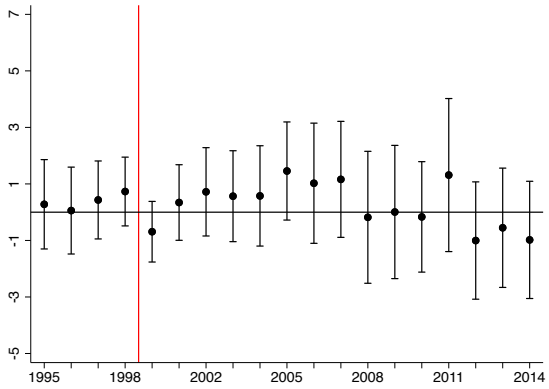
Figure B-6: Yearly reform effect on CLC participation share in different course areas



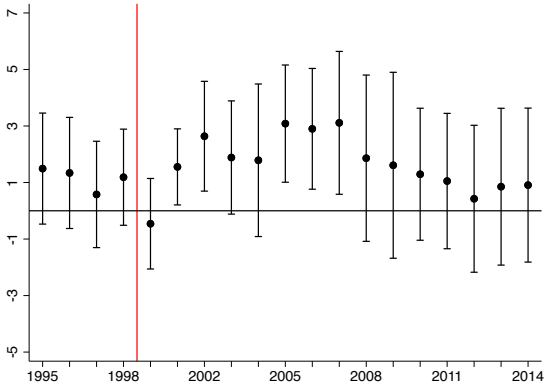
(a) All CLC courses



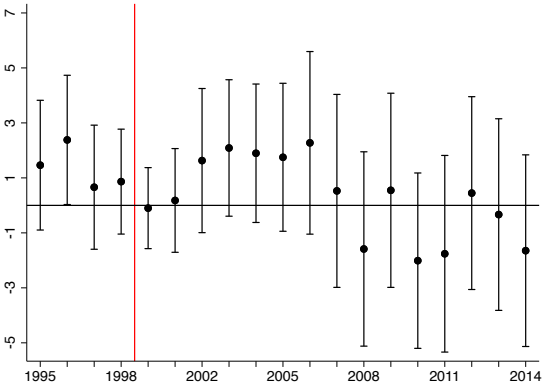
(b) Languages



(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, CLCs statistics, destatis, authors' own calculations.

Table B-1: Average reform effect on CLC participation per 1,000 inhabitants in work-related courses

	(1)	(2)	(3)
Dependent variable: CLC participations 50 to 64 year old persons per 1,000 inhabitants$_{ct}$ in work-related courses			
Male population share 55 to 64$_{ct}$ × post1999$_t$	0.025	0.127	0.107
	(0.081)	(0.082)	(0.087)
Male population share 55 to 64$_{ct}$	0.200**	-0.105	-0.039
	(0.094)	(0.149)	(0.182)
Year fixed effects	x	x	x
County fixed effects	x	x	
Control variables		x	x
County-specific linear trends			x
R-squared	0.122	0.145	0.390
Observations	6,320	6,320	6,320

Notes: Table shows baseline specification with an alternative dependent variable, CLC participations of 50 to 64 year old persons per 1,000 inhabitants. The mean CLC participations in work-related courses are at 1.09 (median: 0.95) per 1,000 inhabitants in 1999 and 1.08 (median: 0.95) in 2014. The mean (median) participations in this time period were 1.26 (1.1). *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, CLC-Statistics, destatis, FEA, authors' own calculations. Significance level: *** p<0.01, ** p<0.05, * p<0.1.

Table B-2: Average and yearly reform effect on CLC participation share in work-related courses: dropping outliers (98% sample)

	(1)	(2)	(3)	(4)
Dependent variable: Share of CLC 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 $64_{ct} \times$ post1999$_t$	2.293***			
	(0.598)			
Male population share$_{c,t}$ (%) $\times$ 1995		-0.982	-0.359	0.436
		(0.966)	(1.085)	(1.114)
Male population share$_{c,t}$ (%) $\times$ 1996		-0.058	0.572	-0.755
		(0.838)	(1.067)	(0.988)
Male population share$_{c,t}$ (%) $\times$ 1997		-0.928	-0.173	1.021
		(0.855)	(1.131)	(1.427)
Male population share$_{c,t}$ (%) $\times$ 1998		-0.047	0.485	-0.298
		(0.856)	(1.229)	(0.984)
Male population share$_{c,t}$ (%) $\times$ 2000		0.127	-0.088	-2.097*
		(0.764)	(1.044)	(1.188)
Male population share$_{c,t}$ (%) $\times$ 2001		1.454**	1.793**	-1.046
		(0.626)	(0.744)	(1.005)
Male population share$_{c,t}$ (%) $\times$ 2002		2.394**	3.616***	-0.522
		(0.995)	(1.362)	(1.107)
Male population share$_{c,t}$ (%) $\times$ 2003		2.327**	3.079**	0.557
		(1.077)	(1.476)	(1.401)
Male population share$_{c,t}$ (%) $\times$ 2004		3.600***	4.606***	1.279
		(1.108)	(1.516)	(1.457)
Male population share$_{c,t}$ (%) $\times$ 2005		2.680*	4.023***	-0.238
		(1.407)	(1.297)	(1.401)
Male population share$_{c,t}$ (%) $\times$ 2006		4.113***	3.248**	1.869
		(1.208)	(1.377)	(1.322)
Male population share$_{c,t}$ (%) $\times$ 2007		3.312***	2.838*	1.136
		(1.244)	(1.452)	(1.647)
Male population share$_{c,t}$ (%) $\times$ 2008		2.293*	2.648*	1.029
		(1.342)	(1.536)	(1.458)
Male population share$_{c,t}$ (%) $\times$ 2009		3.731**	1.102	1.205
		(1.707)	(1.726)	(1.511)
Male population share$_{c,t}$ (%) $\times$ 2010		3.647***	1.698	2.120
		(1.244)	(1.510)	(1.557)
Male population share$_{c,t}$ (%) $\times$ 2011		3.422**	1.749	4.247**
		(1.321)	(1.443)	(1.694)
Male population share$_{c,t}$ (%) $\times$ 2012		2.381**	0.999	3.995**
		(1.154)	(1.432)	(1.813)
Male population share$_{c,t}$ (%) $\times$ 2013		0.818	2.224	1.797
		(1.238)	(1.394)	(1.513)
Male population share$_{c,t}$ (%) $\times$ 2014		0.452	1.606	1.722
		(1.227)	(1.548)	(1.585)
Year fixed effects	x	x	x	x
County fixed effects	x	x	x	x
Control variables	x	x	x	x
R-squared	0.522	0.525	0.524	0.523
Observations	5,733	5,733	5,733	5,733

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, CLC-Statistics, destatis, FEA, authors' own calculations. Significance level: *** p<0.01, ** p<0.05, * p<0.1.

Table B-3: Yearly reform effect on CLC participation share in work-related courses

	(1)	(2)	(3)
Dependent variable: Share of CLC 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} (%)	2.560***	-2.831**	-1.414
	(0.847)	(1.430)	(1.617)
Male population share 55 to 64_{ct} (%) × 1995	0.019	-0.110	-0.442
	(0.892)	(0.944)	(1.267)
Male population share 55 to 64_{ct} (%) × 1996	0.751	0.478	0.349
	(0.813)	(0.827)	(1.092)
Male population share 55 to 64_{ct} (%) × 1997	0.033	-0.233	-0.356
	(0.854)	(0.871)	(1.043)
Male population share 55 to 64_{ct} (%) × 1998	0.309	0.164	-0.005
	(0.740)	(0.738)	(0.807)
Male population share 55 to 64_{ct} (%) × 2000	0.135	0.295	0.193
	(0.675)	(0.684)	(0.696)
Male population share 55 to 64_{ct} (%) × 2001	1.183**	1.544***	1.428**
	(0.552)	(0.563)	(0.577)
Male population share 55 to 64_{ct} (%) × 2002	1.570*	2.295**	2.137***
	(0.877)	(0.890)	(0.823)
Male population share 55 to 64_{ct} (%) × 2003	1.428	2.465***	2.265***
	(0.941)	(0.941)	(0.869)
Male population share 55 to 64_{ct} (%) × 2004	2.519***	3.695***	3.226***
	(0.967)	(0.967)	(0.867)
Male population share 55 to 64_{ct} (%) × 2005	1.337	2.717**	2.308*
	(1.229)	(1.219)	(1.182)
Male population share 55 to 64_{ct} (%) × 2006	2.681**	3.945***	3.157***
	(1.054)	(1.076)	(0.976)
Male population share 55 to 64_{ct} (%) × 2007	2.335**	3.454***	2.386**
	(1.162)	(1.159)	(1.066)
Male population share 55 to 64_{ct} (%) × 2008	1.633	2.610**	1.329
	(1.156)	(1.173)	(1.159)
Male population share 55 to 64_{ct} (%) × 2009	3.165**	4.056***	2.951*
	(1.470)	(1.551)	(1.568)
Male population share 55 to 64_{ct} (%) × 2010	2.684**	3.632***	2.313*
	(1.204)	(1.161)	(1.260)
Male population share 55 to 64_{ct} (%) × 2011	2.829**	3.566***	2.634*
	(1.248)	(1.262)	(1.367)
Male population share 55 to 64_{ct} (%) × 2012	1.997*	2.505**	1.484
	(1.179)	(1.159)	(1.271)
Male population share 55 to 64_{ct} (%) × 2013	0.561	1.090	0.081
	(1.134)	(1.221)	(1.448)
Male population share 55 to 64_{ct} (%) × 2014	0.187	0.769	-0.272
	(1.141)	(1.225)	(1.337)
Year fixed effects	x	x	x
County fixed effects	x	x	
County linear trends			x
Control variables		x	x
R-squared	0.519	0.526	0.639
Observations	5,844	5,844	5,844

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, CLC-Statistics, destatis, FEA, authors' own calculations. Significance level: *** p<0.01, ** p<0.05, * p<0.1

Table B-4: Yearly reform effect on CLC participation share in work-related courses: fixed population share

	(1)	(2)	(3)	(4)
Dependent variable: Share of CLC 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	0.662	0.444	0.262	0.632
	(1.089)	(1.060)	(1.086)	(1.094)
Male population share$_{c,t=1995}$ (%) × 1996	1.213	1.017	-0.734	-0.546
	(1.072)	(1.043)	(0.956)	(0.975)
Male population share$_{c,t=1995}$ (%) × 1997	0.559	0.398	1.062	1.208
	(1.145)	(1.128)	(1.379)	(1.407)
Male population share$_{c,t=1995}$ (%) × 1998	0.782	0.590	-0.250	-0.137
	(1.060)	(1.055)	(0.945)	(0.965)
Male population share$_{c,t=1995}$ (%) × 2000	-0.120	0.087	-1.817	-1.897*
	(0.930)	(0.935)	(1.138)	(1.148)
Male population share$_{c,t=1995}$ (%) × 2001	1.323**	1.793***	-0.473	-0.850
	(0.661)	(0.680)	(0.942)	(0.984)
Male population share$_{c,t=1995}$ (%) × 2002	2.628**	3.445***	0.083	-0.340
	(1.199)	(1.243)	(1.045)	(1.094)
Male population share$_{c,t=1995}$ (%) × 2003	1.952	3.079**	1.323	0.847
	(1.288)	(1.335)	(1.304)	(1.373)
Male population share$_{c,t=1995}$ (%) × 2004	3.091**	4.594***	2.094	1.616
	(1.327)	(1.371)	(1.389)	(1.421)
Male population share$_{c,t=1995}$ (%) × 2005	1.929*	3.864***	0.787	0.018
	(1.097)	(1.190)	(1.294)	(1.376)
Male population share$_{c,t=1995}$ (%) × 2006	1.151	3.256**	2.438**	1.892
	(1.197)	(1.281)	(1.219)	(1.296)
Male population share$_{c,t=1995}$ (%) × 2007	0.760	3.056**	2.002	1.198
	(1.276)	(1.359)	(1.554)	(1.601)
Male population share$_{c,t=1995}$ (%) × 2008	0.286	2.825**	2.333*	1.190
	(1.345)	(1.412)	(1.298)	(1.396)
Male population share$_{c,t=1995}$ (%) × 2009	-1.304	1.460	2.879**	1.516
	(1.539)	(1.611)	(1.383)	(1.468)
Male population share$_{c,t=1995}$ (%) × 2010	-1.102	1.881	3.503**	2.163
	(1.329)	(1.415)	(1.482)	(1.502)
Male population share$_{c,t=1995}$ (%) × 2011	-0.948	1.916	5.414**	4.059**
	(1.427)	(1.451)	(1.664)	(1.657)
Male population share$_{c,t=1995}$ (%) × 2012	-1.424	1.376	5.733**	4.114**
	(1.502)	(1.514)	(1.780)	(1.773)
Male population share$_{c,t=1995}$ (%) × 2013	-0.472	2.357	3.525**	1.791
	(1.393)	(1.447)	(1.365)	(1.495)
Male population share$_{c,t=1995}$ (%) × 2014	-1.190	1.608	3.310**	1.522
	(1.522)	(1.581)	(1.518)	(1.594)
Year fixed effects	x	x	x	x
County fixed effects	x	x	x	x
Control variables		x		x
R-squared	0.500	0.525	0.502	0.524
Observations	5,844	5,844	5,844	5,844

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, CLC-Statistics, destatis, FEA, authors' own calculations. Significance level: *** p<0.01, ** p<0.05, * p<0.1.

Table B-5: Participation in CLCs 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$_{ct}$ (%)	-0.341		-0.045	
	(0.686)		(0.044)	
Average age$_{ct}$		-15.578		-1.425**
		(15.251)		(0.724)
Year fixed effects	x	x	x	x
County fixed effects	x	x	x	x
Control variables	x	x	x	x
R-squared	0.012	0.030	0.075	0.063
Observations	7,622	4,770	7,622	4,770

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, CLC-Statistics, destatis, FEA, authors' own calculations. Significance level: *** p<0.01, ** p<0.05, * p<0.1.

Table B-6: Average reform effect on CLC participation share in work-related courses: female population share

	(1)	(2)	(3)
Dependent variable: CLC participation share 50 to 64$_{ct}$ in work-related courses			
Male population share 55 to 64$_{ct}$ × post1999$_t$	1.984***		2.247*
	(0.565)		(1.312)
Male population share 55 to 64$_{ct}$	-2.262*		-2.942
	(1.332)		(1.829)
Female population share 55 to 64$_{ct}$ × post1999$_t$		1.288**	-0.348
		(0.552)	(1.235)
Female population share 55 to 64$_{ct}$		-0.798	0.846
		(1.015)	(1.380)
Year fixed effects	x	x	x
County fixed effects	x	x	x
Control variables	x	x	x
R-squared	0.523	0.522	0.523
Observations	5,844	5,844	5,844

Notes: The mean CLC participation share in work-related courses grows from 9.3 percent (median: 8.4) in 1999 to 28.3 percent (median: 28.2) in 2014. The mean (median) participation share in this time period was 21.5 (21.1) 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, CLC-Statistics, destatis, FEA, authors' own calculations. Significance level: *** p<0.01, ** p<0.05, * p<0.1.